

Attachment 1



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Building *Nunavut* Together
Nunavut iuqatigiingniq
Bâtir le *Nunavut* ensemble

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Minister of Environment
Ministaat Avatiliqiyitkut
Ministre de l'Environnement

May 22, 2017

Joe Ashevak
Chairperson
Kitikmeot Regional Wildlife Board
P.O. Box 104, Kugaaruk, NU X0B 1K0

Larry Adjun
Chairperson
Kugluktuk Angoniatit Association
P.O. Box 309, Kugluktuk, NU, X0B 0E0

Connie Kapolak
Chairperson
Burnside Hunters and Trappers Organization
P.O. Box 119
Cambridge Bay, NU X0B 0C0

Peter Kapolak
Chairperson
Omingmaktok HTO
NIWS Rankin Inlet
PO Box 219, Rankin Inlet, NU, X0C 0G0

Bobby Greenley
Chairperson
Ekaluktutiak Hunters and Trappers Organization
P.O. Box 1270
Cambridge Bay, NU X0B 0C0
Dear Co-Management Partners,

Re: New regulations concerning the Bathurst Caribou herd harvest management.

Following a review of the Nunavut Wildlife Management Board's decision, consultation with partners, and recognizing the current status of the Bathurst Caribou herd, the Government of Nunavut has established a TAH of thirty (30) male only caribou for the Bathurst caribou herd. The Government also supports the various initiatives aimed at the development of the Bathurst Caribou Management Plan.

The total allowable harvest (TAH) for the Bathurst caribou herd will be effective as of July 1, 2017. The Kitikmeot Regional Wildlife Board will allocate this TAH among the affected Hunters and Trappers Organizations and advise the Department of Environment of their decision on or before June 15, 2017. This will facilitate the distribution of the appropriate number of tags to each HTO having a share of the Bathurst Caribou TAH.

My Department's regional staff and local Conservation Officers will work with co-management partners, particularly the Burnside Hunters and Trappers Association and the Kugluktuk Angoniatit

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To this end, the Government of Nunavut, Department of Environment, would like to offer our technical support and resource staff to assist the Hunters and Trappers Organizations and the Kitikmeot Regional Wildlife Board in further developing this community-based management plan - in whatever ways that may be of assistance.

Our Department is looking forward to working together with you on this community-based co-management initiative that will help foster the re-vitalization and sustainability of Bathurst Caribou.

Please feel free to contact me for any further technical assistance and support on these community-based management initiatives. I can be reached at 867-982-7444 at any time, or LLeclerc@gov.nu.ca.

Regards,

Lisa-Marie Leclerc

Lisa-Marie Leclerc

Regional Wildlife Biologist, Kitikmeot

Department of Environment

Government of Nunavut

c.c. L. Orman

M. Dumond



COSEWIC
Committee on the Status of
Endangered Wildlife in Canada

COSEPAC
Comité sur la situation des
espèces en péril au Canada

Caribou, Monarch butterflies: Canada's iconic migrants at grave risk

OTTAWA, ONTARIO (December 5, 2016). From Coho Salmon to Caribou to the much-cherished Monarch butterfly, migration is a key component of Canadian biodiversity. Migratory species, migration and movement all figured prominently at the semi-annual Committee on the Status of Endangered Wildlife in Canada (COSEWIC) deliberations on species at risk, held November 27 - December 2nd.

Young Coho Salmon from the Interior Fraser River basin leave the watershed and live much of their adult lives at sea before migrating back to their native rivers to lay eggs. The Committee considered threats in both fresh and salt water, and the wildlife species' status was assessed as having improved from Endangered to Threatened. Despite ongoing active management and some improvements, the situation faced by Interior Fraser River Coho Salmon is still perilous.



Caribou, Barren-ground population © Ann Gunn

Another iconic migratory species considered by COSEWIC was Caribou. Several populations migrate hundreds of kilometres en masse between their calving and wintering grounds every year. Caribou have experienced alarming declines. Both science and Aboriginal Traditional Knowledge indicate

unprecedented declines in several herds with some human activities on the landscape being novel, potentially disrupting natural cycles. According to Justina Ray, co-chair of the Terrestrial Mammals Subcommittee, "Caribou are, sadly, very sensitive to human disturbances, and we are disturbing Caribou more and more. These stressors seem to be interacting in complicated ways with rapid warming in the North. Many of the great northern Caribou herds have now fallen to all-time lows, and there is cause for concern that they will not rebound in the same way they have before." COSEWIC considered the status of two such populations for the first time. Both were found to be in trouble: The Caribou Barren-ground population was assessed as Threatened, while the much rarer Torngat Mountain population in far northeastern Canada was assessed at even higher risk - Endangered.

A third migratory species considered by COSEWIC was the Monarch butterfly. These insects fly over 4,000 kilometres south to Mexico in the fall to overwinter. They breed on their return trip, and their great-grandchildren arrive back in Canada in spring. However, the remarkably tiny wintering grounds where Monarchs congregate continue to be chipped away by habitat loss. Monarch butterfly migration is now recognized as a "threatened process" by the International Union for the Conservation of Nature (IUCN). Indeed, it is the only natural process with this unfortunate distinction. COSEWIC assessed the species as Endangered. Jennifer Heron, co-chair of the Arthropods Subcommittee, summed it up: "We need to continue to support the conservation of milkweed caterpillar habitat both here in Canada and along the Monarch's migratory journey, and we need to support continued conservation of critical overwintering areas. Otherwise, Monarch migration may disappear, and Canada may lose this iconic species."



Monarch © Jessica Linton

The Pink-footed Shearwater finds itself in a comparable situation. Breeding on only three small islands off the coast of Chile, many of these birds travel thousands of kilometres north to feed along the coast of British Columbia during our summer months. The species' southern home is under multiple threats from humans and exotic predators, and shearwaters are killed as fishing by-catch throughout its range. This rare bird was re-assessed as Endangered.

Human interference also causes problems for animal movements at smaller, local scales. Dams that stop Westslope Cutthroat Trout from moving between spawning and feeding grounds have contributed to their shrinking distribution in Alberta. This fish's Saskatchewan – Nelson Rivers populations were re-assessed as Threatened. Slow-moving Blanding's Turtles, which can live for 80 years, travel up to three kilometres from nesting beaches and other summer habitats to fewer small freshwater pools where they overwinter, year after year. Vehicles increasingly threaten this rare turtle wherever roads cross the turtles' seasonal routes, and this species was assessed as Endangered in both Nova Scotia and in central Canada.

In contrast to most of the species assessed by COSEWIC, the widely distributed Blue Shark was assessed as Not At Risk in Canada, in part due to ongoing successful management. New satellite tracking data for this renowned long-distance migrant confirmed long-range movements and seasonal migrations between inshore and deeper offshore habitats.

But of the species assessed, Blue Shark was the exception. Many migratory species decline in step with human barriers and habitat changes. The Chair of COSEWIC, Eric Taylor, stated the bottom line: "Disruptions to migratory behavior are associated with the threat of extinction for species all over the world. We will need to continue to change how we use our landscape so that we and wildlife can thrive together. COSEWIC's work assessing Canadian wildlife helps us do that."

Next meeting

COSEWIC's next scheduled wildlife species assessment meeting will be held in April 2017.

About COSEWIC

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<p>Dr. Eric B. (Rick) Taylor Chair, COSEWIC</p> <p>Department of Zoology University of British Columbia Telephone: 604-822-9152 etaylor@zoology.ubc.ca</p>	<p>For general inquiries:</p> <p>COSEWIC Secretariat Canadian Wildlife Service Environment and Climate Change Canada 351 St. Joseph Blvd, 16th floor Gatineau QC K1A 0H3 Telephone: 819-938-4125 Fax: 819-938-3984 ec.cosepac-cosewic.ec@canada.ca www.cosewic.gc.ca</p>
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<p>For inquiries on marine fishes (Blue Shark, Coho Salmon - Interior Fraser population):</p> <p>Alan F. Sinclair Telephone: 250-714-5690 alanfsinclair@me.com</p>	<p>For inquiries on marine mammals:</p> <p>Dr. Hal Whitehead Dalhousie University Telephone: 902-494-3723 hal.whitehead@dal.ca</p>
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Attachment 2



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Department of Environment
Avatiliqiyikkut
Ministère de l'Environnement

July 27, 2017

Joe Ashevak
Chairperson
Kitikmeot Regional Wildlife Board
P.O. Box 104, Kugaaruk, NU, X0B 1K0

Larry Adjun
Chairperson
Kugluktuk Angoniatit Association
P.O. Box 309, Kugluktuk, NU, X0B 0E0

Dear Co-Management Partners,

Re: Status of the Integrated Community Caribou Management Plan (ICCMP) for the Bluenose East Caribou in the Kitikmeot Region.

The sustainability of Bluenose East caribou in Nunavut assures caribou harvest by Inuit for future generations - and this is a shared goal among co-management partners in Nunavut. Following the Nunavut Wildlife Management Board's decision to establish a Total Allowable Harvest of 340 Bluenose East caribou for the 2017 harvest year (see Minister Savikataaq's letter, attached), the Board identified a community-based management plan, the "*Integrated Community Caribou Management Plan (ICCMP)*" for the Bluenose East Caribou in the Kitikmeot Region to be finalized by September 30, 2017, in order to align with other territorial and inter-jurisdictional initiatives related to the management of this herd.

To this end, the Government of Nunavut, Department of Environment, would like to offer our technical support and resource staff to assist the Kugluktuk Angoniatit Association and the Kitikmeot Regional Wildlife Board in further developing this community-based management plan - in whatever ways that may be of assistance. We would also like to follow up on any further sex selectivity harvest discussions that the KRWB and Kugluktuk Angoniatit Association may determine would be helpful.

Our Department is looking forward to working together with you on this community-based co-management initiative that will help foster the re-vitalization and sustainability of Bluenose East Caribou.

P.O. Box 377, Enokhok Building
Kugluktuk, Nunavut X0B 0E0

ᐃ(867) 982-7440
ᐃ(867) 982-3701
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Please feel free to contact me for any further technical assistance and support on these community-based management initiatives. I can be reached at 867-982-7444 at any time, or LLeclerc@gov.nu.ca.

Regards,

Lisa-Marie Leclerc

Lisa-Marie Leclerc
Regional Wildlife Biologist, Kitikmeot
Department of Environment
Government of Nunavut

c.c. L. Orman
M. Dumond

P.O. Box 377, Enokhok Building
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INTEGRATED FISHERIES MANAGEMENT PLAN

Northern Shrimp (*Pandalus borealis*)
and
Striped Shrimp (*Pandalus montagui*)

SHRIMP FISHING AREAS (SFAs) 0, 1, 4-7, the Eastern and Western Assessment
Zones and North Atlantic Fisheries Organization (NAFO) Division 3M

Effective 2017

Pandalus borealis (Krøyer, 1838)



1
2 FOREWORD

3
4 The purpose of this Integrated Fisheries Management Plan (IFMP) is to identify the main
5 objectives and requirements for the Northern shrimp fishery for Shrimp Fishing Areas
6 (SFAs) 0, 1, 4 -7, the Eastern and Western Assessment Zones and the Flemish Cap
7 (NAFO Division 3M) Often referred to as the Northern shrimp fishery, there are two
8 species of shrimp prosecuted *Pandalus borealis* (Northern shrimp) and *Pandalus*
9 *montagui* (Striped shrimp). Unless otherwise specified, the ‘Northern shrimp fishery’ and
10 this IFMP pertain to both species.

11
12 This plan outlines the objectives of this fishery and the management measures that will be
13 used to achieve these objectives. This document also serves to communicate the basic
14 information on the fishery and its management to Fisheries and Oceans Canada (DFO)
15 staff, co-management boards and other stakeholders. This IFMP provides a common
16 understanding of the basic “rules” for the sustainable management of the fisheries
17 resource.

18
19 This IFMP is not a legally binding instrument which can form the basis of a legal
20 challenge. The IFMP can be modified at any time and does not fetter the Minister's
21 discretionary powers set out in the *Fisheries Act*. The Minister can, for reasons of
22 conservation or for any other valid reasons, modify any provision of the IFMP in
23 accordance with the powers granted pursuant to the *Fisheries Act*.

24
25 Where DFO is responsible for implementing obligations under land claims agreements,
26 the IFMP will be implemented in a manner consistent with these obligations. In the event
27 that an IFMP is inconsistent with obligations under land claims agreements, the
28 provisions of the land claims agreements will prevail to the extent of the inconsistency.

29 This is a ‘rolling’ or ‘evergreen’ plan subject to amendment at the discretion of the
30 Minister of Fisheries and Oceans while respecting the applicable legislation, policies and
31 regulations.

32
33 Signature

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25	7. Management Measures
26	8. Shared Stewardship Arrangements
27	9. Compliance Plan
28	10. Performance Review
29	

1 Section 1 – Overview of the Fishery

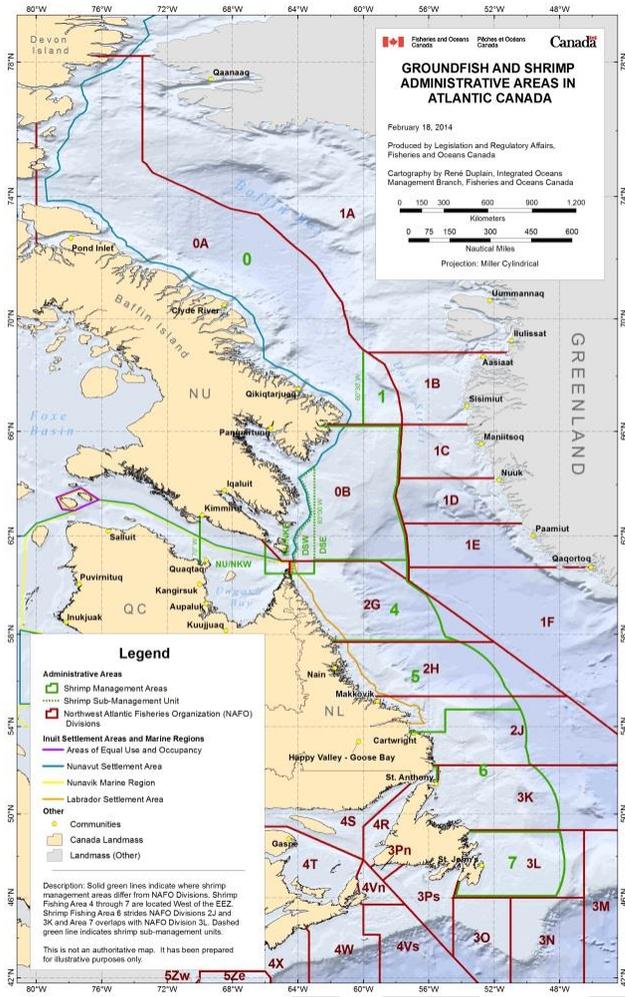
2
3 **1.1 History**

4
5 The Northern shrimp fishery commenced in the early 1970s when an exploratory fishing
6 program confirmed the presence of commercial abundances of shrimp stocks (*Pandalus*
7 *Borealis* and *Pandalus Montagu*) in waters stretching southward from Baffin Island to
8 the northeast coast of Newfoundland. It later expanded to include fishing off the east
9 coast of Newfoundland in Shrimp Fishing Area (SFA) 7 and onto the Flemish Cap
10 (Northwest Atlantic Fisheries Organization [NAFO] Division 3M). Map at Figure 1. A
11 more detailed history of the fishery is available at ANNEX A.

12
13 Between 1978 and 1991, seventeen > 100' sector (offshore) licences were introduced.
14 Quota sharing principles were developed in 1997 and permits were introduced to inshore
15 fish harvesters, thereby giving access to the < 65' fleet (i.e. the inshore fleet). In 2007,
16 these permits were converted to licences. Since 1997, “special” allocations were provided
17 to Indigenous organizations and community groups, including to Nunavut in adjacent
18 northern SFAs.

19
20 Generally, stocks continued to increase until the mid to late 2000s, , after which time the
21 fishable biomass began to decline in southern SFAs, which has been associated with
22 changing oceanic conditions and related ecosystem dynamics. In 2011, NAFO
23 suspended directed fishing for shrimp in Division 3M, and in Division 3L (SFA 7)
24 beginning in 2015. ANNEX B shows Total Allowable Catches (TACs) and allocations by
25 SFA since 1997.

26
27 In 2013, the boundaries in the North (SFAs 2 and 3 at the time) were modified to align
28 with scientific surveys and land claim areas. New allocations for both species were
29 granted to Nunavut and Nunavik inside the respective settlement areas (Figure 2).



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Figure 1. Northern Shrimp Fishing Areas as of 2013. Between 1997 and 2015, the Last In, First Out (LIFO) policy was the main access and allocation tool the Department used to apply reductions (and occasionally increases in certain circumstances) in TAC. In 2016, stemming from recommendations provided by a Ministerial Advisory Panel, LIFO was abolished and replaced with a proportional sharing arrangement in southern SFAs 4, 5, 6 and 7, should it reopen to commercial fishing. In the areas north of SFA 4, access and allocation decisions will continue to be made through the appropriate consultative processes, in a manner consistent with the Land Claims Agreements. More information on LIFO, including the Ministerial Advisory Panel can be found in ANNEX C.

1.2 Type(s) of Fishery

The shrimp fishery in SFAs 0, 1, 4-7, and Davis Strait West is commercial. The fisheries in the Western Assessment Zone (WAZ) and Davis Strait East, and Nunavut and Nunavik East management units are considered to be ‘exploratory stage 2’ of the New Emerging Fisheries Policy, and are licensed under Section 7 of the *Fisheries Act*. There is no shrimp fishery for food, social, ceremonial or recreational purposes.

1
2 **1.3 Participants**

3
4 ***The >100' shrimp sector***

5
6 Commonly referred to as the 'offshore' fleet, there are seventeen >100' sector licences
7 currently held by fourteen corporate entities. There has been no increase in the number of
8 >100' shrimp sector Northern shrimp licences issued since 1991. The current > 100'
9 sector licence holdings by company and representative organization are listed in ANNEX
10 D. The Canadian Association of Prawn Producers (CAPP) and the Northern Coalition
11 (NC) represent 16 of the 17 offshore licences. In total, 4.5 of the > 100' sector licences
12 are held by Indigenous interests.

13
14 The >100' shrimp sector, comprising vessels with length overall (LOA) greater than
15 30.48m (100ft) and weight greater than 500t, is comprised of approximately ten factory
16 freezer trawlers. The > 100' sector vessels operate out of ports in Newfoundland and
17 Nova Scotia, with occasional landings in Greenland when fishing in far northern waters
18 as ice and other environmental conditions permit. The shrimp harvested by the >100'
19 shrimp sector is size sorted, with most of the sizes being cooked, and then frozen at sea,
20 and packaged for export to various global markets.

21
22 Fishing trips last from 20 to 75 days. Vessels generally make about 9 - 12 trips per year,
23 averaging 300-320 sea days annually.

24 ***The Inshore Fleet***

25 The inshore fleet or sector is composed of Newfoundland and Labrador (NL) based
26 inshore vessels with maximum vessel eligibility of LOA < 89' 11";, the NL-based
27 "midshore" fleet with LOA between 65' and 99', and the Quebec (QC) fleet comprised of
28 Lower North Shore Quebec based vessels <89' 11".

29 Between 1997 and 2000 new access for an inshore shrimp fishery was granted to fish
30 harvesters in Newfoundland and Labrador and Quebec in the southern SFAs 4 and 6.

31 Initially the inshore fleet (NL and QC) comprised of approximately 390 licence holders.
32 Since 2007 through rationalization the number decreased to approximately 260 licence
33 holders. A few of these inshore licences are issued to Indigenous organizations as
34 commercial communal licences. In SFA 6, Quebec harvesters have access to 2.45% of
35 the inshore fleet allocation.

36 The inshore fleet in NL is represented by the Fish Food and Allied Workers Union
37 (FFAW) through five fleet committees (2J, 3K north, 3K south, 3L, and 4R) elected by
38 the licence holders. The inshore Quebec licence holders are represented by L'Association
39 des Capitaines Propriétaires de la Gaspésie (ACPG).

40
41 Shrimp caught by the inshore fleet is generally landed fresh (and sometimes frozen
42 specifically from SFA 4) to be cooked, peeled and further processed as necessary by
43 onshore licensed processing plants. The inshore fleet's operations are based in NAFO

1 Divisions 2J, 3KL, 4R and 4S and are administered based on the enterprise's homeport,
2 by NAFO Division in the following manner: 2J, 3K north (north of 50°30'North), 3K
3 south (south of 50°30'North), 3L, 4R and 4S. Currently the fishery is only conducted in
4 SFA 6 with limited effort in SFA 4 and 5, however from 2000 – 2014 the inshore fleet
5 also fished in SFA 7.

6 7 *Special Allocation Holders*

8
9 During some periods of quota increase in nearly all SFAs, the Minister provided
10 “special” allocations to organizations, communities or entities including Indigenous
11 organizations for their economic benefit. Most of these are not commercial licence
12 holders and, depending on the SFA, their allocations are primarily harvested by the >100'
13 shrimp sector through royalty arrangements. All special allocations in SFAs 4, 5 and 6
14 can be harvested by either the offshore or inshore fleet. However, in SFA 6, if the inshore
15 fleet harvests the allocation, an arrangement with an inshore fleet must be approved.
16 Additionally, some of these special allocation holders are issued a temporary licence and
17 harvest their allocations with their own vessels. Initially, and until the abolishment of
18 LIFO in 2016, special allocations generally remained at a fixed amount and since many
19 special allocations were the last to gain entry into the fishery, they were the first to be
20 removed or reduced if the TAC fell to certain thresholds under LIFO. However, with the
21 move to proportional percent shares in the southern SFAs in 2016, those special
22 allocation holders in SFAs 4 – 7 now hold a percent share of the TAC in that particular
23 SFA.

24 25 *Nunavut, Nunavik and Nunatsiavut Land Claimants*

26
27 There are three land claims agreements with provisions relating to the management of the
28 Northern shrimp fishery: The Nunavut Land Claims Agreement (NLCA) (1993), the
29 Nunavik Inuit Land Claims Agreement (NILCA) (2005) and the Labrador Inuit Land
30 Claims Agreement (LILCA) (2007). Each of the agreements provides for consideration of
31 Inuit harvesting opportunities related to shrimp.

32
33 Nunavut's shrimp resources are fished by individual Nunavut fishing companies. The
34 NWMB provides its decisions and recommendations to the DFO Minister on the sub-
35 allocation of Nunavut shrimp resources to individual Nunavut based fishing companies
36 for a specified number of years. Nunavut sub-allocation recipients may be issued a
37 temporary licence to participate in the fishery. Also, 1.5 of the offshore shrimp licences
38 are held by a Nunavut fishing company, which provides quotas in SFA 0, 1, the EAZ and
39 4-7.

40 Pursuant to NILCA, Nunavik Inuit's shrimp allocations are provided to Makivik
41 Corporation (or a Makivik Designated Organization) to fish on their behalf. Makivik also
42 holds a > 100' sector licence which provides shrimp quotas in SFA 0, 1, the EAZ and 4-
43 7, and therefore the issuance of a temporary licence is not necessary.

1
2 Allocations in Management Units (MUs) Nunavut East, Nunavik East in the EAZ, and
3 Nunavut West and Nunavik West, located in Hudson Strait in the WAZ, are reserved for
4 Nunavut and Nunavik shrimp harvesters, as the MUs are located inside the Nunavut
5 Settlement Area (NSA) and the Nunavik Marine Region (NMR).

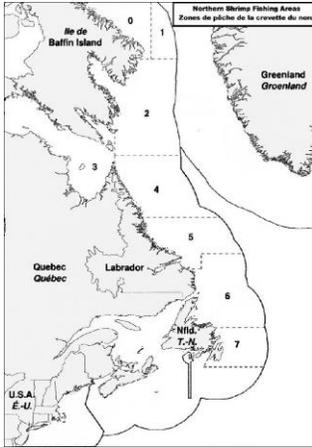
6
7 Labrador Inuit allocations are fished via communal commercial licences issued to the
8 Nunatsiavut Government (NG) which can be harvested by either the offshore or inshore
9 fleet. Portions of the EAZ, SFAs 4 and 5 fall both within the Labrador Inuit Settlement
10 Area (LISA) and adjacent waters as described in the LILCA. A portion of SFA 6 also
11 falls within Waters Adjacent to the Zone. Labrador Inuit interests also have 1.5 offshore
12 shrimp licences which provide quotas in SFA 0, 1, the EAZ and 4-7.

13 **1.4 Location of the Fishery**

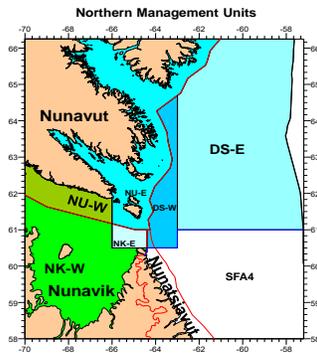
14
15 Subject to any closures in effect, the fishery occurs off the coast of eastern Canada from
16 47°15' N (Flemish Cap and the northern edge of the Grand Banks (Division 3M) to 69°
17 N (Baffin Bay). Most fishing occurs between depths of 200m and 600m. SFAs were
18 created to distribute fishing effort and improve the effectiveness of management regimes.

19
20 Prior to 2013, shrimp fishery management in northern waters consisted of many
21 overlapping quotas for both species (*P. borealis* and *P. montagui*). Further, management
22 units were not aligned with the science assessment zones or the Nunavut or Nunavik land
23 claim Settlement Area boundaries. As of 2013 (Figure 1), boundaries were modified and
24 SFAs were aligned with the Nunavut Settlement Area (NSA), the Nunavik Marine
25 Region (NMR) and the EAZ and WAZ survey boundaries. New MUs within these SFAs
26 alleviate concentration of fishing effort for *P. montagui* in the Resolution Island area and
27 also eliminate overlapping management units and quotas. As a result of these boundary
28 changes, new or increasing quotas for *P. montagui* and *P. borealis* in Hudson Strait and
29 Davis Strait were established.

30
31 The realignment of boundaries with the survey assessment zones and the creation of
32 management units (MUs) within the NSA and NMR took several years to complete and
33 involved consultation and engagement with relevant management boards and land claims
34 beneficiaries, as well as with other stakeholders (e.g., the offshore fleet and the
35 provinces) in the fishery. The new MUs are enforced by condition of licence. An
36 amendment to the Atlantic Fisheries Regulations will be required to reflect the shrimp
37 MU boundary changes in the WAZ and EAZ. A map of the management boundaries prior
38 to 2013 is at Figure 2.



1
2
3 Figure 2 – Map prior to the 2013 Boundary Changes



4
5 Figure 3- Map showing Eastern Assessment Management Units (Blue) and Western
6 Assessment Management Units (Green)

7
8 *P. borealis* (Northern shrimp) is the main species harvested in SFA 0, 1, Davis Strait and
9 SFAs 4-6. *P. borealis* is also harvested as part of the directed shrimp fishery MUs
10 Nunavut and Nunavik West and as bycatch in MUs Nunavut and Nunavik East. A second
11 species, *P. montagui* (Striped shrimp), is directed for in MUs Nunavut and Nunavik East
12 and West, and as bycatch in MU Davis Strait East and SFA 4. Coordinates of the fishery
13 can be found at ANNEX E.

14
15 In the shrimp fishery, there are both SFAs and management units. SFA boundaries are the
16 same delineations for both science assessments and management purposes. Management
17 units are smaller management areas within a SFA. Collectively, SFAs and management
18 units are referred to as management areas in this IFMP.

19
20 **1.5 Fishery Characteristics**

21 ***Gear***

22 Most of the >100' sector and inshore sector vessels use otter trawls, with a very limited
23 number using beam trawls. The minimum mesh size for otter and beam trawls is 40mm.

24

1 To effectively minimize the bycatch of other species, the use of a Nordmore Grate is a
2 mandatory measure, and is described in detail in Section 7.6.

3 4 ***Management***

5
6 Northern shrimp fishery management is based on a two-year cycle. In year one, DFO
7 Science provides stock status results in a full stock assessment process. TAC
8 recommendations to the Minister are based on science recommendations, the
9 Precautionary Approach framework that includes Harvest Decision Rules, and
10 consultations with stakeholders through NSAC and relevant wildlife management boards.
11 In year two, DFO Science provides a stock status update that is used to determine TAC,
12 also in consultation processes with stakeholders and wildlife management boards.

13
14 The >100' sector fishery is managed under the Enterprise Allocation (EA) (ANNEX F)
15 system whereby quota is divided equally among the 17 licences, except in SFA 0 which
16 is fished under a competitive regime. When Division 3M was open to commercial
17 fishing, it was managed using an effort based system, with the > 100' fleet equally
18 sharing Canada's allocation. The >100' sector and Nunavut quotas in the Davis Strait
19 East MU are exploratory (licenced under Section 7 of the *Fisheries Act*) but both
20 exploratory and commercial fisheries are managed consistently. The Nunavut and
21 Nunavik MUs are completely within the NSA and NMR respectively. The >100' sector
22 holds no quota in the Nunavut and Nunavik MUs, and access to these areas is limited to
23 those enterprises that receive allocations in these areas, as amended from time to time.

24
25 The inshore fishery in both NL and QC is managed under a competitive regime but in NL
26 the fishery is conducted with trip limits and harvesting caps determined and managed by
27 industry since 1997. The season for this fleet generally occurs from April through to
28 December, with most harvesting between May and October.

29 30 **1.6 Governance**

31 32 ***Fisheries Act, Regulations and Policies***

33
34 The Northern shrimp commercial fisheries are regulated by Canada's *Fisheries Act*, and
35 the regulations pursuant to it, including (but not limited to) the *Fishery (General)*
36 *Regulations*, the *Atlantic Fishery Regulations, 1985*, the *Oceans Act* and the *Species at*
37 *Risk Act*. The *Fisheries Act* gives the Minister of Fisheries and Oceans ultimate
38 responsibility for the management of marine fisheries. The management of the
39 commercial fisheries is also governed by a suite of policies related to the granting of
40 access, economic prosperity, resource conservation and Indigenous use, including the
41 Commercial Fisheries Licensing Policy for Eastern Canada 1996. Information on these
42 and other policies can be found on the Internet at:

43 <http://www.dfo-mpo.gc.ca/fm-gp/policies-politiques/index-eng.htm>

44
45 www.dfo-mpo.gc.ca/acts-loi-eng.htm

46 <http://www.fishaq.gov.nl.ca/departement/legislation.html>

1
2 ***Sustainable Fisheries Framework***
3

4 DFO has had a Sustainable Fisheries Framework (SFF) in place since 2009, which
5 provides the basis for Canadian fisheries (including Northern shrimp) to be conducted in
6 a manner that support conservation and sustainable use. It incorporates existing fisheries
7 management policies with new and evolving policies. The SFF also includes tools to
8 monitor and assess initiatives geared towards ensuring an environmentally sustainable
9 fishery, and identifies areas that may need improvement. Overall, the SFF provides the
10 foundation of an ecosystem-based and precautionary approach to fisheries management
11 in Canada. The policies that facilitate an ecosystem based approach to fisheries
12 management include *A Fishery Decision-Making Framework Incorporating the*
13 *Precautionary Approach, Policy for Managing the Impacts of Fishing on Sensitive*
14 *Benthic Areas* and the *Policy on Managing Bycatch*.

15
16 These documents are available on the Internet at: [http://www.dfo-mpo.gc.ca/reports-](http://www.dfo-mpo.gc.ca/reports-rapports/regs/policies-politiques-eng.htm)
17 [rapports/regs/policies-politiques-eng.htm](http://www.dfo-mpo.gc.ca/reports-rapports/regs/policies-politiques-eng.htm)
18

19 ***Land Claims***
20

21 To date, there are three land claims agreements in place that must be taken into
22 consideration in the management of the Northern Shrimp fishery: The *Nunavut*
23 *Agreement, Labrador Inuit Land Claims Agreement* and the *Nunavik Inuit Land Claims*
24 *Agreement*. These Agreements are treaties within the meaning of section 35 of the
25 *Constitution Act, 1982*. Land claims agreements establish a system for the co-
26 management of fisheries resources within and adjacent to these land claims settlement
27 areas. The Agreements (among other things) set out the harvesting rights of the
28 beneficiaries to the respective Agreements, provide for the establishment of wildlife
29 management structures, set out the role of those structures and cooperative management
30 processes, and set out procedural and substantive requirements on the Minister. The
31 Government of Canada retains ultimate responsibility for wildlife management within
32 and outside respective settlement areas.
33

34 The Nunavut Agreement is available at:
35 <http://laws-lois.justice.gc.ca/eng/acts/N-28.7/>
36

37 The Labrador Inuit Land Claims Agreement is available at:
38 <http://laws-lois.justice.gc.ca/eng/acts/L-4.3/>
39

40 The Nunavik Inuit Land Claims Agreement is available at:
41 <http://laws-lois.justice.gc.ca/eng/acts/N-28.5/>
42

43 ***Northwest Atlantic Fisheries Organization (NAFO)***
44

45 SFA 1 (NAFO Division 0A) is part of a trans-boundary Canada-Greenland stock
46 managed individually by each jurisdiction. The shrimp stock is distributed in NAFO

1 Subarea 1 (in Greenlandic waters) and NAFO Division 0A east of 60°30'W, which in
2 Canada is fished in SFA 1. At the request of Canada and Denmark (on behalf of
3 Greenland) NAFO's Scientific Council (SC) completes annual assessments of this shrimp
4 stock and provides science advice and a TAC recommendation.

5
6 SFA 7 (NAFO Division 3L) is part of a straddling stock managed by NAFO. Canadian
7 harvesters fished in SFA 7 from 2000 – 2014. Consistent with NAFO's precautionary
8 approach framework, SFA 7 has been closed to directed fishing since 2015 due to
9 declines in biomass indices and concern for this resource.

10
11 NAFO Division 3M is a high seas stock managed by NAFO but through effort control
12 (limits on number of vessels and days on ground for each member country) instead of
13 quotas. Canadian > 100' sector vessels had fished in this area from 1994 – 2011. 3M has
14 been closed to directed fishing since 2011.

15 16 **Decision Making Process**

17 Management of the Northern shrimp fishery is done in consultation with stakeholders
18 primarily through the Northern Shrimp Advisory Committee (NSAC). NSAC strives to
19 reach consensus among stakeholders when making recommendations to the Minister for
20 decision. Stakeholder perspectives, science results and other considerations are presented
21 to the Minister for decision. The Minister retains ultimate authority and responsibility for
22 management and conservation of fish resources. NSAC membership and terms of
23 reference are located in ANNEX G.

24 As the Department employs multi-year management for commercial fisheries, NSAC
25 meetings are scheduled every two years, barring any circumstance that may require
26 convening the Committee in interim years. The meetings coincide with the years in which
27 science assessments are conducted and are scheduled to occur in the odd numbered years
28 (2019, 2021, etc). However, in recent years, due to declines observed in the south and the
29 overall economic importance of the fishery, NSAC has generally convened annually.

30 Minutes of NSAC meetings can be found under "Fisheries" at: [http://www.dfo-
31 mpo.gc.ca/reports-rapports-eng.htm#3](http://www.dfo-mpo.gc.ca/reports-rapports-eng.htm#3)

32
33 In order to address new or ongoing issues, working groups comprised of representation
34 from NSAC membership are formed. Some working groups are struck to resolve single
35 issues, while others function to address longer term issues. Examples of the latter include
36 a working group to oversee Marine Stewardship Council (MSC) certification. Activities
37 of any working group during the year are presented to the Committee at the advisory
38 meeting.

39
40 In addition, consultation with the NL inshore shrimp fleet also occurs as needed,
41 generally prior to the start of each season to discuss sharing of the inshore quota among
42 the five inshore fleets (2J, 3Kn, 3Ks, 3L and 4R) and other operational matters as
43 required.

1
2 **1.7 Approval Process**
3

4 Recommendations of NSAC are brought to the Minister of Fisheries and Oceans for
5 decision. The Minister's decisions are communicated to NSAC and incorporated into the
6 IFMP and / or other departmental documentation (i.e. management decision website) as
7 appropriate.
8

9 Overall authority and responsibility for resource conservation and management rests with
10 the Minister. However, in the case of SFAs / MUs that fall within and/or adjacent to
11 defined settlement area boundaries of the Nunavut, Nunavik and/or Labrador Inuit Land
12 Claims Agreements, these Agreements provide for the establishment of resource or
13 wildlife co- management structures whose roles and responsibilities vary from advisory
14 to decision making.
15

16 Where co-management structures have both a decision making (within settlement area
17 boundaries) and advisory role (outside settlement areas) under their respective
18 Agreements, the interaction between these structures and the Minister follows a
19 prescribed process whereby the Minister may accept, reject or vary a decision of the co-
20 management structure. Land Claims agreements also set out circumstances and processes
21 for which government must seek the advice of co-management structures as well as the
22 processes for seeking this advice.
23

24 In accordance with the terms of the respective agreements, requests for decisions or
25 recommendations are submitted by DFO to relevant Land Claims co-management
26 structures. With respect to shrimp in the NSA and NMR, the NWMB and NMRWB
27 jointly provide TAC recommendations and harvest levels for the respective settlement
28 areas. The TJFB is the primary body to make recommendations to the Minister in relation
29 to conservation and management issues in the LISA, and to advise the Minister on
30 conservation and management of fish in waters adjacent to the Zone.
31

32 Other senior departmental officials, such as the Regional Director General, or Director
33 General of Fisheries Resource Management in Ottawa may make management decisions
34 pertaining to the day to day operations of the fishery that are relatively straight forward
35 and that do not relate to TAC.
36

37 Fisheries Management decisions can be found at:
38 <http://www.dfo-mpo.gc.ca/decisions/index-eng.htm>
39

40

Section 2 - Science

41 **2.1 Biological Synopsis**

42 **Northern Shrimp (*Pandalus borealis*)**



1

2 Figure 4: *Pandalus borealis*, or northern shrimp

3 Northern Shrimp (*Pandalus borealis*) are found in the Northwest Atlantic from Baffin
4 Bay south to the Gulf of Maine, usually between 150 and 600 metres deep, often in areas
5 where the ocean floor is soft and muddy and where temperatures near the bottom range
6 from about 0 to 6 °C (DFO 2017a and DFO 2017b).

7

8 Northern Shrimp are protandrous hermaphrodites. They first mature as males, mate as
9 males for one to three years and then change sex; spending the rest of their lives as
10 mature females. Most shrimp reach male sexual maturity during the second or third year
11 of life and generally the transition to the female form takes place in winter when the
12 shrimp are a few years old. Mating takes place in late summer and fall. Fertilized eggs
13 are attached to the female's abdominal appendages for seven to eight months until they
14 hatch in the spring. Larvae are pelagic, spending three to four months in the water
15 column. At the end of this period, they move to the bottom and take up the lifestyle of the
16 adults (DFO 2017a and DFO 2017b).

17

18 In more northern areas, shrimp are thought to live longer than eight years, while those in
19 the south likely live for six or seven years. Shrimp can grow to about 15 to 16 centimetres
20 in total length, although the average size is about half of this. They are considered
21 harvestable once their carapace length exceeds 17 millimetres, which occurs at
22 approximately three years of age. Most of the fishable biomass is female (DFO 2017a
23 and DFO 2017b) however, the portion that is female varies by area and year.

24

25 **Striped Shrimp (*Pandalus montagui*)**

26



27

28 Figure 5 *Pandalus montagui*, or striped shrimp

29 Striped Shrimp (*Pandalus montagui*) are found from Davis Strait south to the Bay of
30 Fundy. Striped Shrimp prefer a hard bottom and are typically found in waters with a
31 temperature of -1 to 2 °C at depths of 100 to 500 metres (DFO 2017a and DFO 2017b).

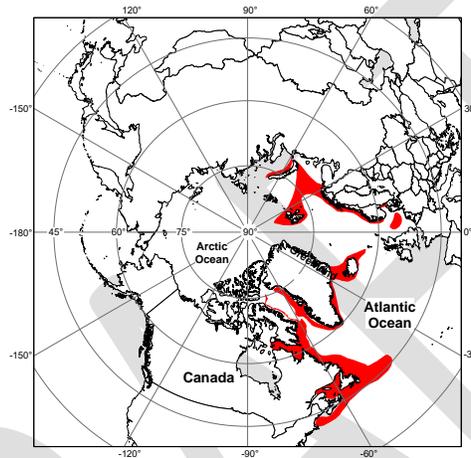
32

1 Striped Shrimp are protandrous hermaphrodites, functioning as males early in their lives
2 then changing sex and reproducing as females for the remainder of their lives. Females
3 usually produce eggs once a year in late summer to fall and carry them, attached to their
4 abdomen, through the winter until spring, when they hatch. Newly hatched shrimp spend
5 three to four months as pelagic larvae. At the end of this period, they move to the bottom
6 and take up the lifestyle of the adults. They migrate into the water column during the
7 night. The migration consists of mainly males and smaller females (DFO 2017b).

8

9

10

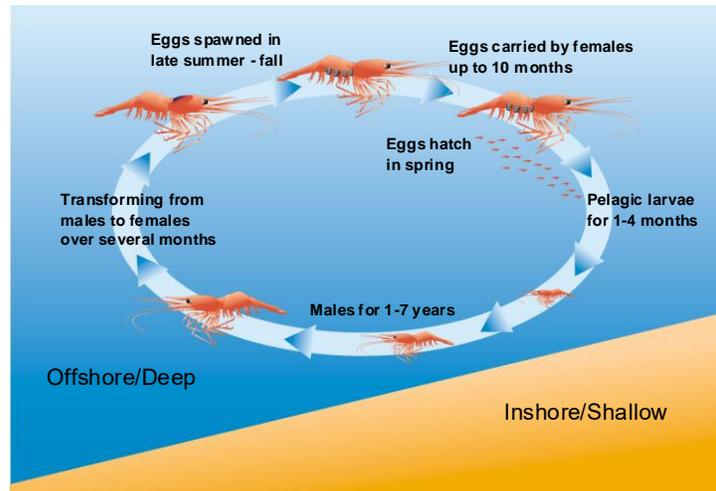


11

12

13 Figure 6. Distribution of Northern Shrimp (*Pandalus borealis*) in the northern
14 hemisphere (redrawn and modified from Bergström Bergström, 2000)

Life cycle of *Pandalus borealis*



1

2 Figure 7. The general life cycle of *Pandalus borealis* and *P. montagui* (Aschan, pers
3 comm.)

4

5 **2.2 Ecosystem Interactions**

6

7 The recent long-term warming trend in waters of the northwest Atlantic is associated with
8 both climate change and the warm phase of the Atlantic Multi-Decadal Oscillation. A
9 suite of associated changes (e.g. slowing down of the Labrador Current, reduction in ice
10 coverage, more frequent extreme weather events) can have important effects on the
11 marine ecosystem impacting all trophic levels. A warming ecosystem may affect many
12 commercial species (DFO 2014).

13

14 Sea ice dynamics are an important driver of the spring phytoplankton bloom. The timing
15 of the bloom has an influence on Northern Shrimp recruitment and has been correlated
16 with shrimp production rates. Overall, ecosystem production seems to be, at least in
17 recent decades, mainly regulated by bottom-up processes. This implies that current trends
18 in the climate system and lower trophic levels would be expected to impact overall
19 ecosystem productivity (DFO 2014).

20

21 As a forage species, shrimp is an important prey item for several species, including
22 Atlantic Cod (*Gadus morhua*), Greenland Halibut (*Reinhardius hippoglossides*), redfish
23 (*Sebastes spp.*), skates (*Raja radiata*, *R. spinicauda*), wolffish (*Anarhichas spp.*), and
24 Harp Seals (*Phoca groenlandica*). This is particularly important when the availability of
25 alternate high-energy prey is low.

26

27

1 Shrimp are primarily harvested by bottom trawls, which can disrupt benthic communities
2 and habitats such as corals and sponges. Concentrations of coral and sponge constitute
3 “Significant Benthic Areas” that are sensitive to bottom trawling due to the sessile nature
4 and low growth rate of these organisms. Benthic communities may also constitute fragile
5 ecosystems in that bottom trawling can reduce their diversity and modify their structure.
6 In 2010, DFO held a national science advisory process to review available information
7 and provide science advice regarding the occurrence, sensitivity and ecological function
8 of corals, sponges and hydrothermal vents in Canada. Information on this process can be
9 found at: [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2010/2010_041-
11 eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2010/2010_041-
10 eng.html). Further refinement of the delineation of aggregations of cold-water coral and
12 sponge as Significant Benthic Areas, and presentation of information on the fishing
13 activity in relation to these significant areas, was reviewed at a national science advisory
14 process in 2016. [The Science Advisory Report resulting from this process can be found
15 at: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2017/2017_007-eng.html.](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2017/2017_007-eng.html)

16 **2.3 Indigenous Traditional Knowledge and Fisher Traditional Ecological** 17 **Knowledge**

18
19 Indigenous and fisher Traditional Ecological Knowledge (TEK) is an important
20 component of fisheries management and is used together with scientific knowledge for
21 effective fisheries decision-making. DFO routinely consults resource users on a wide
22 range of topics (e.g. management issues, stock assessment studies, quotas and
23 management measures), and incorporates their views and traditional knowledge in the
24 development of scientific research and fishery management plans. While Indigenous
25 peoples did not traditionally fish Northern shrimp, Indigenous and commercial fishers
26 have knowledge of the marine ecosystem (e.g. climate change, sea ice patterns) and their
27 observations can contribute to an understanding of long-term changes in environment that
28 ultimately affect the management of the Northern shrimp fishery.

29 30 **2.4 Stock Assessment**

31
32 Stock assessment results can be found on the DFO Canadian Science Advisory
33 Secretariat website:
34 <http://www.isdm-gdsi.gc.ca/csas-sccs/applications/Publications/index-eng.asp> (See
35 ANNEX H: Stock Assessment and Precautionary Approach.)

36
37 Resource status is assessed based on indices from fishery-independent surveys conducted
38 by DFO and industry, trends in fishery catch per unit effort (CPUE) derived from
39 logbooks and observer datasets, and biological sampling from multiple sources. Resource
40 status in SFAs 5 and 6 (Northern Shrimp) is updated annually based on DFO fall multi-
41 species trawl survey data. Resource status in the EAZ, WAZ and SFA 4 (Northern and
42 Striped Shrimp) is updated annually based on Northern Shrimp Research Foundation-
43 DFO summer trawl survey data.

44
45 The surveys provide information on shrimp distribution and length frequencies which are
46 used to calculate indices of total abundance, fishable biomass and spawning stock
47 biomass. Additionally, the fall multi-species surveys provide data on bottom temperature,

1 predation and consumption. Fishable biomass is the weight of all shrimp (both males and
2 females) which have a carapace length greater than 17 millimetres. Female spawning
3 stock biomass is defined as the weight of all female shrimp regardless of size, though
4 most are of fishable size. To determine the exploitation rate index, the commercial catch
5 is divided by the survey fishable biomass index from the previous year (for fall surveys)
6 or from the same year (for summer surveys) (DFO 2017a and DFO 2017b).

7
8 The various indices also provide information on fishery performance, including
9 exploitation rate and distribution of fishing effort, composition of shrimp catches, and
10 inferences on the state of fishable biomass and female spawning stock biomass.
11 Information on female spawning stock biomass has been used to develop proxy reference
12 points under the Precautionary Approach Framework for some stocks.

13 **2.5 Stock Scenarios**

14 Northern Shrimp – SFA 7

15
16 The Northern shrimp stock in SFA 7 has declined since 2007 and is below the limit
17 reference point for biomass (B_{lim}). Due to declines in biomass indices and concern for
18 this resource, SFA 7 has been closed to directed fishing since 2015.
19
20
21
22

23 Northern Shrimp – SFA 6

24
25 The Northern shrimp resource in SFA 6 has been declining since 2006 and is in the
26 critical zone of the precautionary approach framework. As of the 2016 survey, fishable
27 and female spawning stock biomass indices were at the lowest levels since this DFO
28 multi-species survey time series began in 1996. Environment and ecosystem indicators in
29 the area indicate that indices will likely remain low in the short term (DFO 2017b).
30

31 Northern Shrimp – SFA 5

32
33 The Northern shrimp resource in SFA 5 is in the healthy zone of the precautionary
34 approach framework. Biomass index declines are more difficult to interpret in this area
35 due to the narrow range of biomass indices (DFO 2017b).
36

37 Northern Shrimp – SFA 4

38
39 The Northern shrimp resource in SFA 4 is in the healthy zone of the precautionary
40 approach framework. The Biomass has not shown a significant trend in either direction
41 since the survey began in 2005 (DFO 2017b).
42

43 Striped Shrimp – SFA 4

44
45 The fishable biomass for the Striped shrimp resource in SFA 4 has varied without trend.
46 The fluctuations in the fishable biomass index are likely due to the strong currents near

1 the northern border. There is no TAC for this resource but a bycatch limit is in place
2 (DFO 2017b).

3 4 Northern Shrimp – Eastern Assessment Zone

5
6 The Northern shrimp resource in the Eastern Assessment Zone is in the healthy zone of
7 the precautionary approach framework. The fishable biomass index has varied without
8 trend around the long-term mean. The fluctuations in biomass are likely due to strong
9 currents in Hudson Strait (DFO 2017a).

10 11 Striped Shrimp – Eastern Assessment Zone

12
13 The fishable biomass index within the PA Framework for the Striped shrimp resource in
14 the Eastern Assessment Zone has varied without trend around the long-term mean. The
15 fluctuations in the fishable biomass index are likely due to the strong currents near the
16 southern border (DFO 2017a).

17 18 Northern Shrimp – Western Assessment Zone

19
20 The Northern shrimp resource in the Western Assessment Zone decreased in 2016
21 compared to 2015. The 2014 survey began a new time series, not directly comparable
22 with previous surveys. Because the time series is so short, trends cannot yet be inferred
23 (DFO 2017a).

24 25 26 Striped Shrimp – Western Assessment Zone

27
28 The Striped shrimp resource in the Western Assessment Zone decreased in 2016
29 compared to 2015. The 2014 survey began a new time series, not directly comparable
30 with previous surveys. Because the time series is so short, trends cannot be inferred.
31 (DFO 2017a)

32 33 Northern Shrimp – SFA 1

34
35 The Northern shrimp resource in SFA 1 is a part of the Canada/Greenland shared
36 population, with Canada having an access to a relatively small portion of the fishery. The
37 assessment of the entire stock is performed by the NAFO SC, while each fishery is
38 managed by individual countries. In 2016 the stock was assessed to be in relatively good
39 condition (11% above B_{msy}). The risk of the stock being below the B_{lim} was very low (less
40 than 1%). The outlook for this stock is positive, with either a stable or positive growth
41 trajectory, providing the mortality pressure remains the same.

42 43 **2.6 Precautionary Approach Framework for Northern Shrimp**

44 The Fishery Decision-Making Framework Incorporating the Precautionary Approach
45 (PA) applies to fish stocks that are the targets of a commercial, recreational, or

1 subsistence fishery. It may be applied more broadly to other stocks, if necessary or as
 2 circumstances warrant.

3 The Framework requires that a harvest strategy be incorporated into respective fishery
 4 management plans to keep the removal rate moderate when the stock status is healthy,
 5 promote rebuilding when stock status is low, and provide for a low risk of serious or
 6 irreversible harm to the stock. It also requires a rebuilding plan is in place when a stock
 7 reaches the Critical Zone. In general, the precautionary approach in fisheries
 8 management is about being cautious when scientific knowledge is uncertain, and not
 9 using the absence of adequate scientific information as a reason to postpone or fail to take
 10 action to avoid serious harm to fish stocks or their ecosystem. This approach is widely
 11 accepted as an essential part of sustainable fisheries management (DFO 2006).

12 A precautionary approach to the management of the shrimp fishery, consistent with the
 13 basic tenants set out in the Framework, is in place for most Northern Shrimp fishery
 14 areas. Priority is given to monitoring the stock and establishing a data time series to
 15 support management decisions. Biomass indices, commercial catch levels, and
 16 exploitation rate indices are used to indicate stock status. Scientific uncertainty is
 17 quantified by including standard errors for these indices. This approach is based on
 18 biological criteria established by Science and peer-reviewed through the applicable
 19 Canadian Science Advisory Secretariat (CSAS) or NAFO Scientific Council processes.
 20 Scientific uncertainty and uncertainty related to the implementation of management
 21 measures for Northern shrimp are explicitly considered when evaluating stock status and
 22 making management decisions. The application of a precautionary approach to this
 23 fishery is done in concert with industry, co-management organizations, and other
 24 stakeholders through NSAC and other relevant processes.

25
 26 Precautionary Approach Reference Points

27
 28 Reference points for Northern shrimp were developed using proxies. The provisional
 29 upper stock reference (USR) was defined as 80%, and the provisional lower reference
 30 point (LRP) as 30%, of the geometric mean of female spawning stock biomass (SSB)
 31 index over a productive period. Because of differences in survey history, the reference
 32 periods were taken to be 1996-2003 for SFA 6, 1996-2001 for SFA 5, 2005-2009 for
 33 SFA 4, and 2006-2008 for EAZ. Reference points for Striped Shrimp in SFA 4, EAZ, and
 34 WAZ, and for Northern Shrimp in WAZ are in the process of being developed.

35
 36 Reference Points for Northern (borelais) and Striped (montagui) Shrimp

SFA	Critical Zone	LRP	Cautious Zone	USR	Healthy Zone
SFA 4 borealis	SSB<20,400 t	20,400 t	20,400 t ≤ SSB < 54,400 t	54,400 t	SSB≥54,400 t
SFA 5	SSB<15,200 t	15,200 t	15,200 t ≤ SSB < 40,700 t	40,700 t	SSB≥40,700 t
SFA 6	SSB<82,000 t	82,000 t	82,000 t ≤ SSB < 219,000 t	219,000 t	SSB≥219,000 t
EAZ borealis	SSB<6,800 t	6,800 t	6,800 t ≤ SSB < 18,200 t	18,200 t	SSB≥18,200 t
EAZ montagui	SSB<2,300 t	2,300 t	2,300 t ≤ SSB < 6,100 t	6,100 t	SSB≥6,100 t

37

1 A harvest rate strategy is the approach taken to manage the harvest of a stock and is a
2 necessary element of any fishery plan. In order to implement the PA, pre-agreed harvest
3 decision rules and management actions for each zone are essential components of a
4 harvest rate strategy. Harvest Decision Rules for shrimp stocks with a PA in place are at
5 ANNEX I.

6 References for additional information on stock status and the Precautionary Approach for
7 Northern and Striped Shrimp are in ANNEX H.

8 **2.7 Research**

9

10 Shrimp are an important forage species within the ecosystem, particularly in the absence
11 of alternative high energy prey, and therefore management of the shrimp fishery should
12 adopt a more conservative approach than would otherwise be adopted under a single
13 species management approach. There is a need for a better understanding of ecosystem
14 demands and impacts of commercial fishing on shrimp as a forage species and to
15 incorporate this into future assessments. This research would be reflected in the use of
16 additional ecosystem indicators in the assessments and in the future modelling work that
17 will help develop, and refine, new precautionary approach reference points (DFO 2013).
18 A better understanding of these factors could potentially lead to ecosystem based
19 management rather than single species management.

20

21 Effects of climate change on shrimp resources should be considered when making
22 management decisions. More research is required to determine whether environmental
23 variables could be used in conjunction with recruitment signals to predict future stock
24 size (DFO 2013).

25

26 The Department conducts research independent of other organizations but also in concert
27 with other research groups, such as NAFO's Scientific Council and the Northern Shrimp
28 Research Foundation (NSRF). For a list of research activities, see ANNEX J. This list of
29 ongoing and potential future research activities should be considered as provisional, and
30 as such is subject to change. For example, SFA 7 is managed by NAFO and ultimately
31 the Department can make requests for research but any final decisions are outside of our
32 purview. Additionally, considerations such as emerging issues, changing priorities as
33 well as the availability of human and financial resources influence the research
34 undertaken.

35

36 Literature Cited

37

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40

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43

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2 Labrador Region (Divisions 2J3KL). DFO Can. Sci. Advis. Sec. Sci. Resp. 2014/049.

3
4 DFO, 2017a. Assessment of Northern Shrimp, *Pandalus borealis*, and Striped Shrimp,
5 *Pandalus montagui*, in the Eastern and Western Assessment Zones, February 2017. DFO
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7
8 DFO, 2017b. An assessment of Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing
9 Areas 4-6 and of Striped Shrimp (*Pandalus montagui*) in Shrimp Fishing Areas 4 in
10 2016. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2017/012

11 12 Section 3 Economic, Social and Cultural Considerations

13
14 The Northern shrimp fishery in Canada makes an important contribution to regional
15 economic development and growth in Eastern Canada and the Arctic through the use of
16 required operational goods and services and the employment and training of local
17 residents engaged in the various steps of the shrimp supply chain from harvesting to
18 processing to distribution/export. The Arctic Northern shrimp fishery vessels employ a
19 substantial number of Inuit and Innu residing in northern Labrador, Nunavik and Nunavut
20 (See Annex K for further employment information). The formation of Northern
21 harvesting partnerships has been an important source of revenue for Northern
22 development. The Northern shrimp fisheries supports harvesting as well as processing
23 plants and logistics services, providing important local employment most notably in
24 Newfoundland and Labrador, but also in New Brunswick, Nova Scotia and Quebec.
25 Additionally, goods and services needed to support vessel operations and land-based
26 processing production and distribution are important contributors to the local economy
27 creating jobs and generating income in various industries. Among the contributing
28 activities are vessel and gear repair, maintenance, stevedoring, provisioning (food and
29 fuel), observer coverage, and travel/transportation.

30 **3.1 Domestic Landings¹ and Exports**

31 Canada, as one of the world's leading producers of cold-water shrimp, saw a strong
32 increase of 44% in landed value for the Canadian Northern Shrimp fishery from 2013 to
33 2015 (See Annex K, for details on landings, including by fleet). This increase was
34 exclusively due to notable price increases, as landed quantities decreased 17% over the
35 same period.

36
37 The Canadian Northern Shrimp fishery is harvested by two fleets; the <89'11" inshore
38 fleet and the >100' offshore fleet. Inshore vessels deliver mainly wet shrimp to onshore
39 plants for processing (cooking and peeled). The >100' fleet processes and packages
40 shrimp on board factory trawlers, primarily cooked shell on; raw small size (industrial)
41 shrimp that is too small for cooked shell-on markets is cooked and peeled in shore-based
42 processing plants in Canada and other countries.

¹ Source: Canadian Atlantic Quota Reports

1 Export volumes of Canadian Northern shrimp decreased 14% from 77,000 mt in 2013 to
2 67,000 mt in 2015². The value of Northern shrimp exports increased annually from
3 \$327M in 2013 to \$439M in 2015 (See Annex K for more detail). Northern shrimp
4 accounted for approximately 7% of Canada's total fish and seafood export value in 2015.
5 Of this, 80% was generated by Canada's top four export destinations in Asia and Europe,
6 in particular China (\$126M), Denmark (\$88M), the United Kingdom (\$85M), and Iceland
7 (\$52M). There was strong price growth over the period, with average prices for all
8 Northern Shrimp products rising 56%. Prices received by Canadian producers are
9 influenced by the interaction of global supply and demand of shrimp (cold-water and
10 warm-water shrimp) and shrimp substitutes, as well as other factors (resource
11 availability, exchange rates).
12
13

14 Section 4 Management Issues

16 **4.1 Management Challenges during Periods of Ecosystem Change**

17
18 The decline in shrimp production in SFA 6 has been associated with various environment
19 and ecosystem changes including a recent warming trend, early timing of the
20 phytoplankton bloom and increasing biomass of predatory fishes.. Given declining per-
21 capita net production of shrimp, commercial fishing pressure will now be influencing
22 stock declines more than it did in the past (i.e. prior to 2009).The current PA (Section
23 2.6) was defined based on the mean of female spawning stock biomass index over a
24 productive period, based on available data and consistent with the PA Framework. It has
25 been suggested that the current reference points may not be appropriate for the current
26 state of the shrimp resource as they were derived based on a period of more favourable
27 ecosystem conditions. A Science Response Process was held in 2017 to review the
28 reference points used in the PA for Northern Shrimp in SFA 6. The report from this
29 process can be found at [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-
30 RS/2017/2017_009-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-
30 RS/2017/2017_009-eng.html). It was concluded that it is not currently clear whether
31 shrimp are experiencing a new productivity regime, whether there were low or high
32 productivity regimes in the past, or where the stock lies relative to its potential production
33 in current conditions. Due to the uncertainties, the current reference points remain
34 unchanged at this time. However, DFO Science is working on developing models for
35 Northern Shrimp in SFA 4-6. If an appropriate model is developed, it will be used to
36 inform the need to revise the current PA and to predict how the stock will respond to
37 different exploitation rates.
38

39 **4.2 Climate Change**

40
41 It is not known to what extent climate change affects shrimp abundance, distribution or
42 overall ecological conditions, including predator prey relationships.
43

² Source: DFO EXIM Trade Database: Statistics Canada, International Trade Division.

1 The long-term warming trend in waters off of NL is associated with climate change, and
2 with the warm phase of the Atlantic Multi-decadal Oscillation, a key indicator of climate
3 conditions over the North Atlantic. Associated with the warming trend is the slowing
4 down of the Labrador Current, a reduction in ice coverage, and more frequent extreme
5 weather events which can have important effects on the ecology of the marine ecosystem,
6 impacting all trophic levels and long-term prospects for commercial species.

7 Given that the current warm phase is expected to continue in the near term in NAFO
8 Divisions 2J3KL (Southern SFA 5, and the entirety of SFAs 6 and 7), and may possibly
9 persist for more than a decade, the Department held a science response process in the
10 summer of 2014 to provide an overview of the prospects for key Newfoundland and
11 Labrador stocks, including Northern shrimp, over the next three to five years within the
12 context of increasing temperatures. The warming trend in environmental conditions has a
13 detectable negative impact on shrimp production. Reduced productivity is also
14 associated with the increasing biomass of predatory fish and exploitation rates of shrimp.
15

16 Unfavourable environmental conditions for shrimp are expected to continue in the short
17 term. The Science response can be found at [http://www.dfo-mpo.gc.ca/csas-
18 sccs/Publications/ScR-RS/2014/2014_049-eng.html](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ScR-RS/2014/2014_049-eng.html)
19

20 **4.3 Conflicts between shrimp and crab**

21
22 Snow crab and shrimp fisheries occur on common grounds in Divisions 2J3K. The
23 presence of conflict has resulted in research activities and closed areas. Results of a 2005
24 study indicated that shrimp bottom trawling could be associated with an increased
25 incidence of crab damage (i.e. leg loss). However, there is no evidence that shrimp
26 trawling imposes substantial mortality on hard-shelled Snow crab.
27

28 An area of the Hawke Channel was closed to all fisheries, except Snow crab, beginning
29 in 2002. The primary rationale for the closed area was in response to the Fisheries
30 Resources Conservation Council recommendations in 2000 and 2001 to protect juvenile
31 turbot and spawning cod respectively. The crab harvesters in 2J supported the closure as
32 it addressed their concerns of the possible negative effect of shrimp trawling on the snow
33 crab resource. A 2012 study found the closure had no impact on improving Snow crab
34 catch rates. An area of 3K, in the Funk Island Deep, was first closed to gillnetting in 2002
35 and was later closed to bottom trawling through a combination of mandatory and
36 voluntary closures in 2005 out of concern for Snow crab. No formal studies on the
37 effectiveness of this closure have been conducted to date. (Additional information on
38 Closed Areas can be found in Section 7.3.)
39

40 **4.4 Groundfish Bycatch / Presence of Groundfish**

41
42 The use of the Nordmore grate markedly reduced groundfish bycatch, however increases
43 in some groundfish stocks have resulted in the potential for increased bycatch. This
44 increase in groundfish has and may continue to require the implementation of additional
45 management measures that allow the Northern shrimp fishery to operate efficiently while
46 not jeopardizing recovering groundfish stocks. As knowledge on bycatch and its impact

1 improves, management measures may be introduced or modified in licence conditions
2 (e.g. move away provisions) or other mechanisms.

3
4 As the presence of groundfish, most notably cod, has increased in the southern areas,
5 inshore fishers are of the view that its presence and abundance may be altering shrimp
6 behavior, presence and abundance, causing shrimp to move higher in the water column
7 where it would not be detected by the DFO multi-species surveys. Additionally, shrimp
8 are an important food source for cod and the increased predation overall, particularly
9 while alternative high-energy prey (i.e. capelin) is low, may be having a negative impact
10 on shrimp. This is one of the priorities identified by the Science / Resource Management
11 Working Group mentioned in section 8.1.

12 13 **4.5 Depleted Species**

14 ***Species at Risk Act (SARA)***

15 The leatherback sea turtle (*Dermochelys coriacea*) is listed as endangered under SARA
16 and is occasionally encountered in the Northern shrimp fishery, however the use of the
17 Nordmore grate prevents it from being inadvertently captured. Two species of wolffish,
18 *Anarhichus denticulatus* (Northern) and *Anarhichus minor* (Spotted), are bycatch in the
19 Northern shrimp fishery and listed as *threatened* under SARA. A third species, the
20 Atlantic Wolffish (*Anarhichas lupusis*) is also listed under SARA with Special Concern
21 designation.

22
23 Northern shrimp licence conditions prohibit the retention of the above mentioned SARA
24 species listed as endangered or threatened and clearly state that it must be returned to the
25 place from which it was taken, and if alive, in a manner that causes it the least harm.
26 Further, the licence conditions require that any interactions with species at risk must be
27 reported in the logbook, detailing location, time of catch and the quantity, weight and
28 condition (alive or dead) of the animal.

29
30 For further details, please visit the SARA Public Registry at
31 <http://www.registrelep-sararegistry.gc.ca/default.asp?lang=en&n=24F7211B-1>

32 33 **4.6 Oceans and Habitat Considerations**

34 35 ***Benthic Issues***

36 As described in Section 7.3, there are several mandatory and voluntary closures within
37 the geographic range of the Northern shrimp fishery to address concerns for various
38 species and/or sensitive benthic habitats. NSAC established a Working Group on Closed
39 Areas (later renamed the Ecosystems Working Group) to specifically address benthic
40 issues should they arise and to provide related advice to NSAC.

41 42 **4.7 Gear Impacts**

43
44 A review of trawl impacts was conducted in 2006 by the Department, which concluded
45 that bottom-contact gear have an impact on benthic populations, communities and

1 habitats. Addressing impacts requires case by case assessments, with solutions
2 customized to the particular set of circumstances leading to the impacts. The 2006 review
3 of trawl impacts can be found at [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-
4 AS/2006/2006_025-eng.htm](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2006/2006_025-eng.htm)
5

6 Because the trawl is mechanically attached to the vessel, losing gear in this fishery is
7 extremely rare. Due to the cost, most, if not all vessels will search and retrieve any lost
8 trawl.
9

10 **4.8 International Issues**

11 NAFO Division 0A east of 60°30' W and Subarea 1, which in Canadian waters occurs in
12 SFA 1, is a transboundary stock stock between Canada and Greenland. In response to
13 requests from both jurisdictions, the NAFO Scientific Council provides scientific advice
14 on catches. There is currently no agreement in place between the two countries regarding
15 processes to set the global TAC, or to determine sharing arrangements. Canada and
16 Greenland have entered into both formal and informal discussions that seek to advance
17 progress on achieving a joint management approach to this stock. In the absence of such
18 an agreement, and based on its own assumptions of risk, Greenland sets its own TAC and
19 assigns Canada a percentage of this TAC (less than 3%). Canada, on the other hand,
20 traditionally sets a global TAC consistent with Scientific Council advice, and claims
21 roughly 14.2% of this to be fished domestically.

22 Until such time that an agreement is in place, Canada continues to unilaterally establish
23 the TAC and claim its share of 14.2%. Harvest Decision Rules for SFA 1 are at ANNEX
24 H.
25

26 **5. Objectives**

27 **5.1 FISHERY OBJECTIVES**

28 Fisheries and Oceans Canada, with its co-management partners and stakeholders, strives
29 to manage this fishery to maximize economic benefits in an ecologically sustainable
30 manner. The long-term objectives relate to conservation and sustainable harvest, benefits
31 to stakeholders and the co-management of the shrimp resource. Corresponding short term
32 objectives, strategies and management measures have been implemented, or are in the
33 process of being developed.

Conservation and Sustainable Harvest (Long term objective)

- To promote the sustainable utilization of Northern shrimp stocks.
- To promote cost-effective harvesting strategies that ensures compliance with objective-oriented management and conservation measures and promotes a responsible image for all fleet sectors.
- To mitigate the negative impacts on other species, habitat, and the ecosystem

- where shrimp fishing occurs.
- Within specified resource management constraints, to promote a harvest level that stabilizes industry infrastructure and meets marketing requirements, in the pursuit of economic viability objectives for the shrimp sector.
- To promote fishing practices that avoid or mitigate negative impact on sensitive habitat and species.
- To explicitly recognize the ecosystem role of shrimp in TAC-setting decisions, particularly as a forage species.
- To keep stocks in, or return to the Healthy Zone as per the PA Framework.

Strategies (short term objective)	Management Measures (short term objective)
<p>Precautionary Approach</p> <ul style="list-style-type: none"> • Utilize a precautionary approach framework when setting exploitation rates for the directed fishery • The significant role of shrimp as a forage species is taken into account in decision making • Manage activity in ecologically sensitive areas • Promote the development of sustainable fishing practices. • Manage by-catch or mortality for all non-targeted species • Employ effective monitoring and surveillance tools and mechanisms that ensure compliance with conservation measures 	<p>Precautionary Approach (Section 2.6)</p> <ul style="list-style-type: none"> • Provide biomass and abundance estimates through timely science surveys • Utilize indicators of stock and fishery change • Control fishing mortality by setting annual TAC, taking into account the role of shrimp in the ecosystem • Utilize appropriate exploitation rates and reference points, which take into account the role of shrimp in the ecosystem • Use fishery closures / closed areas to achieve conservation objectives as required • Prohibit bottom contact fishing in established Sensitive Benthic Areas • Enforce regulations against discarding and highgrading • Require a maximum of 22 (SFA 6,7) or 28 mm (SFA 1,4, 5 and in the management units in the Eastern Assessment Zone (EAZ) and Western Assessment Zone (WAZ)) separator grates as condition of licence • Require live release of species listed under SARA as endangered or threatened • Observer coverage is targeted at 100% for > 100' vessels and 10% for inshore boats • Use of Vessel Monitoring Systems for all shrimp boats • Employ Dockside Monitoring Programs for 100% of inshore landings • Employ aerial and dockside surveillance in addition to period audits of landings and catch

	information outside regular operations
--	--

1

<p>Benefits to Stakeholders (long term objective)</p> <ul style="list-style-type: none"> • To promote the continued development of a commercially viable and self-sustaining fishery • To provide fair access to and equitable sharing of the Northern shrimp resource. • Helps industry maintain Marine Stewardship Council Certification
--

<p>Strategy (short term)</p> <ul style="list-style-type: none"> • No new access to this fishery • When dealing with TAC changes in the SFAs 4, 5 and 6, use percent shares as the primary policy guiding allocations. When dealing with TAC changes in the northern SFAs in the WAZ and EAZ, make allocation decisions on a case by case basis, respecting Land Claim obligations • Balance fleet capacity with resource availability • Enterprise and licence combining for the inshore fleet • Fulfill obligations with respect to fishery resources as defined in the Nunavut Land Claims Agreement, the Labrador Inuit Land Claims Agreement and the Nunavik Inuit Land Claims Agreement. 	<p>Management Measures (short term)</p> <ul style="list-style-type: none"> • Continue Enterprise Allocation structure for >100' sector • Continue to limit entry to the fishery through licensing • Consult with management boards in Land Claim areas on TAC levels in or adjacent to their settlement area waters
---	--

2

Co-management of the Resource (long term objective)

- Co-management of the resource in or adjacent Land Claim settlement areas involves working with the Inuit of Nunavut, Nunavik, and Nunatsiavut
- At NAFO, for the Flemish Cap (3M) and 3L shrimp fisheries, to promote a TAC and quotas management scheme, or otherwise controlling fishing effort to achieve a sustainable fishery.
- With Greenland, for NAFO Division 0A and Subarea 1 shrimp, to continue to promote an agreed TAC and quota and management scheme.
- To promote a co-management approach, providing licence holders with an effective sharing of responsibility, accountability and decision making, within the constraints of the *Fisheries Act*, the precautionary approach and Harvest Decision Rules.

Strategy (short term objective)

- Regular and open dialogue and communication to help foster relationships with Land Claimants; adherence to obligations as per various Land Claims
- Maintain an effective consultative process for resource users to participate in the decision-making process
- Establish Multi-stakeholder Working Groups designed to examine domestic and international issues, e.g. Conservation and Compliance, Closed Areas, Marine Stewardship Council Certification
- Contribute to and participate in NAFO meetings
- Providing experts to NAFO Scientific Council
- Conduct bi-lateral negotiations between Canada and Greenland, with input and participation from industry
- Manage Joint Project Agreement between DFO and the Northern Shrimp Research Foundation to pursue mutually beneficial scientific activities

Management Measures (short term objective)

- Organize annual Northern Shrimp Advisory Committee (NSAC) meetings
- Convene Working Groups as appropriate
- Convene Shrimp Working Group under NAFO consultative process as appropriate
- Convene domestic consultations and bi-lateral discussions with Greenland as appropriate
- Collaboratively define science priorities and design appropriate research activities

1
2 At advisory meetings, a review of the *P. borealis* and *P. montagui* fisheries takes place
3 which includes a discussion of whether these objectives are being met and key
4 management issues are being addressed. As part of this process, the information gathered
5 through other evaluation processes like the Department's Sustainability Survey for
6 Fisheries is used to help identify areas for improvement in the management of these

1 fisheries and through consultation with stakeholders, potential improvements are
2 explored and priorities established.

3 **6 ACCESS AND ALLOCATION**

4 **6.1 Access and Allocations**

5
6 In addition to measures based on precautionary and ecosystem-based management, DFO
7 applies principles of *access* and *allocation* to the administration of the Northern shrimp
8 fishery.

9
10 Access is described as “the opportunity to harvest or use fisheries resources, generally
11 permitted by licences or leases issued by Fisheries and Oceans Canada under the
12 authority of the Minister of Fisheries and Oceans. The Department shall take Aboriginal
13 and treaty rights to fish into account when providing these opportunities.”

14
15 Access to the Northern shrimp fishery is considered stable for both the >100’ sector and
16 the inshore fleet. There is no new access to the Northern shrimp fishery, and
17 consideration must be given to relevant Land Claims when making access and allocation
18 decisions.

19
20 Allocation is “the amount or share of the fisheries resource and/or effort that is
21 distributed or assigned by the Minister of Fisheries and Oceans to those permitted to
22 harvest the resource.”

23
24 The Minister can, for conservation purposes or for any other valid reasons, modify
25 access, allocations and sharing arrangements as outlined in this IFMP in accordance with
26 the powers granted pursuant to the *Fisheries Act*.

27
28 Following the TAC decision, quotas are established for the fleets and special allocation
29 holders that have access to that management area.

30
31 Quotas and allocations from 1996 – present can be found in the Profile of Access at
32 ANNEX B.

33 34 **6.2 Harvesting of Northern Shrimp Allocations**

35
36 When significant quota increases occurred in the Northern shrimp fishery between 1997
37 and 2016, special allocations were often created to benefit various groups (inshore
38 affected fishers, Indigenous groups, etc.). Over the years, specific harvesting
39 requirements were introduced that determined which fleet is permitted to harvest these
40 allocations and in some cases, specify landing requirements. In 2017, the decision was
41 taken that holders of special allocations in SFA 6 could choose to have their allocation
42 harvested by the inshore fleet and / or the offshore fleet, however arrangements with
43 inshore harvesters would need to occur on a fleet level and not at the individual harvester
44 level in order to address leveraging and other concerns.

1 Harvesting Of Northern Shrimp Allocations

2

Fleet / Interest	EAZ						WAZ		SFA			Fished Only By:
	SFA 0	SFA 1	DS W	DS E	NU E	NK E	NU W	NK W	SFA 4	SFA 5	SFA 6	
>100' sector	●	●	●	●					●	●	●	Any >100' sector Northern shrimp licence holder
Nunavut (NU)		●	●	●								Any NU temporary or > 100 sector Northern shrimp licence holder with sub-allocations in that area
					●		●					Those enterprises that receive allocations in these areas, as amended from time to time
Nunavik (NK)			●			●		●				Any > 100' sector Northern shrimp licence holder or vessel acquired by NK interests
		●										
Makivik		●										Any > 100' sector Northern shrimp licence holder
Northern Coalition										●		
IACF Cartwright to L'Anse au Clair										●		Any Canadian wetfish trawler >65' – 99' or > 100' sector Northern shrimp licence holder
IACF Northern Peninsula										●		
Inshore									●			< 90' inshore vessel or > 100' sector Northern shrimp licence holder
Nunatsiavut Government									●	●		
NunatuKavut Community Council										●		
Imakpik Fisheries										●		
Innu Nation									●	●		
St. Anthony Basin Resources											●	Any > 100' sector Northern shrimp licence holder, and / or through an arrangement with an approved inshore fleet sector
Fogo Island CoOp											●	
Inshore Fleet											●	Any < 90' inshore licence holder

4 In an attempt to encourage development in the early years of the fishery, the Department
 5 allowed licence holders to charter foreign vessels to harvest their allocations. This
 6 practice was phased out over time and today all vessels in the fishery are Canadian and
 7 carry mostly Canadian crews. The exception to this rule is the use of foreign vessels as
 8 short term charter replacements to cover exceptional cases such as vessel loss, or in
 9 extremely rare cases, when there is a shortage of Canadian vessel capacity.

10 6.3 Percent shares

11 The Northern shrimp TAC for each of the SFAs 0 to 6 is allocated to the >100' shrimp
 12 sector, special allocation holders and the inshore fleet depending on the MU/SFA. Prior
 13 to 2016, the LIFO policy was the main tool the Department used to determine access and
 14 allocations for each management area, subject to Land Claims considerations. LIFO is
 15 described in ANNEX C.

16 Beginning in 2016, the Department, by Ministerial decision, implemented stable percent
 17 shares to remaining allocation holders in each of the southern SFAs (4-6). The Minister

1 modified the percent shares in SFA 4 in 2017 to increase the share of the adjacent
 2 Labrador Inuit. Such an approach is not feasible in northern areas where land claims
 3 obligations require consideration of any changes in TAC on a case by case basis. Percent
 4 shares determine the amount of allocations to participants in SFAs 4, 5 and 6.

Fleet / Interest	SFA 4	SFA 5	SFA 6	SFA 7*
Offshore (equally divided among >100' licence holders)	76.2%	38.04%	23.1%	20.2%
Inshore	5.3%	-	69.6%	65.7%
Innu Nation	8.5%	5.19%	1.7%	-
Nunatsiavut Government	10%	9.9%	-	-
Northern Coalition**	-	28.0%	-	-
NunatuKavut Community Council	-	6.22%	-	-
Inshore Affected Cod Harvesters (Cartwright to L'anse au Clair)	-	8.84%	-	-
Inshore Affected Cod Harvesters (Northern Peninsula)	-	1.04%	-	-
Imakpik Fisheries	-	2.77%	-	-
St Anthony Resource Basin Inc (SABRI)	-	-	4.5%	-
Fogo Island Co-Op	-	-	1.1%	-
PEI Consortium	-	-	-	9.4%
Miawpukek First Nation	-	-	-	4.7%

5
 6 *Should NAFO take the decision to resume commercial fishing in SFA 7, the quota
 7 allocation key will be as described.

8 ** Northern Coalition's share is divided equally among Labrador Fishermen's Union
 9 Shrimp Company (2 shares), Torngat Fish Producers Coop, Unaaq Fisheries, Qikiqtaaluk
 10 Corporation, Makivik Corporation and Nunatsiavut Group of Companies

11
 12 **7 MANAGEMENT MEASURES**

13
 14 **7.1 Total Allowable Catch**

15 Stocks are managed through TAC in each SFA. The TAC is the total amount of shrimp
 16 that is permitted to be caught for that fishing season in each SFA, and is determined
 17 annually. Generally, the TAC and fleet quotas fluctuate each year by management area.
 18 With the implementation of percent shares in SFAs 4 - 6, as the overall TAC changes, the
 19 fleet quotas / allocations are adjusted accordingly.

20
 21 TACs in most management areas are guided according to the harvest decision rules
 22 outlined in the Precautionary Approach Framework for Northern shrimp (section 2.6) and
 23 include perspectives obtained during consultations with stakeholders as well as other
 24 relevant information. For SFA 1, following consultation with relevant stakeholders,
 25 Canada adopts an overall TAC (shared between Canada and Greenland), and claims its
 26 domestic share based on the formula of 17% of 5/6 of the overall TAC (14.2%) accepted
 27 by Canada, recognizing that 1/6th of the area would be inshore waters in Greenland with
 28 the remaining 5/6 being offshore areas. There are also specific processes in place to
 29 establish TACs and quotas in the WAZ and EAZ which require specific decisions and
 30 recommendations from the NWMB and NMRWB. The TAC in SFA 7 is set by NAFO.

1 The latest TAC announcements can be found at: [http://www.dfo-](http://www.dfo-mpo.gc.ca/decisions/index-eng.htm)
2 [mpo.gc.ca/decisions/index-eng.htm](http://www.dfo-mpo.gc.ca/decisions/index-eng.htm) and the Profile of Access at ANNEX B.
3

4 **7.2 Fishing Seasons**

5 The fishing season for the Northern shrimp >100' sector is from January 1 – December
6 31 for transboundary and NAFO managed stocks (SFAs 0, 1, 3L (SFA 7) and 3M), and
7 April 1 – March 31 for DFO managed stocks, (SFAs EAZ, WAZ, 4, 5, and 6). The
8 inshore trawlers' season is generally from April 1 – December 31, or until the quota is
9 taken, whichever comes first. The opening of the fishery depends on the TAC being
10 announced and for the inshore trawlers, is also based on the sharing of the inshore quota
11 between the 2J, 3K north, 3K south, 3L and 4R fleets. Fishing seasons are regulated
12 under the authority of the Atlantic Fishery Regulations, 1985.
13

14 **7.3 Closed Areas**

15 The following closed areas have been implemented for conservation purposes related to
16 habitat and / or benthic issues, and are regulated through a variation order under the
17 authority of the *Atlantic Fishery Regulations, 1985*.
18

19 **7.3.1 Hatton Basin - Coral Protection Zone**

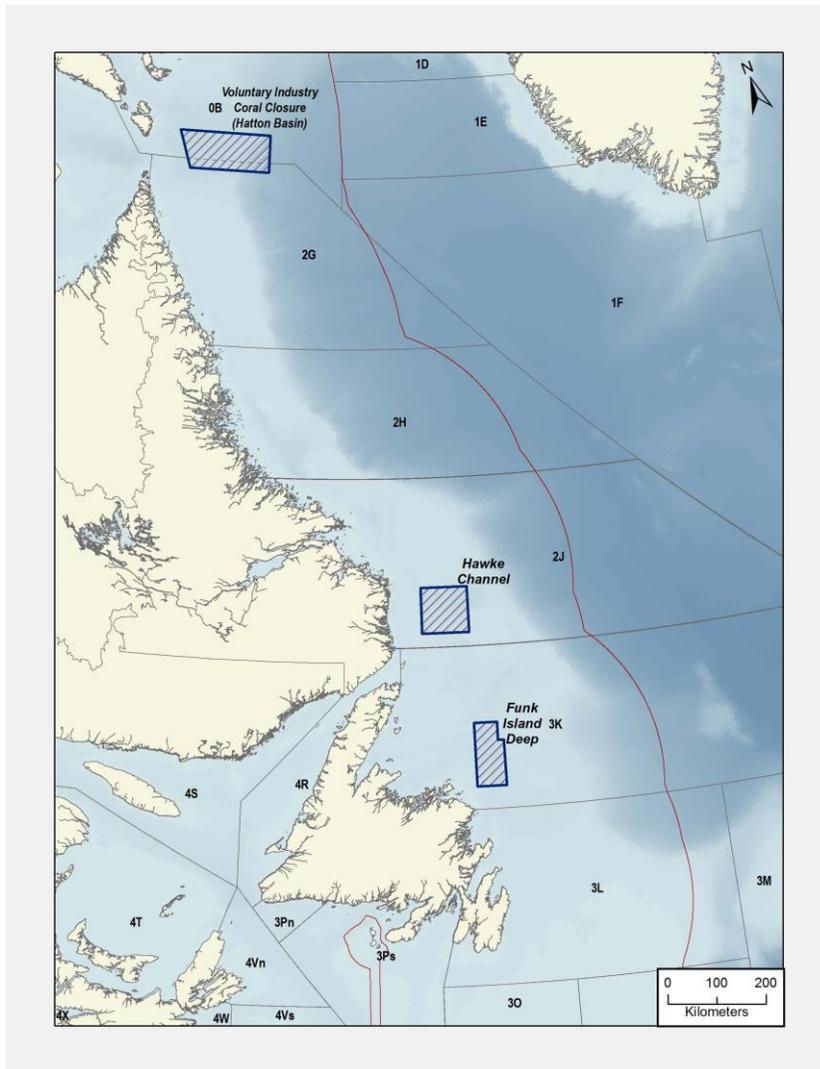
20 In 2007, the > 100' sector shrimp and groundfish sectors introduced a 12,500 square
21 kilometre (3,644 square nautical miles) Coral Protection Zone in the northern Labrador
22 Sea to protect coral concentrations in that area (see Figure 8). This was part of an
23 industry-led initiative, sponsored by CAPP, the Groundfish Enterprise Allocation Council
24 (GEAC), and the NC, which also includes other conservation measures designed to
25 promote marine stewardship and the preservation of sensitive marine ecological features.
26

27 **7.3.2 Hawke Channel Closed Area**

28 The primary rationale for the closed area was in response to the Fisheries Resource
29 Conservation Council recommendations in 2000 and 2001 to protect juvenile turbot and
30 spawning cod respectively. In 2001, due to concerns about the impact of bottom trawling
31 for shrimp on crab fishing grounds, a proposal for a pilot project involving a “no-trawl”
32 zone was received from the 2J crab licence holders. After consultation with stakeholders
33 and a review of available information, in September 2002, DFO implemented a 400
34 square nautical mile ‘no-trawl/no-gillnetting’ study area to conduct work similar to that
35 conducted in Division 3K. The 2J ‘no-trawl/no-gillnetting’ study area was expanded to
36 cover 2,576 square nautical miles in July 2003 (Figure 8). Since the Hawke Box has
37 been closed, there have been no studies undertaken to determine if the closure is having
38 any effect on cod and turbot populations. Given this lack of substantiated evidence, the
39 Hawke Box closure has been a long standing issue with some industry.
40

41 **7.3.3 Funk Island Deep Closed Area**

42 The Funk Island Deep closed area in SFA 6, was originally closed in 2002 to gillnetting
43 to protect snow crab, and in 2005 the closure was extended to include the inshore shrimp
44 trawlers, with their concurrence. This closed area covers roughly 2,119 square nautical
45 miles and is a voluntary closure for the > 100' sector shrimp trawlers (Figure 8).



2

3

4 Figure 8 – Fishery Closures

5

6 **7.3.4 Vulnerable Marine Ecosystems Closed Areas (in the NAFO Regulatory Area)**

7

8 Since 2008, the Northwest Atlantic Fisheries Organization has undertaken extensive
 9 scientific research on Vulnerable Marine Ecosystems (VME). This is part of its ongoing
 10 commitment to an ecosystems approach to fisheries management and to fulfill its
 11 commitment to prevent significant adverse impacts on VMEs as called for by the United
 12 Nations General Assembly resolution 61/105.

13

14 Following the identification by NAFO of areas identified as VMEs in the NAFO
 15 Regulatory Area, fourteen areas have been closed to bottom contact fishing, including
 16 two closures that cover a portion of Division 3N to protect significant concentrations of
 17 corals and sponges, to prevent the significant adverse impacts of bottom fishing activities
 18 on VMEs known to occur or likely to occur. One closed area is in 3K, known as the

1 Orphan Knoll, where the Northern Shrimp fishery occurs. No vessel shall engage in
2 bottom fishing activities in the following area in Division 3K enclosed by straight lines
3 joining the following points in the order which they are listed:

4
5 50 degrees 00 minutes 30 seconds North 45 degrees 00 minutes 30 seconds West
6 51 degrees 00 minutes 30 seconds North 45 degrees 00 minutes 30 seconds West
7 51 degrees 00 minutes 30 seconds North 47 degrees 00 minutes 30 seconds West
8 50 degrees 00 minutes 30 seconds North 47 degrees 00 minutes 30 seconds West
9

10 **7.3.5 Inshore Crab Areas Closures**

11
12 As a result of concerns about the impact of bottom trawling on Snow crab, at the request
13 of the inshore crab fleets in 3KL the inshore Snow crab fishing areas are closed to all
14 bottom dragging fisheries in SFAs 6 and 7, which includes Northern shrimp fishing by
15 the inshore shrimp trawlers.

16
17• SFA 6 - Fishing is not authorized in that portion of SFA 6 inshore of a straight line
18 connecting by the following coordinates:

19 52 degrees 15 minutes North latitude, 55 degrees 26 minutes West longitude to
20 52 degrees 15 minutes North latitude, 54 degrees 20 minutes West longitude to
21 51 degrees 20 minutes North latitude, 54 degrees 57 minutes West longitude to
22 51 degrees 20 minutes North latitude, 54 degrees 20 minutes West longitude to
23 51 degrees 00 minutes North latitude, 54 degrees 20 minutes West longitude to
24 51 degrees 00 minutes North latitude, 55 degrees 09 minutes West longitude to
25 50 degrees 30 minutes North latitude, 55 degrees 30 minutes West longitude to
26 50 degrees 30 minutes North latitude, 54 degrees 20 minutes West longitude to
27 50 degrees 10 minutes North latitude, 54 degrees 20 minutes West longitude to
28 50 degrees 10 minutes North latitude, 53 degrees 20 minutes West longitude to
29 49 degrees 35 minutes North latitude, 53 degrees 20 minutes West longitude to
30 49 degrees 35 minutes North latitude, 52 degrees 50 minutes West longitude to
31 49 degrees 15 minutes North latitude, 52 degrees 50 minutes West longitude.
32

33• SFA 7 - Fishing is not authorized in that portion of SFA 7 inshore of a straight line
34 connecting by the following coordinates:

35
36 49 degrees 15 minutes North latitude. 52 degrees 51 minutes West longitude to
37 47 degrees 26 minutes North latitude, 52 degrees 03 minutes West longitude to
38 46 degrees 28 minutes North latitude, 52 degrees 31 minutes West longitude to
39 46 degrees 12 minutes North latitude, 53 degrees 32 minutes West longitude to
40 46 degrees 17 minutes North latitude, 53 degrees 32 minutes West longitude to
41 46 degrees 30 minutes North latitude, 54 degrees 18 minutes West longitude.
42

43 **7.3.6 Marine Protected Areas**

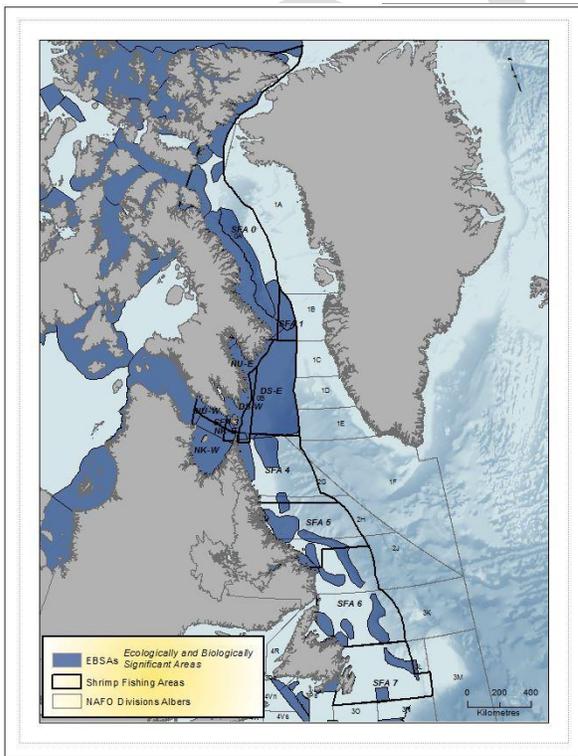
44 The Government of Canada has agreed to domestic and international marine conservation
45 targets (MCTs) to conserve 10% of coastal and marine areas through effectively
46 managed networks of protected areas and 'other effective area-based conservation

1 measures' by 2020 (Aichi Target 11). To further highlight these targets as a priority, the
2 Government of Canada identified an interim target of 5% by 2017.

3
4 In support of MCT, a Network of Marine Protected Area (MPAs) and other effective
5 area-based conservation measures (i.e. *Fisheries Act* closures) is currently being
6 developed in the Newfoundland and Labrador Shelves Bioregion to support the
7 conservation and sustainable management of marine resources and their habitats. Within
8 NAFO Divisions 2GHJ3KL there are two inshore MPAs established under the *Oceans*
9 *Act*. The Gilbert Bay MPA is located on the southeast coast of Labrador in NAFO
10 Subdivision 2J and covers approximately 60 km². This MPA was designated in 2005 to
11 conserve and protect Gilbert Bay golden cod and its habitat. The Eastport MPA is located
12 in Bonavista Bay in NAFO Subdivision 3L. It was also designated as an MPA in 2005
13 and covers 2.1 km². The conservation objective of the MPA is to maintain a viable
14 population of American lobster through the conservation, protection, and sustainable use
15 of resources and habitats; and to ensure the conservation and protection of threatened or
16 endangered species.

17 Ecologically and Biologically Significant Areas

18
19
20 Within the range of the Northern shrimp fishery, 17 Ecologically and Biologically
21 Significant Areas (EBSAs) have been identified (Figure 9), however division 3L is part
22 of a larger area currently being re-evaluated and could potentially change.
23



24
25
26 Figure 9: Ecologically and Biologically Significant Areas (EBSAs) located within the
27 range of the Northern shrimp fishery.

1
2 EBASs are identified by science and other experts as areas that are particularly important
3 to the structure and function of the marine environment or a particular ecosystem. They
4 are not based on regulation, and are not managed in the way MPAs are managed. Rather,
5 their identification is intended to raise awareness and draw attention to activities that may
6 threaten an area. The identification of EBSAs is a tool for calling attention to areas that
7 have particularly high ecological or biological significance, to facilitate provision of a
8 greater-than-usual degree of risk aversion in the management of activities in such areas.
9

10 Further information on these EBSAs can be found in the following documents:

11
12 [http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-
13 DocRech/2007/RES2007_052_e.pdf](http://www.dfo-mpo.gc.ca/csas-sccs/Publications/ResDocs-DocRech/2007/RES2007_052_e.pdf)

14
15 http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_048-eng.pdf
16 http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2011/2011_055-eng.html
17 http://www.dfo-mpo.gc.ca/csas-sccs/publications/sar-as/2015/2015_049-eng.pdf
18

19 **7.4 Enterprise Allocations**

20
21 Enterprise Allocations (EA) are the total quota that each > 100' sector licence holder is
22 allocated in each management area. Quota transfers among allocation holders are
23 permitted in all SFAs, however access to the Nunavut and Nunavik MUs is limited to
24 those entities receiving allocations in these areas, as amended from time to time. EAs also
25 apply to the four inshore licences with allocations in SFA 4. EA is similar to an
26 individual quota. EAs are managed as a condition of licence. The EA Program is
27 described in ANNEX F.

28 **7.5 Quota Reconciliation**

29 Quota reconciliation is the process of deducting inadvertent quota overruns from one year
30 to the next, with the enterprise(s) paying for the full allocation, and fishing only that
31 portion remaining after the previous year's overruns have been deducted. This procedure
32 is applied to all sectors participating in this fishery.
33

34 Quota reconciliation is not a penalty or sanction; it is an accounting of overruns to ensure
35 that quotas are respected. However, for the inshore fleet, DFO will close fisheries when
36 established quotas are reached or projected to be reached, and those who continue to fish
37 after the closure may be subject to prosecution.

38 **7.5.1 >100' Sector Season Bridging**

39 Season bridging was first introduced in 2007. Season bridging refers to a licence holder
40 1) borrowing from the following year's quota to be fished in the current year; or 2)
41 transferring some of the current year's unused quota to be caught in the following year
42 (carry forward). The ability to season bridge provides the >100' sector harvesters with
43 increased flexibility to better prosecute the fishery and adjust to mechanical problem,
44 weather and ice conditions and resource availability. This policy applies to >100' sector

1 licence holders in Davis Strait East and West and SFAs 4 – 6 without limitation when the
2 stock is in the Healthy Zone. “Without limitation” means that all 17 licences could carry
3 forward or borrow their permitted amount of quota in the same SFA. Should there be a
4 conservation concern in a particular SFA as evidenced by its positioning in the Cautious
5 zone of the PA framework, season bridging amounts may be capped or suspended in that
6 particular SFA, as has been the case in SFA 6 since 2012.

7
8 The >100’ sector licence holders may each carry forward a total of 750t from the
9 previous year’s uncaught commercial quota, with no limitation in any Healthy SFA, that
10 must be fished during the first 90 days (April 1 – June 30) of the new fishing seasons for
11 SFAs 5 and 6, and the first 120 days (April 1 – July 31) for Davis Strait and SFA 4.

12
13 Licence holders may borrow up to 500t from the next year’s quota in SFAs 4 – 6 and
14 Davis Strait, with no limitation in any Healthy SFA, to be fished during the last 30 days
15 (March 1 – 31) of the fishing season.

16 **7.5.2 Inshore Fleet Season Bridging**

17 Beginning in 2012, Season bridging for the inshore shrimp fleet allowed limited bridging
18 of unharvested quota in SFA 6 from one year to the next, contingent on the stock being in
19 the Healthy Zone. Should there be a conservation concern in a particular SFA as
20 evidenced by its positioning in the Cautious zone of the PA framework, season bridging
21 amounts may be capped or suspended. Fleets have the opportunity to request carry
22 forward prior to the end of the fishing season. Carry forward will be limited to 5% of the
23 inshore fleet’s quota up to a maximum of 1,500t.

24 25 **7.6 Fishing Gear Restrictions**

26 The minimum mesh size authorized while fishing for shrimp is 40mm throughout the
27 otter trawl. The minimum mesh size requirement is regulated through the *Atlantic*
28 *Fishery Regulations, 1985*.

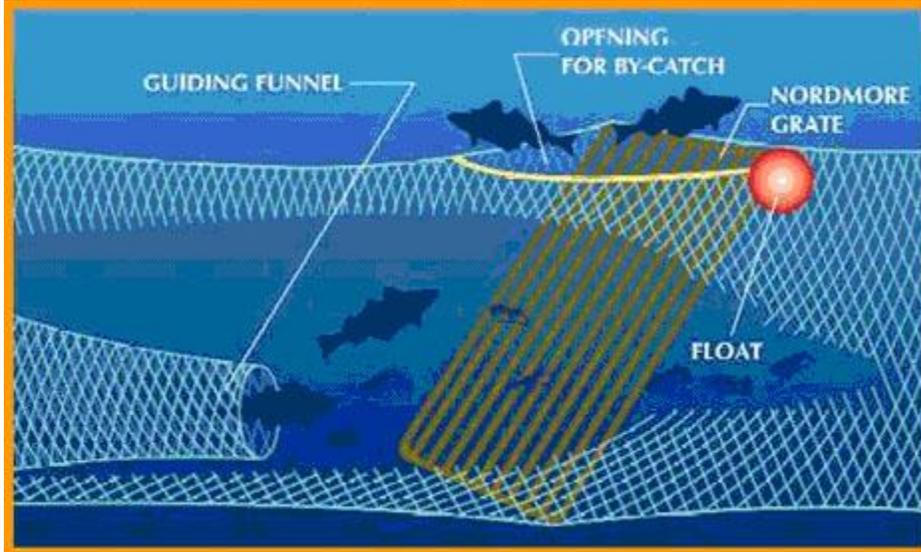
29
30 The otter trawl must be configured with toggle and chain lengths set to a minimum of
31 71.12cm (28 inches), length measured from the centre of the toggle hole to the fishing
32 line (bolch line) for both > 100’ sector and inshore vessels.

33 34 *Nordmore Grate*

35 As a result of concerns about the level of by-catch of marine mammals, turtle and
36 groundfish species by the small-meshed shrimp trawls and the effect on their populations,
37 an exclusion device known as the Nordmore grate was introduced in the Canadian shrimp
38 fishery in 1993. This device sorts out the larger species, allowing them to escape through
39 an opening in the top of the net, while allowing smaller shrimp to pass through and be
40 retained in the cod-end of the net (Figure 10).

41
42 Although grates were not mandatory in the most northern areas prior to 1997, the >100’
43 shrimp sector had been using them voluntarily in all areas for some time. In 1997, the
44 grate was made mandatory in all areas and is now required in all shrimp trawls, in all
45 SFAs, at all times. The maximum grate spacing for the inshore shrimp trawlers is 22mm.

1 The >100' shrimp sector uses a 22mm in SFAs 0, 1, 6, 7, and outside the Canadian
2 Fisheries Waters in 3L, and 28mm grate in the EAZ, WAZ, and SFAs 4 and 5.



3
4
5 Figure 10 – Nordmore Grate

6 **7.7 Incidental Catch**

7
8
9 Information on bycatch is obtained by the Department from logbooks completed and
10 submitted by industry, and from observer data. DFO Science compiles data and produces
11 reports and updates.

12
13 Minimizing the bycatch of groundfish in all Atlantic fisheries is extremely important
14 given the conservation concerns for the groundfish stocks and the management measures
15 in place for their protection. All shrimp vessels fishing in Canadian waters use sorting
16 grates to separate and release marine mammals, turtles and groundfish (and other finfish)
17 species. Further efforts to minimize by-catch may be required with the listing of
18 additional protected species under the SARA. Closed areas are an additional measure to
19 minimize bycatches and negative interaction with groundfish and other species. In
20 absolute and relative terms, and especially compared to shrimp fisheries in many other
21 parts of the world, bycatches in the Northern shrimp fishery are very low – averaging less
22 than [2%] of the directed shrimp catch by weight.

23
24 A number of provisions are employed with respect to incidental catch in the Northern
25 shrimp fishery. These include:

- 26
27
- 28 • All incidentally caught species shall be returned to the water from where they were
29 taken and where alive in a manner that causes the least harm.
 - 30 • In the event that the total incidental catch of all groundfish species in any set exceeds
31 the greater of 2.5% or 100 kg total weight, the licence holder/operator must
32 immediately change the vessel's fishing area by a minimum of 10 nautical miles from
any coordinate during the last tow.

- 1 • If total bycatches of capelin in any haul exceed the greater of 5 metric tonnes or 10
2 percent by weight of the catch of shrimp, the licence holder/operator shall employ
3 active avoidance measures to reduce capelin bycatch. If a subsequent tow is made in
4 the same area within 72 hours of the first tow and the subsequent haul contains
5 bycatches of capelin exceeding 5 metric tonnes or 10 percent by weight of the catch
6 of shrimp, the licence holder/operator must change fishing area by a minimum of 10
7 nautical miles from any position of that tow. The operator must record in the logbook
8 the active avoidance measures taken in response to the first haul which contains
9 excessive capelin bycatch. The operator must also record in the logbook the position
10 (latitude and longitude) at time of capelin bycatch, as well as the quantity caught by
11 weight in kilograms.

12 13 **7.8 Control and Monitoring of Removals**

14
15 Access to Northern shrimp stocks is regulated through fishing licences, and measures that
16 include, but are not limited to shrimp fishing area, season, quotas and enterprise
17 allocations, and gear specifications.

18
19 At-sea observers monitor for compliance of the management measures including by-
20 catch, discarding and highgrading, gear restrictions, area and closed time provisions.
21 Observers also collect valuable scientific information including size composition, catch,
22 effort, by-catch composition etc. Dockside monitoring by a certified Dockside
23 Monitoring company is conducted on all landings from the inshore fleet. Dockside
24 monitoring of shrimp landed from the >100' shrimp sector is not required because of the
25 100% observer coverage. Completion and submission of accurate fishing log books and
26 fish purchase slips are required.

27 28 **7.9 Quota Monitoring and Bycatch**

29
30 Catch estimates including bycatch levels are supplied by the licence holder on a daily
31 basis. This is supplied through the completion and submission of a fishing logbook. For
32 vessels >100', a daily hail on catch is required.

33
34 Observers estimate catch and by-catch based on observations of catches within the
35 codend and by estimating the total packout product weight. All shrimp caught must be
36 counted against the quota.

37
38 Additional information on compliance protocol for Northern shrimp is at Section 9.

39 40 **7.10 Decision Rules**

41
42 As described, for each SFA there are rules related to TAC level, gear type, season and
43 closed areas, as well as other limits as outlined in the Northern shrimp condition of
44 licence. Additionally, the PA Framework requires that Harvest Decision Rules are
45 developed that provide details on the harvest rates and possibly other management
46 procedures that are required in each zone, or steps within a zone. These management

1 actions are designed to achieve the desired outcome by affecting the removal rate. For
2 Northern shrimp, the spawning stock biomass is used to determine what PA zone the
3 stock is in – Healthy, Cautious or Critical. Ultimately, the Minister has full authority on
4 setting TACs.

5
6 Past management decisions, including TACs, for Northern shrimp can be found here:
7 <http://www.dfo-mpo.gc.ca/decisions/index-eng.htm>

8
9 The PA is described in section 2.6, and the Harvest Decision Rules are at ANNEX I.

10 11 **7.11 Licencing**

12 The Northern shrimp fishery is a limited entry fishery with no new licences available.
13 Only those who held a licence in the previous year will be eligible for renewal of that
14 licence in the current year. The Minister of Fisheries and Oceans has absolute discretion
15 under the *Fisheries Act* for the issuance of fishing licences. Licences may be reissued to a
16 new licence holder upon the request of the current licence holder. In the case of offshore
17 corporations, only those that have a majority of Canadian ownership are eligible to obtain
18 licences. Generally, in the inshore fishery, only independent core fish harvesters are
19 eligible to obtain a licence, they may decide to hold this licence in their wholly-owned
20 corporations.

21 Nunavut sub-allocation recipients receive a temporary licence.

22 *Additional Inshore Licencing/ Allocation Measures- NL*

- 23 • Beam Trawl Licences:
 - 24 ○ 3K and 3L Shrimp beam trawl licences cannot be converted to otter trawl
 - 25 licences,
 - 26 ○ 3K and 3L Shrimp beam licences are not eligible for reissuance.
- 27 • SFA 4 Licences:
 - 28 ○ SFA 4 Northern shrimp licences may be reissued to an eligible 3L
 - 29 Independent Core fish harvester who does not currently hold a Northern
 - 30 shrimp licence.
 - 31 ○ Reissuance of SFA 4 Northern shrimp licences to individuals or entities in
 - 32 NAFO Division 2GHJ may be considered.
 - 33 ○ The permanent transfer of allocations from the SFA 4 inshore Northern
 - 34 shrimp fleet to the >100' shrimp sector is not permitted.
- 35 • Other general licencing policy provisions will apply.

36 37 Enterprise Combining & Licence Combining in the Inshore Sector

38 Enterprise combining is a voluntary fleet self-rationalization policy which allows most
39 shrimp licence holders in Newfoundland and Labrador to acquire Northern shrimp from
40 an enterprise within the same NAFO Division that is exiting the industry; other eligibility
41 provisions apply. Licence Combining is similar to Enterprise Combining but does not
42 require the enterprise holding the shrimp licence to exit the fishery, all other licences in
43 the enterprise will not be cancelled. A maximum of four harvest caps may be held by one
44 enterprise, however 3K south based enterprises hold a maximum of five harvest caps; this
45 in order to reach a level of parity with a fully combined 3K north based enterprise Shrimp

1 Fishing Area 6 Northern shrimp licence. Shrimp beam trawl licences in 3KL and 3L are
2 not eligible for enterprise combining. In addition, inshore enterprise allocations (EAs) in
3 SFA 4 are eligible for combining within SFA 4.
4

5 **7.12 Logbooks & Purchase Slips**

6 Catch estimates including by-catch levels are supplied by the licence holder on a daily
7 basis. This is supplied through the completion and submission of a fishing logbook, either
8 paper or electronic. For vessels >100 ft, a daily hail on catch is required. All shrimp
9 caught must be counted against the quota.
10

11 Logbooks are one of the monitoring tools used in this fishery. Under Section 61 of the
12 *Fisheries Act*, all licence holders are required to complete and return logbooks to DFO.
13 Logbooks must be completed accurately, in accordance with instructions provided.
14 Logbook data is vital to both monitoring catch and for the science assessment process.
15 Prompt return of logbooks is vital to ensure all logbook data is available for science
16 assessments in January. The mandatory completion and return of logbook is a condition
17 of licence. Shrimp purchase slips are required to be submitted by processors.
18

19 **7.13 Dockside Monitoring**

20 The objective of the Dockside Monitoring Program (DMP) is to provide accurate, timely,
21 and independent third party verification of landings to ensure the TAC is not overrun, and
22 to ensure licence holders' catches are accurately accounted. DMP constitutes one of the
23 primary sources of landing information on which the management of the inshore fishery
24 is based. The fishing industry and the Department are therefore dependent on the
25 accurate verification of landings by Dockside Monitoring Corporations (DMCs). All
26 DMP costs are the responsibility of individual fish harvesters or fishing fleets. It is also
27 the responsibility of licence holders to ensure that monitors who oversee the offloading of
28 catches are certified by Fisheries and Oceans Canada. The dockside monitoring
29 requirement is managed as a condition of licence.
30

31 Dockside monitoring by a certified Dockside Monitoring company is conducted on all
32 inshore fleet landings. Dockside monitoring of shrimp landed from the >100' shrimp
33 sector is not required because of the 100% observer coverage.
34

35 **7.14 At-Sea Observers**

36 The At-Sea Observer Program was designed to collect independent third party fisheries
37 data for science, resource management and compliance and deterrence purposes. This
38 important component of fishery management provides information and an at-sea presence
39 while fisheries are on-going. At-Sea Observers observe, record and report detailed
40 biological and fishery data, such as size composition, catch, bycatch composition, fishing
41 effort and all catch data, fishing gear type, fishing location, discarding and highgrading,
42 gear restrictions, area and closed time provisions, etc.

43 The fishery is monitored by extensive industry-funded at-sea observer coverage. The
44 >100' shrimp sector and Nunavut temporary licence holders carry 100% observer
45 coverage resulting in approximately 2000 observer days annually. Observer coverage
46 requirement for the inshore fleet is based on a 10% coverage target. Inshore licence

1 holders are required to carry at-sea observers at the request of DFO. Licence conditions
2 are not valid unless a letter of arrangement from the observer company is attached
3 confirming payment of observer fees. The at-sea observer requirement is managed as a
4 condition of licence.

5 **7.15 Vessel Monitoring System**

6 As a means to ensure compliance with regulations regarding the area fished, mandatory
7 use of the electronic vessel monitoring system (VMS) was fully implemented in 2004.
8 By utilizing VMS in the fishery there is more accurate, complete and detailed statistical
9 information on the location and timing of fishing activity for DFO Science and Fisheries
10 Management, and improved compliance for restricted areas and more efficient
11 deployments of Conservation and Protection (C&P) resources. VMS includes an
12 automatic location and communication (ALC) device that will transmit the vessel's
13 position to DFO. Fish harvesters are responsible for covering the cost of the ALC device,
14 its installation on-board their vessel, and the cost of operations. The VMS requirement is
15 managed as a condition of licence.

16 17 **7.16 NAFO Regulatory Area**

18 NAFO REGULATORY AREA – The Northern shrimp fishing licence is not valid for
19 operating in the NAFO Regulatory Area (NRA) unless the NAFO Schedule is attached
20 and the licence holder/operator has received a briefing from the Offshore Compliance
21 Unit, NL Region. While operating in the NRA outside Canadian Fisheries Waters, the
22 licence holder/operator shall abide by the NAFO Conservation and Enforcement
23 Measures.

24 25 **7.17 Land Claims Restrictions**

26 Fishing for shrimp is only permitted in the NSA as defined in the Nunavut Land Claims
27 Agreement (NLCA), or in the NMR as defined in the Nunavik Inuit Land Claims
28 Agreement (NILCA) to enterprises that receive allocations in these areas, as amended
29 from time to time.

30 31 **7.18 Species at Risk Act**

32
33 The *Species at Risk Act* (SARA) came into force in 2003. Under the SARA species may
34 be identified as “at risk”. The purposes of the Act are: “...to prevent wildlife species
35 from being extirpated or becoming extinct, to provide for the recovery of wildlife species
36 that are extirpated, endangered or threatened as a result of human activity and to manage
37 species of special concern to prevent them from becoming endangered or threatened.” A
38 main issue related to species at risk is the incidental capture of species of Wolffish. Their
39 status as species at risk in Canada results in legal protection and mandatory recovery
40 requirements. Protection under the Act prohibits killing, harming and harassing of
41 individuals and also prohibits damaging or destroying their residence, i.e., protection of
42 critical habitat.

43
44 Three species of Wolffish are commonly caught as bycatch. Two species, the Northern
45 wolffish (*Anarhichas denticulatus*) and the Spotted wolffish (*Anarhichas minor*), are
46 listed as “threatened” under SARA and therefore prohibitions apply. Both species have

1 undergone a decline in population size of more than 90% since the late 1970's. For these
2 two species, current management measures, as conditions of licence for the fishery,
3 require that they be returned to the water at the site where they are captured. Release
4 should be done as quickly as possible without harm to the Wolffish in order to maximize
5 the animal's survival, however, dead wolffish must also be returned to the water. A third
6 species, the Striped wolffish (*Anarhichas lupus*), is listed as "special concern" and is also
7 protected under SARA. Conditions of licence require reporting of interactions with
8 wolffish while conducting fishing operations, in the logbook.

9
10 To address the condition of these wolffiish species, DFO, in conjunction with industry,
11 fish harvesters and other governmental departments, has developed a *Recovery Strategy*
12 *for Northern Wolffish and Spotted Wolffish, and Management Plan for Atlantic Wolffish*
13 *in Canada* that has identified actions to protect and recover these species.

14
15 The Species at Risk Public Registry can be accessed at: [http://www.registrelep-](http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm)
16 [sararegistry.gc.ca/sar/index/default_e.cfm](http://www.registrelep-sararegistry.gc.ca/sar/index/default_e.cfm)

17 18 **7.19 Other Inshore Management Measures, NL Region**

- 19• All shrimp harvested must be landed
- 20• Freezing of shrimp is not permitted on the vessel during any trip, except the four SFA 4
21 licence holders
- 22• Mechanical shrimp sorting device are not authorized on board the vessel
- 23• The Licence Holder/Operator shall not fish in more than one Shrimp Fishing Area during
24 the same Shrimp fishing trip, unless there is an At-sea Observer onboard the fishing
25 vessel. If an At-sea Observer is onboard the fishing vessel, the Licence Holder/Operator
26 is authorized to fish multiple Shrimp Fishing Areas during the same trip
- 27• The Licence Holder/Operator shall not fish in more than one Shrimp Fishing Area during
28 the same tow
- 29• Under existing regulations, transport licenses are required to transport Northern shrimp
30 by vessels other than fishing vessels. For the inshore fleet transport licences will only be
31 issued for transporting Northern shrimp that has been landed on shore. Transshipment
32 from inshore fishing vessels is not authorized

33 34 **8 SHARED STEWARDSHIP ARRANGEMENTS**

35
36 There are mechanisms not based on policy or a regulatory framework that allow the
37 Department to advance conservation aspects of the Northern shrimp fishery.

38 39 **8.1 Working Groups**

- 40 Working Groups: There are several NSAC Working Groups established to address
41 ongoing issues or resolve one time occurrences. Ongoing working groups include:
- 42 • Marine Stewardship Council – aids industry in maintaining their MSC certification,
43 which was achieved in 2008
 - 44 • Ecosystems – looks at issues such as closed areas, corals and sponges, and other
45 ecosystem related concerns
 - 46 • Precautionary Approach – established to improve the current PA

- 1 • SFA 1 PA – established to develop HDRs and a PA for SFA 1, which is a shared
2 stock with Greenland
- 3 • DFO Science / Resource Management / Industry Working Group – established to
4 look at issues and make recommendations to NSAC on issues where Science and
5 Resource Management intersect.

6 7 **8.2 Northern Shrimp Research Foundation**

8
9 DFO has partnered with the Northern Shrimp Research Foundation (NSRF) to conduct a
10 shrimp survey in SFA 4 and the EAZ since 2005. In 2012, section 10 of the *Fisheries Act*
11 was adopted, which changed the administrative rules around Joint Projects. Beginning in
12 2014 the NSRF and DFO also worked collaboratively to do the science survey in the
13 Western Assessment Zone. This survey is the only independent source of information of
14 shrimp stocks in these areas, providing the necessary information for determining stock
15 status in the Precautionary Approach Framework and informing decisions on TAC.

16
17 Beginning in 2013 and subject to annual Ministerial approvals, a 1,700t allocation of
18 shrimp from SFA 4 has been used to generate the financing required to cover the costs of
19 the Northern shrimp survey pursuant to section 10 of the *Fisheries Act*. For this work,
20 DFO enters into a collaborative agreement with the NSRF to perform the activities. The
21 quota for the surveys was added as a NSRF allocation in SFA 4 and generates proceeds
22 of approximately \$1.5 million to fully cover costs of the survey conducted by NSRF.

23
24 As per the draft National Policy for Allocating Fish for Financing Purposes, project
25 proponents must demonstrate support (2/3 majority) for both the proposal and the
26 allocation that will be set aside to finance the activity before it is approved by the
27 Department.

28 29 **8.3 Closed Areas**

30
31 Information on closed areas, including voluntary closures can be found in section 7.3.

32 33 **9 COMPLIANCE PLAN**

34
35 The Conservation and Protection program promotes and maintains compliance with
36 legislation, regulations and management measures implemented to achieve the
37 conservation and sustainable use of Canada's aquatic resources, and the protection of
38 species at risk, fish habitat and oceans.

39
40 The program is delivered through a balanced regulatory management and enforcement
41 approach including:

- 42
- 43 • Promotion of compliance through education and shared stewardship;
- 44 • Monitoring, Control and Surveillance (MCS) activities; and,
- 45 • Management of major cases /special investigations in relation to complex
46 compliance issues.

1 The deployment of Conversation and Protection resources in the northern shrimp fishery
2 is conducted in conjunction with the management plan objectives as well as in response
3 to emerging issues. The mix of enforcement options available and overriding
4 conservation objectives determine the level and type of enforcement activity. The
5 enforcement operational planning process is designed to establish priorities based on
6 management objectives and conservation concerns. The monitoring and evaluation
7 elements of enforcement operational plans facilitate in-season adjustments should
8 conservation concerns and/or significant non-compliance emerge. Additionally, the
9 National Fisheries Intelligence Service (NFIS) is to have a growing role in advising
10 Conversation and Protection programs through intelligence-led, fully integrated, threat-
11 risk based priority setting and decision making practices.

12 **9.1 Regional Compliance Program Delivery**

13
14 Conservation and Protection is responsible for compliance and enforcement work related
15 to all the regional fisheries, as well as habitat, the Canadian Shellfish Sanitation Program,
16 and other activities. Given the magnitude of the task, allocation of time towards a specific
17 fishery is based in large part on an assessment of risk to the resource. In relation to the
18 Northern shrimp fishery, the primary activities conducted by C&P include the following:
19

20 • **Education and Shared Stewardship**

21 Conservation and Protection Supervisors and Area Chiefs will actively participate in
22 annual consultations with the fishing industry and Indigenous organizations. Compliance
23 issues will be presented and recommendations requested for resolution. As well,
24 informal meetings will continue as required to resolve in-season matters.
25

26 As part of its activities under the education pillar, C&P will present and discuss fisheries
27 conservation with fishers on a regular basis. The resulting information will be used as
28 part of the planning process within C&P.
29

30 • **Monitoring, Control and Surveillance**

31
32 C&P promotes compliance with the management measures governing the northern
33 shrimp fishery by the following means:
34

35 ***Patrols and Inspections:*** C&P Detachments will conduct shrimp patrols by vehicle,
36 vessel, and fixed wing aircraft in accordance with national/regional priorities and
37 operational plan. Detachments will ensure that monitoring and inspections of fish landing
38 activity are carried out.
39

40 ***Dockside Monitoring:*** The Dockside Monitoring Program (DMP) provides for
41 independent third-party verification of landed catch in metric units by a DFO certified
42 Dockside Observers. DMP is required in the northern shrimp fishery for all landings from
43 <100ft vessels, but is not currently required on shrimp landed from >100ft vessels due to
44 100% observer coverage.

1 **Aerial Surveillance:** Conservation and Protection will ensure that surveillance flights are
2 conducted throughout the season as part of the operational plan. Dedicated air
3 surveillance patrols are conducted in the northern shrimp fishery areas utilizing both
4 Transport Canada and DFO contracted air surveillance aircraft.

5
6 **Vessel Monitoring:** The VMS system will be relied upon to provide real-time data on the
7 location of vessels within this fleet. Utilization of this resource will assist officers in
8 monitoring fishing activity, monitoring closed areas, deploying resources, determining
9 the port of destination and the estimated time of arrival to port. The VMS data will also
10 be relied upon to conduct future analysis and comparisons of fishing activity.
11 Additionally, for more complete coverage, there is an agreement in place with Greenland
12 to share VMS data.

13
14 **At-sea Observer Program:** At-Sea Observers will be deployed in accordance with the
15 established deployment plan to observe record and report aspects of the fishing activity.
16 The resulting data will be utilized to compare reported catch composition of vessels
17 against other available sources of information (DMP, Logbooks, observed trips vs. non-
18 observed trips). There is 100% Observer Coverage for vessels over 100 feet and 10% for
19 smaller inshore vessels, other requirements include daily hails, catch reports and port
20 entry reports.

21
22 Fishery Officers will review quota monitoring reports to ensure individual quotas are not
23 exceeded.

24 25 **9.2 Consultation**

26
27 Shared stewardship and education are achieved in Northern Shrimp Fishery through a
28 renewed emphasis on the importance of C&P communication with the community at
29 large including:

- 30
- 31 • C&P participation in advisory meetings with Resource Management, other DFO
 - 32 branches and industry to determine expectations in relation to monitoring, control and
 - 33 surveillance activities.
 - 34 • Presentations to client/stakeholder groups, including school visits or community
 - 35 awareness programs.
 - 36 • Informal interaction with all parties involved in the fishery on the wharf, during
 - 37 patrols or in the community to promote conservation.
 - 38 • Internal DFO consultation with Resource Management and other DFO branches to
 - 39 assess the effectiveness of enforcement activities and to develop recommendations for
 - 40 the upcoming season.

41 42 **9.3 Compliance Performance**

43
44 Post season analysis sessions will be conducted between C&P and Resource Management
45 staff to review issues encountered during the previous season and to make

1 recommendations on improving management measures. The initial sessions will be
 2 conducted at the Area level, followed by a regional session that will be held with other
 3 sectors.

4
 5 The C&P program captures and maintains compliance activity information, The
 6 following table gives a breakdown of Fishery Officer enforcement effort and compliance
 7 results in the shrimp fishery for the past five years.
 8

TABLE 2 Northern Shrimp- Enforcement Summary

Year	Fishery Officer Patrol Hours	Violation Break-down					
		Warning Issued	Charges Laid	Charges Pending	Charges not Approved	NAFO Citations	Tickets Issued
2012	980.5	27	6	0	0	0	0
2013	815	29	9	1	1	0	0
2014	829.75	24	5	0	0	1	0
2015	686	31	5	5	3	0	0
2016	667.5	23	1	9	0	0	0

9
 10 **9.4 Current Compliance Issues**

11 Conservation and Protection issues may differ for the >100' sector and the inshore fleet
 12 but overall include: fishing gear requirements; quota monitoring; by-catch; highgrading;
 13 licence conditions; dockside monitoring requirements; shrimp species verification of
 14 borealis or montagui; and, area/time closures.

15
 16 Compliance concerns in this fishery include fishing closed areas, hail requirements for
 17 port entry, bycatch, discards, and misreporting of the species and /or area of capture. The
 18 objective to address the issues are to minimize compliance concerns while ensure
 19 compliance with the management measures as outlined in the Strategy.
 20

21 **9.5 Compliance Strategy**

22
 23 C&P develops operational plans that outline monitoring and compliance activities that
 24 will be carried out by C&P personnel adjacent to shrimp management areas. C&P
 25 Regions collaborate on the development of these operational plans, both formally (e.g.
 26 Northern Operations Committee) and informally. Detachment's will promote effective
 27 monitoring and enable personnel to effectively maintain compliance with management
 28 measures.
 29

30 The objectives of the operational plans are to provide a body of information that will
 31 provide guidance to C&P personnel, while engaged in monitoring and reviewing of
 32 fisheries, to ensure compliance and conduct investigations. Sources of information to be
 33 used include vessel positioning data, officer inspection data, fishing logs, DMP records,
 34 briefing and de-briefing of observers, and at sea observer records. Operational plans and
 35 program results will be routinely assessed to ensure compliance principles are met.

1
2 Compliance strategies include:
3

- 4 • Compliance promotion activities with all stakeholders
- 5 • Stewardship activities including the NSAC sub-committee on conservation and
6 compliance
- 7 • Report-a-Poacher program through crime stoppers
- 8 • Scheduled dedicated and multi-tasked air surveillance , and other sea surveillance as
9 per operational requirements
- 10 • 100% coverage of At-Sea Observers for the > 100' sector
- 11 • 100% dockside monitoring for inshore vessels, and other dockside checks
- 12 • Auditing of landings data
- 13 • Investigating non-compliance
- 14 • Taking enforcement actions including warnings and prosecutions where
15 noncompliance is detected
- 16 • Enforcing Vessel Monitoring Systems (VMS) requirements, including an agreement
17 with Greenland on sharing of VMS data
- 18 • Working with other enforcement partners, including Transport Canada (use of
19 surveillance aircraft), Department of National Defence (vessel and surveillance
20 aircraft use, as available) and Greenlandic Fisheries Authorities (exchange of
21 information and best practices).

22 23 **10 PERFORMANCE REVIEW**

24
25 The Sustainability Survey for Fisheries is completed annually to help DFO self-assess
26 progress towards sustainability, identify gaps in knowledge and practices, and to report
27 externally on performance and progress towards sustainable management of fisheries.
28

29 Under multiyear management, every second year NSAC convenes to discuss current
30 science advice, management measures and performance of the fishery. The NSAC
31 meeting is an opportunity for stakeholders to review the fishery, and raise any point or
32 concern and if necessary, propose changes to management that could improve the
33 operations and/ or overall sustainability.
34

35 A regular review of the Northern shrimp fishery is conducted at NSAC meetings and
36 includes an assessment of whether the objectives are being achieved and key
37 management issues are being addressed. Stakeholder experience and feedback,
38 information gathered through other evaluation processes and science assessments are
39 used to identify and determine key issues and objectives, as well as potential strategies
40 for achieving outcomes.

41 **11. Glossary**

42
43 *Abundance*: Number of individuals in a stock or a population.

44
45 *Age Composition*: Proportion of individuals of different ages in a stock or in the catches.

1
2 *Biomass*: total weight of all individuals in a stock or a population.
3
4 *Bycatch*: The unintentional catch of one species when the target is another.
5
6 *Catch per Unit Effort (CPUE)*: The amount caught for a given fishing effort. Ex: tonnes
7 of shrimp per tow, kilograms of fish per hundred longline hooks.
8
9 *Communal Commercial Licence*: Licence issued to Indigenous organizations pursuant to
10 the *Aboriginal Communal Fishing Licences Regulations* for participation in the general
11 commercial fishery.
12
13 *Discards*: Portion of a catch thrown back into the water after they are caught in fishing
14 gear.
15
16 *Dockside Monitoring Program (DMP)*: A monitoring program that is conducted by a
17 company that has been designated by the Department, which verifies the species
18 composition and landed weight of all fish landed from a commercial fishing vessel.
19
20 *Ecosystem-Based Management*: Taking into account species interactions and the
21 interdependencies between species and their habitats when making resource management
22 decisions.
23
24 *Fishing Effort*: Quantity of effort using a given fishing gear over a given period of time.
25
26 *Fishing Mortality*: Death caused by fishing, often symbolized by the mathematical
27 symbol F .
28
29 *Fixed Gear*: A type of fishing gear that is set in a stationary position. These include traps,
30 weirs, gillnets, longlines and handlines.
31
32 *Food, Social and Ceremonial (FSC)*: A fishery conducted by Indigenous groups for food,
33 social and ceremonial purposes.
34
35 *Gillnet*: Fishing gear: netting with weights on the bottom and floats at the top used to
36 catch fish. Gillnets can be set at different depths and are anchored to the seabed.
37
38 *Groundfish*: Species of fish living near the bottom such as cod, haddock, halibut and
39 flatfish.
40
41 *Landings*: Quantity of a species caught and landed.
42
43 *Maximum Sustainable Yield (MSY)*: Largest average catch that can continuously be taken
44 from a stock.
45

1 *Mesh Size*: Size of the mesh of a net. Different fisheries have different minimum mesh
2 size regulation.
3

4 *Mobile Gear*: A type of fishing gear that is drawn through the water by a vessel to entrap
5 fish. These include otter trawls and Danish/Scottish Seines.
6

7 *Natural Mortality*: Mortality due to natural causes, symbolized by the mathematical
8 symbol M.
9

10 *Observer Coverage*: When a licence holder is required to carry an officially recognized
11 observer onboard their vessel for a specific period of time to verify the amount of fish
12 caught, the area in which it was caught and the method by which it was caught.
13

14 *Pelagic*: A pelagic species, such as herring, lives in midwater or close to the surface.
15

16 *Population*: Group of individuals of the same species, forming a breeding unit, and
17 sharing a habitat.
18

19 *Precautionary Approach*: in fisheries management is about being cautious when
20 scientific knowledge is uncertain, and not using the absence of adequate scientific
21 information as a reason to postpone action or failure to take action to avoid serious harm
22 to fish stocks or their ecosystem. This approach is widely accepted as an essential part of
23 sustainable fisheries management.
24

25 *Quota*: Portion of the total allowable catch that a unit such as vessel class, country, etc. is
26 permitted to take from a stock in a given period of time.
27

28 *Recruitment*: Amount of individuals becoming part of the exploitable stock e.g. that can
29 be caught in a fishery.
30

31 *Research Survey*: Survey at sea, on a research vessel, allowing scientists to obtain
32 information on the abundance and distribution of various species and/or collect
33 oceanographic data. Ex: bottom trawl survey, plankton survey, hydroacoustic survey, etc.
34

35 *Species at Risk Act (SARA)*: The Act is a federal government commitment to prevent
36 wildlife species from becoming extinct and secure the necessary actions for their
37 recovery. It provides the legal protection of wildlife species and the conservation of their
38 biological diversity.
39

40 *Spawner*: Sexually mature individual.
41

42 *Spawning Stock*: Sexually mature individuals in a stock.
43

44 *Stock*: Describes a population of individuals of one species found in a particular area, and
45 is used as a unit for fisheries management. Ex: NAFO area 4R herring.
46

1 *Stock Assessment*: Scientific evaluation of the status of a species belonging to a same
2 stock within a particular area in a given time period.

3
4 *Total Allowable Catch (TAC)*: The amount of catch that may be taken from a stock.

5
6 *Tonne*: Metric tonne, which is 1000kg or 2204.6lbs.

7
8 *Trawl*: Fishing gear: cone-shaped net towed in the water by a boat called a "trawler".
9 Bottom trawls are towed along the ocean floor to catch species such as groundfish. Mid-
10 water trawls are towed within the water column.

11
12 *Validation*: The verification, by an observer, of the weight of fish landed.

13
14 *Vessel Size*: Length overall.

15
16 *Year-class*: Individuals of a same stock born in a particular year. Also called "cohort".
17

18 ANNEXES

19 ANNEX A - History of the Northern Shrimp Fishery

20 21 HISTORICAL OVERVIEW

22
23 The Northern shrimp fishery began back in the early 1970s when DFO conducted
24 exploratory cruises that verified the presence of shrimp stocks off Newfoundland and
25 Labrador.

26
27 In 1977, four Canadian companies (all with Gulf-based processing facilities) were
28 licensed to prosecute the Labrador shrimp fishery under co-operative arrangements to
29 determine the commercial feasibility of harvesting these stocks.

30
31 Landings continued to increase significantly into the 1980s and 1990s, and additional
32 offshore licences were added; by 1991 there were 17, and no additional offshore licences
33 have been issued since this time.

34
35
36 In 1989 the Enterprise Allocation (EA) regime, which was introduced in 1987 on a trial
37 basis was adopted permanently, with the introduction of mandatory, industry paid,
38 observer coverage.

39
40 During the early years, many licence holders reduced their risk by using foreign vessels
41 to harvest allocations of Northern shrimp. By 1990, all licence holders were required to
42 use Canadian flagged vessels with Canadian crews to harvest all allocations. The
43 exception to this rule is the use of replacement vessels on a temporary basis.
44

1 In 1996, then Minister Mifflin announced that DFO was calling for proposals on
2 principles for the sharing of potential quota increases as the fishery expanded to include
3 inshore and special allocation holders.

4
5 In 1996, the >100' shrimp sector held quota in all SFAs except for SFA 7; these 1996
6 amounts in each SFA were the thresholds below which sharing to no offshore entities
7 would cease and formed the foundation of the LIFO policy. Additionally, the total 1996
8 quota (36,700t) was considered an overall threshold, meaning that if a TAC fell below the
9 threshold in one area, it could preclude sharing in another.

10
11 In 1997, existing licence holders supported the sharing of quota increases as the fishery
12 opened to other stakeholders.

13
14 In 2010, due to a declining biomass in SFA 6, the LIFO principle was triggered for the
15 first time resulting in the complete removal of two special allocation holders. The
16 remainder of the reductions was shared by the inshore and >100' shrimp sectors at 10%
17 and 90% respectively. The remaining special allocation holders were not affected. With
18 the exception of 2015, LIFO continued to be triggered every year in SFA 5, 6 and / or 7
19 until it was abolished in 2016, which resulted in the full or partial removal of several
20 special allocation holders.

21
22 The reductions and the consequent application of LIFO in 2010 and 2011 lead to an
23 external review of the principles, policies and methodologies used to apply the reductions
24 was carried out by Ernst & Young. They concluded that the Department did correctly
25 interpret and apply the appropriate principles, policies and methodologies to the
26 reductions; however they noted the Department should endeavour to increase
27 communication with stakeholders in the future.

28
29 The Northern shrimp fishery first achieved Marine Stewardship Council certification in
30 2008, and by 2012, the full > 100' sector and inshore portions of the Northern shrimp
31 fishery attained joint Marine Stewardship Council Certification.

32
33 In 2013, the boundaries in the North (SFAs 2 and 3 at the time) were modified to align
34 with scientific surveys and land claim areas. For the first time, allocations were granted
35 to Nunavik proper in the Nunavik Marine Region. The boundary change included new
36 allocations for both species to both Nunavut and Nunavik inside the respective settlement
37 areas, which comprise the WAZ. The management boards representing Nunavut and
38 Nunavik agreed to share the TACs 50/50.

39
40 Also as a result of the boundary changes in 2013, new commercial and exploratory
41 allocations for borealis and montagui were created for the Eastern Assessment Zone, and
42 were granted to the >100' sector, as well as Nunavut and Nunavik. The new TACs and
43 allocations in the EAZ and WAZ are not comparable to 2012 levels or earlier in SFAs 2
44 and 3.

1 For the 2013/14 season, 1,700t of the increased TAC in SFA 4 was allocated off the top
2 to the Northern Shrimp Research Foundation survey through the use of fish provision in
3 the *Fisheries Act*. Additionally, a cap of 4,033t was first placed on montaguui bycatch in
4 SFA 4.

5
6 In 2016, LIFO was replaced by proportional sharing in SFAs 4 – 6, with allocation
7 holders receiving a percent share of the respective TAC. Decisions in the North will be
8 made on a case by case basis considering Land Claims obligations.

10 ANNEX B - PROFILE OF ACCESS

11 Need to provide a link\\

12 ANNEX C – Information on the Last In, First Out (LIFO) Policy

13 The Last In, First Out (LIFO) principle was a key allocation tool the Department used
14 between 1996 – 2016. LIFO had been described in principle in all Northern shrimp
15 IFMPs since 1997, however the term “LIFO” was first used in the 2003 IFMP. The
16 sharing arrangements and principles agreed to in 1997 formed the basis of LIFO, which
17 recognized the exploratory work and dependence of the offshore fleet. During the late
18 1990s, when the shrimp stocks continued to increase, the fishery opened up to other
19 participants in SFAs 4 – 6. Participation in northern areas began to expand in 1999.

20
21 LIFO was an approach to sharing the changes in TAC depending on the SFA, and was
22 described as follows:

23
24 *To ensure the viability of the traditional, >100' shrimp sector was not jeopardized, the*
25 *1996 quota levels in each SFA were set as thresholds. Sharing will only take place in a*
26 *particular SFA if the quota rises above the threshold of that Area. If quotas decline in*
27 *future years back down to the thresholds, the sharing will end and the new, temporary*
28 *entrants will leave the fishery. The overall 1996 quota (37,600t) for all Areas combined*
29 *will also be used as a threshold to determine sharing. Thus a major decline in one or*
30 *more SFAs could preclude further sharing in any Area. Should there be a decline in the*
31 *abundance of the resource in the future, temporary participants will be removed from the*
32 *fishery in reverse order of gaining access – last in, first out. Temporary licences and*
33 *temporary allocations will only continue as long as the overall threshold level or*
34 *individual threshold levels are maintained when quotas are set.*

35
36 In 2006, DFO announced that additional access to the shrimp fishery would be frozen to
37 encourage stability in the short term. In 2007, the Newfoundland and Labrador's inshore
38 fleets' temporary licences were converted to regular licences to facilitate the
39 rationalization of the inshore shrimp fishery through Enterprise Combining.

40
41 LIFO was applied to manage changes in quotas when the TAC fell to a range below the
42 threshold for that SFA. . When this occurred, special allocation holders were removed
43 first from the fishery, with the remainder of the reductions shared among the > 100'

1 sector and inshore fleet according to prearranged sharing formulas, (proportional to how
2 quota increases had been received) , which varied by SFA.

3
4 A special allocation was a maximum amount for that group at that TAC level or greater,
5 with the premise that the special allocation holder entered the fishery at the *previous* TAC
6 level, at which point their allocation would have been 0. Therefore, the LIFO policy
7 recognized that a special allocation holder would hold a proportional level of quota if the
8 TAC was between these two levels.

9
10 Beginning in 2010, decreases began occurring in the southern range of the Northern
11 shrimp fishery, triggering the LIFO policy each year in one or more SFAs. LIFO was
12 applied in 2010 and 2011 in SFA 6. In 2012, LIFO was applied in SFA 6 as a
13 proportionate increase and in SFA 7 as a proportionate decrease. In 2013, LIFO was
14 applied to reductions in SFAs 5 and 6. In 2014, the TAC and all allocations were fully
15 reinstated in SFA 5.

16
17 In terms of LIFO, SFA 7 was unique in that the fishery began in 2000, after the LIFO
18 thresholds were announced in 1997. Three allocation holders entered the SFA 7 fishery at
19 the same time, unlike the other SFAs, and therefore no threshold existed. However, to be
20 consistent with the management measures in other SFAs, the same principles applied
21 governing access and allocations in SFA 7. By 2014, the TAC in SFA 7 fell to a level at
22 which the Miawpukek First Nation held no quota, leaving only the original three
23 stakeholders; their quotas were reduced to the same proportions as when they first
24 entered the fishery. Beginning in 2015, the SFA 7 fishery was closed to commercial
25 fishing.

26 27 **Independent Review**

28
29 The 2010 and 2011 application of LIFO to the reductions in SFAs 6 and 7 led to several
30 stakeholders in the fishery criticizing the Department's approach publicly and at NSAC
31 meetings. An independent reviewer (Ernst & Young) was tasked with analyzing whether
32 the policies, methodologies and principles on applying TAC reductions amongst fleets
33 and special allocation holders were respected and appropriately applied to the decision
34 making process for Northern shrimp. Stakeholder participation in the review was high,
35 with all relevant stakeholders in the fishery, including the > 100' sector and inshore fleet,
36 special allocation holders, provincial and territorial governments and agencies, and
37 relevant land claims Management Boards and Inuit organizations, were provided the
38 opportunity to participate in the process through interviews, open forum discussions,
39 conference calls, meetings and/or written submissions.

40
41 The final report determined that the appropriate departmental policies, principles and
42 methodologies were used in both the TAC reductions that occurred in SFA 6 and with the
43 application of the LIFO principle as it is defined. It also recommended increased
44 transparency in the establishment of policies and principles and in their application and
45 interpretation.

46

1 More information on the independent review can be found at [http://www.dfo-](http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/reports-rapports/eap-pce/index-ns-cn-eng.htm)
2 [mpo.gc.ca/fm-gp/peches-fisheries/reports-rapports/eap-pce/index-ns-cn-eng.htm](http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/reports-rapports/eap-pce/index-ns-cn-eng.htm)
3

4 **Ministerial Advisory Panel (MAP)**

5
6 LIFO remained a highly contentious issue with varying perspectives from stakeholders
7 especially when reductions were first applied in 2010. Given the complexity of the issue
8 and need for a broad range of expertise, a Ministerial Advisory Panel (MAP) comprised
9 of four individuals was appointed by the Minister in April 2016, tasked with providing
10 advice on whether the LIFO policy specific to the Northern shrimp fishery should be
11 continued, modified or abolished.
12

13 The MAP operated as an independent, external body, however the Department provided
14 operational and logistic support to their process. The MAP held five public stakeholder
15 meetings in Newfoundland and Labrador, and one each in Iqaluit and Halifax. It received
16 41 written submissions and over 100 in-person presentations in an open and transparent
17 process. All relevant interests in the fishery participated in the review.
18

19 In the final report delivered to the Minister in June, 2016, the MAP concluded that LIFO
20 was not a sustainable instrument of public policy. Their principle recommendation was
21 that LIFO should be replaced by proportional percent shares. The recommendation to
22 move to percentage shares was approved by the Minister after additional NSAC
23 consultations with stakeholders on the abolishment of LIFO in SFAs 4 – 6. Percent shares
24 allow for increased predictability in allocations, and for participants to share equitably in
25 any changes in TAC. In the northern SFAs, proportional percent shares were not
26 implemented, rather access and allocation decisions will continue to be made through the
27 appropriate consultative processes in a manner consistent with the Land Claims
28 Agreements, on a case by case basis.
29

30 In establishing the percent shares for the southern areas, adjacency, fairness and
31 Indigenous access were among the key considerations for the Department.
32

33 Information related to the MAP process, including Terms of Reference, written
34 submissions, supplementary MAP recommendations and the MAP's final report and
35 conclusions can be accessed at:

36
37 [http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/comm/shrimp-crevette/shrimp-](http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/comm/shrimp-crevette/shrimp-crevette-eng.htm)
38 [crevette-eng.htm](http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/comm/shrimp-crevette/shrimp-crevette-eng.htm)
39

40 **ANNEX D Northern shrimp licence holders and their representative organizations**

Year Issued	# of Licences	Licence Holder	Representative Organization
1978	2	Labrador Fishermen's Union Shrimp Co. Ltd.	Northern Coalition (NC)
1978	2	Ocean Choice International Inc.,	Canadian Association of Prawn Producers (CAPP)

1978	2	Mersey Seafoods Ltd.,	CAPP
1978	1	M.V. Osprey Ltd,	CAPP
1978	1	Crevettes Nordiques,	CAPP
1978	1	Atlantic Shrimp Co. Ltd.,	CAPP
1978	1	Torngat Fish Producers Coop Society Ltd.,	NC
1978	1	Caramer Ltd.,	CAPP
1979	1	Makivik Corp,	NC
1987	1	Pikalujak Fisheries Ltd.,	independent
1987	1	Qikiqtaaluk Corporation,	NC
1987	1	Harbour Grace Shrimp Co.,	CAPP
1987	1	Unaaq Fisheries Inc.,	NC
1991	1	Newfound Resources Ltd.	CAPP

1

2 **ANNEX E - Coordinates of the Fishery**

3

4 Subject to conditions of licence, and not including closed area coordinates, the waters of
5 the management units in which fishing for shrimp is permitted are:

6

7 (a) In the waters of Management Unit 0: Canadian Fisheries Waters in Davis Strait and
8 Baffin Bay that lie north of latitude 66°15'N, south of latitude 78°10'N, west of longitude
9 60°30'W, and east of longitude 80°W.

10

11 (b) In the waters of Management Unit 1: Canadian Fisheries Waters in Davis Strait and
12 Baffin Bay that lie north of latitude 66°15'N and east of longitude 60°30'W.

13

14 (c) In the waters of Management Unit **Davis Strait East (DS E)**: between 61°N and
15 66°15'N, east of 63°W and east of the Nunavut Settlement Area.

16

17 (d) In the waters of Management Unit **Davis Strait West (DS W)**: between 60°30'N and
18 66°15'N west of 63°W and east of the Nunavut Settlement Area and Nunavik Marine
19 Region.

20

21 (e) In the waters of Management Units Nunavut East (NU E) and/or Nunavik East (NK
22 E): the area inside the Nunavut Settlement Area east of 66°W; and the area inside the
23 Nunavik Marine Region east of 66°W and north of 60°30'N. Access to the NSA or the
24 NMR is limited to those enterprises which have been allocated quotas in these areas,
25 which is amended from time to time.

1
2 (f) In the waters of Management Units Nunavut West (NU W) and/or Nunavik West (NK
3 W): the area inside the NSA bounded by 70°W and 66°W; and the area inside the NMR
4 bounded by 70°W and 66°W to 60.30°N. Access to the NSA or the NMR is limited to
5 those enterprises which have been allocated quotas in these areas, which is amended from
6 time to time.

7
8 (g) In the waters of Management Unit 4: Canadian Fisheries Waters adjacent to the Coast
9 of Labrador that lie north of latitude 57°15'N, south of latitude 61°00'N excluding that
10 portion north of 60.30N, east of the Nunavik Marine Region and Nunavut Settlement
11 Area and west of 63W longitude.

12
13 (h) In the waters of Management Unit 5: Canadian Fisheries Waters adjacent to the Coast
14 of Labrador that lie north of a line drawn from shore at latitude 53°45'N, east to longitude
15 55°00'W, thence north to latitude 54°45'N, thence east to the outer limits of Canadian
16 Fisheries Waters and south of latitude 57°15'N.

17
18 (i) In the waters of Management Unit 6: Canadian Fisheries Waters adjacent to the Coast
19 of Southern Labrador and Northern Newfoundland that lie north of latitude 49°15'N and
20 south of a line drawn from shore at latitude 53°45'N, east to longitude 55°00'W, thence
21 north to latitude 54°45'N, thence east to the outer limits of Canadian Fisheries Waters.
22

23 **ANNEX F - NORTHERN SHRIMP ENTERPRISE ALLOCATION PROGRAM**

24 **Establishment and Utilization of Enterprise Allocations**

25 Access and quotas allocated to > 100' sector licence holders are known as enterprise
26 allocations (EA), and those licence holders shall participate equally in such access and
27 quotas.

28 EAs shall be based on the Total Allowable Catch (TAC) established for the respective
29 Northern Shrimp Fishing Areas.

30 EAs to individual licence holders will be in the form of "licence quotas" which are equal
31 allocations of shrimp expressed in absolute amounts or tonnages.

32 >100' sector licence holders will have equal access to all Northern shrimp stocks and
33 fishing areas for which the sector has EAs (SFAs 0, 1, 4-6 and MUs Davis Strait. The EA
34 for each licence, for each SFA, is determined by dividing the quota set for the >100'
35 sector in that SFA by seventeen (the number of > 100' sector licences in the fishery).

36 **Administrative Guidelines for Enterprise Allocations in the Northern Shrimp** 37 **Fishery**

- 38 1. No permanent transfers of EAs between enterprises are permitted.

- 1 2. Inter-enterprise transfers of EAs are permitted on a temporary basis. Quota is
2 freely transferable between and within enterprises provided that:
3 ○ the transfer applies only to the current season;
4 ○ notification of the transfer registered in the EA Temporary Transfer
5 System (EATTS)
6 3. Licence holders will have 30 days following the end of the fishing season to
7 complete transfers in order to cover any inadvertent overruns of their EAs.

8 **ANNEX G - NORTHERN SHRIMP ADVISORY COMMITTEE MEMBERSHIP**
9 **AND TERMS OF REFERENCE**

10 **CHAIR**

11 Director General, Resource Management Operations, DFO – Ottawa or by another
12 representative of Fisheries and Oceans Canada.

13 **MEMBERS**

14 Atlantic Shrimp Company Ltd.
15 Baffin Fisheries Coalition
16 Canadian Association of Prawn Producers (CAPP)
17 Caramer Limited
18 Crevettes Nordiques Ltée.
19 Imakpik Fisheries
20 Ocean Choice International
21 Harbour Grace Shrimp Company Ltd.
22 Labrador Fishermen's Union Shrimp Company
23 Nunatsiavut Government
24 Makivik Corporation
25 Mersey Seafoods Ltd.
26 M.V. Osprey Ltd.
27 Newfoundland Resources Ltd.
28 Northern Coalition
29 NunatuKavut Community Council
30 Nunavut Offshore Allocation Holders Association (NOAHA)
31 P.E.I Atlantic Shrimp Corp.
32 Pikalujak Fisheries Ltd.
33 Qikiqtaaluk Corporation
34 Torngat Fish Producers Cooperative Society Ltd.
35 Unaaq Fisheries Inc.
36 Department of Fisheries, Aquaculture, and Environment P.E.I.
37 Department of Environment, Government of Nunavut
38 Ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec
39 New Brunswick Department of Agriculture, Fisheries, and Aquaculture
40 Newfoundland and Labrador Department of Fisheries and Land Resources
41 Nova Scotia Department of Agriculture and Fisheries
42 DFO - Newfoundland and Labrador Region

- 1 DFO - Quebec Region
- 2 DFO - Maritimes Region
- 3 DFO – Gulf Region
- 4 DFO - Central and Arctic Region
- 5 DFO – Ottawa NHQ
- 6 Nunavut Wildlife Management Board
- 7 Nunavik Marine Region Wildlife Board
- 8 Nunatsiavut Government
- 9 Torngat Joint Fisheries Board (TJFB)
- 10 Association of Seafood Producers (ASP)
- 11 Fish, Food and Allied Workers Union (FFAW)
- 12 Fogo Island Co-operative Society
- 13 Innu Nation – Labrador
- 14 Qikiqtani Inuit Association
- 15 Nunavut Tunngavik Inc
- 16 Regroupement des Associations de Pêcheurs de la Basse Côte Nord
- 17 St. Anthony Basin Resources Inc. (SABRI)
- 18 One representative from each FFAW inshore fleet - 2J, 3K north, 3K south, 3L, 4R, and
- 19 the Association des Capitaines Propriétaires de la Gaspésie
- 20

21 **PURPOSE**

22 The Northern Shrimp Advisory Committee (NSAC) serves as a forum for the discussion
 23 of issues on the management and development of the Northern shrimp fishery providing
 24 advice and recommendations to the Minister of Fisheries and Oceans.

25 **SCOPE**

26 NSAC will provide input on Integrated Fisheries Management Plans respecting Northern
 27 shrimp, including but not limited to advice on:

- 28 • quota allocations and other regulatory measures (such as seasons, size limits and
- 29 gear restrictions) and amendments thereto;
- 30 • conservation and compliance issues; and
- 31 • licencing policy.

32 **MEMBERSHIP**

33 Membership on the NSAC shall be limited to:

- 34 • one representative of each company that holds a >100’ sector Northern shrimp
- 35 fishing licence;
- 36 • one representative of each area and fishers receiving special allocations or holding
- 37 inshore fishery licences;
- 38 • one provincial or territorial or land claim-government representative from each of
- 39 New Brunswick, Newfoundland and Labrador, Nova Scotia, Prince Edward
- 40 Island, Quebec, Nunavut Territory, Nunatsiavut and Nunavik Inuit ,

- 1 • one representative of recognized industry associations/groups
- 2 • representatives from Fisheries and Oceans Canada.

3 **PROCEDURES**

4 No formal voting procedures will be entrenched in the conduct of the NSAC; rather it
5 will seek to operate on a consensus basis.

6 Meetings will be convened at dates and times agreed upon by the chair and there will be
7 at least one meeting every second year. The NSAC may determine that additional
8 meetings are necessary and request the chair to make arrangements accordingly. The
9 chair shall be responsible for notifying all members of any meeting.

10 The chair shall establish, in consultation with the NSAC members, agenda items for
11 NSAC meetings. These items will be subject to the consensus of NSAC members at the
12 commencement of each meeting.

13 Ad hoc working groups may be established by the NSAC to review specific issues and
14 report their findings to NSAC as a whole.

15 If a member cannot attend an NSAC meeting, that member may nominate an alternate by
16 notifying the chair as far in advance of the meeting as possible.

17 Non-members may attend NSAC meetings. They may not sit at the table but can
18 participate in discussions following input from members.

19 **ADMINISTRATION**

20 Summary minutes of each meeting will be prepared in both official languages (French
21 and English). The summary minutes will be distributed by the Department of Fisheries
22 and Oceans after they are reviewed and accepted by the chair. Minutes of NSAC
23 meetings can be found at:

24 <http://www.dfo-mpo.gc.ca/reports-rapports-eng.htm#3>

25 **ANNEX H – Stock Assessment and Precautionary Approach Framework**

26 Stock Assessment and Precautionary Approach

27

28 The Science Advisory Reports for northern shrimp are available on the DFO Canadian
29 Science Advisory Secretariat website:

30

31 An assessment of Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas 4-6 and
32 of Striped Shrimp (*Pandalus montagui*) in Shrimp Fishing Areas 4 in 2016:

33 http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2017/2017_012-eng.html

34

35 Assessment of Northern Shrimp, *Pandalus borealis*, and Striped Shrimp, *Pandalus*
36 *montagui*, in the Eastern and Western Assessment Zones, February 2017:

1 http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2017/2017_010-eng.html

2
3 SFA 7 is assessed and managed by the Northwest Atlantic Fisheries Organization
4 (NAFO). NAFO 0 + 1 is assessed by NAFO but managed independently by Canada and
5 Greenland. Science advice can be found on the NAFO website:

6
7 In order to find the advice for SFA 7, follow the link below and click on Scientific
8 Advice and then NAFO Stocks. The information for SFA 7 is located in the link entitled:
9 Northern Shrimp in Div. 3LNO.

10 <http://www.nafo.int/science/nafo-stocks.html>

11
12 In order to find the advice for NAFO 0 + 1, follow the link below. The information for
13 NAFO 0 + 1 is located in the link entitled: Northern shrimp in SA 0+1.

14 <http://www.nafo.int/science/coastal.html>

15 16 **ANNEX I : Harvest Decision Rules SFA 4 – 6, EAZ, SFA 1**

17 Harvest Decision Rules (HDRs) SFA 4 – 6, EAZ

18 The following provisional rules are to be used when setting TACs.

19 **When SSB is Above the Upper Stock Reference (USR):**

- 20 • Measures should generally promote the SSB remaining above the URP.
- 21 • The base target exploitation rate will be 15% of exploitable biomass. This rate can
22 increase gradually, particularly as an artifact of a stable TAC strategy applied
23 during a time of declining SSB while in this zone, subject to monitoring/signals
24 that excessive fishing mortality is being exerted on the stock.
- 25 • The exploitation rate should not exceed FMSY, a level that is yet to be calculated,
26 but is thought to be well above the base target exploitation rate. Changes in the
27 TAC should generally not exceed 15% of the previous TAC, unless the stock is
28 declining precipitously.
- 29 • Government should not facilitate any increase in industry capacity/infrastructure
30 during any period.

31 **When SSB is between the Limit Reference Point (LRP) and the Upper Stock** 32 **Reference (USR) (i.e. in the Cautious Zone):**

- 33 • Measures should generally promote the SSB rebuilding towards the URP, subject
34 to natural fluctuations that may be expected to occur in biomass and survey
35 results.
- 36 • If SSB is in the upper half of the Cautious Zone, the exploitation rate should not
37 exceed 2/3 FMSY, thought to be significantly above 15% of exploitable biomass
- 38 • If SSB is in the second lowest quadrant of the Cautious Zone, the exploitation rate
39 should not exceed 1/2 FMSY, thought to be above 15% of exploitable biomass

- 1 • If SSB is in the lowest quadrant of the Cautious Zone, the exploitation rate should
2 not exceed 15% of exploitable biomass
- 3 • The TAC should not be increased if the SSB is projected to decline or is within a
4 declining trend
- 5 • Changes in the TAC should generally not exceed 15% of the previous TAC,
6 unless the stock is declining precipitously.

8 **When SSB is Below the Limit Reference Point (LRP):**

- 9 • Measures must explicitly promote an increase in the biomass above the LRP
10 within 6 years of falling below the LRP.
- 11 • Any fishing mortality must be in the context of a rebuilding plan, and should not
12 exceed 10%.

14 **Harvest Strategy SFA 1**

16 **Preamble**

17 Shrimp Fishing Area (SFA) 1 is the Canadian management unit that is part of a trans-
18 boundary stock that is harvested and managed separately by both Greenland and Canada.
19 While an agreement with respect to TAC-setting or quota shares has not yet been
20 reached, there is full cooperation with respect to scientific research, surveillance and
21 enforcement, and a full exchange of information between the two jurisdictions. Both
22 States refer to the NAFO/ICES Pandalus Assessment Group (NIPAG) for formal
23 scientific advice, which is provided annually. The stock is assessed as a single
24 population.

25 **Stock Assessment**

26 The assessment framework incorporates a logistic stock-recruit model, fitted by Bayesian
27 methods, that uses CPUE and survey series as biomass indicators, and includes as
28 removals catch data, assumed free of error, as well as a term for predation by Atlantic
29 Cod, using available series of cod biomass. The model is used to provide short term (1
30 year) and medium term (5 year) projections.

31 **Stock Status deficiencies**

32 After a decade of increasing biomass and expanding distribution in the 1990's, both the
33 biomass and the fishery have contracted back towards the north. Fishable biomass has
34 declined since its 2003 peak, but is currently estimated to remain above Bmsy; the risk of
35 being below Blim (30% of Bmsy) is very low (<1%).

36 **Harvest Decision Rules (HDRs)**

37 **Preamble**

38 In the absence of a TAC-setting and quota-sharing agreement with Greenland on this
39 trans-boundary stock, the approach outline below will be taken by Canada. Reference
40 points and scientific advice are based on a quantitative assessment model and stock
41 composition indices as articulated by the Scientific Council (SC) of the Northwest

1 Atlantic Fisheries Organization (NAFO). Previous work by the SC has shown that a
2 maintained mortality risk of 35% is low enough to keep stock levels safely at or above
3 B_{MSY} .

4 The Harvest Strategy will remain in place until such time that Canada and Greenland may
5 adopt common Harvest Decision Rules.

6 Objectives

- 7 • Achieve/maintain the stock in the Healthy Zone ($>80\%$ of B_{MSY})
- 8 • Avoid serious harm to the reproductive capacity of the stock by maintaining biomass
9 $>30\%$ of B_{MSY}
- 10 • Avoid total removals in excess of maximum sustainable yield
- 11 • Manage the TAC and quotas to facilitate a balance of opportunity and stability in the
12 industry, subject to the need to respond to precipitous biomass declines
- 13 • Maintain Canada's quota share of this trans-boundary stock.

14 Reference Points

- 15 • Healthy Zone = $>80\%$ of B_{MSY}
- 16 • Cautious Zone = $>30\%$ B_{MSY} and $< 80\%$ B_{MSY}
- 17 • Critical Zone is $<30\%$ B_{MSY}
- 18 • Limit Reference Point for biomass (B_{lim}) = 30% of B_{MSY}

19 Limit Reference Point for total mortality = Z_{MSY}

20 Harvest Decision Rules (HDRs)

21 The Canadian quota will be 17% of 5/6 of the TAC designated by Canada, or 14.2%
22 of the entire designated TAC.

- 23 • When the biomass is above 80% of B_{MSY} , the risk of being above Z_{MSY} should be less
24 than 35%, based on the 3-year projections.
- 25 • When the biomass is between 30-80% of B_{MSY} , the risk of being above Z_{MSY} based on
26 the 3-year projections should not exceed 17-35%, with the risk tolerance being lower
27 the closer the biomass is to B_{lim} , with 17% at the lower end and 35% of the upper
28 end of this range.
- 29 • If the biomass is below the Healthy Zone and approaching B_{lim} (middle of the
30 cautious zone) then a special meeting will be sought with Greenland to develop
31 actions that endeavor to mitigate or reverse the decline (e.g. a rebuilding plan). In the
32 absence of agreement on measures to be taken, special conservation measures may be
33 taken unilaterally by Canada.

34 Notes:

- 35 • Biomass refers to fishable biomass as calculated by the assessment model. Biomass
36 values are to be based on point estimates.

- 1 • Precipitous decline: When the biomass decreases by more than 25% in the cautious
2 zone; a special NSAC discussion will be held to evaluate all available biomass signals
3 and the recent stock trend to determine if special conservation measures are required
4 and/or consultations with Greenland on appropriate measures will be triggered
- 5 • Canadian quotas that are uncaught in one year may be carried forward to the
6 following year in accordance with criteria and levels to be agreed between DFO and
7 quota holders as long as the harvest level is consistent with the HDRs above.
- 8 • These HDRs are subject to change as Canada further develops guidance on the
9 application of the PA framework on its domestic fisheries. This could include rules
10 that provide stability in TAC (i.e. a maximum and minimum percentage change).
11

12 **ANNEX J- NORTHERN SHRIMP RESEARCH – Provisional and Subject to** 13 **change**

14 **On-going Research (as of 2016):**

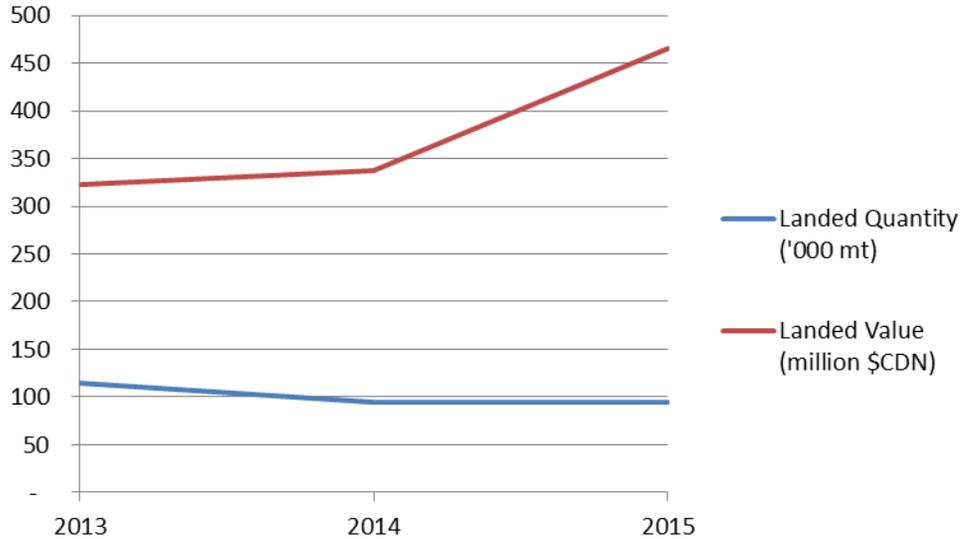
- 15 • In SFAs 5, 6 and 7, continue with the autumn DFO survey in 2HJ3KLNO, and the
16 spring DFO survey in 3LNOPsn.
- 17 • In SFA 4, WAZ and EAZ continue with summer DFO-NSRF survey on an annual
18 basis in order to determine and update shrimp biomass indices. Also, continue to
19 collect data on environmental covariates with the intent of developing relationships
20 with the shrimp distribution.
- 21 • In WAZ, DFO will attempt to analyze spatial/temporal variability of shrimp
22 distribution. Two cruises, in addition to the annual DFO-NSRF survey, will be
23 performed to study seasonal variability in shrimp biomass distribution.
- 24 • Continue to conduct genetic analysis to delineate stock assessment area(s), especially
25 for use in modeling. Preliminary results from completed work indicate shrimp are
26 genetically similar along the eastern coasts of NL (SFAs 4-7).
- 27 • Continue efforts to develop age-length keys for Northern Shrimp.
- 28 • Continue efforts to develop an assessment model.
- 29 • Continue to gather and analyze information related to corals, sponges and other
30 vulnerable marine ecosystems.
- 31 • Continue to analyze trends in the fish community (including shrimp).
- 32 • Continue diet studies of major groundfish species (predators of shrimp).
- 33
- 34

35 **Potential Future Research**

- 36 • Conditional on the development of an accepted assessment model, to begin a
37 Management Strategy Evaluation in order to develop modeled harvest decision rules.
- 38 • To determine trophic level for key species (including shrimp) using diet composition
39 and stable isotopes.
- 40 • To develop fisheries production potential models.
- 41 • To analyze relationships between shrimp catch survey results and measured
42 environmental covariates to seek potential linkages (responses) of the stock to large
43 scale oceanographic variability.

1 Explore relationships/correlations between groundfish and shrimp, including various
2 size classes of both, from available survey data.
3 ANNEX K – Economic Information

4 *Canadian Northern Shrimp Fishery, Total Domestic Landings, 2013-2015³*



5

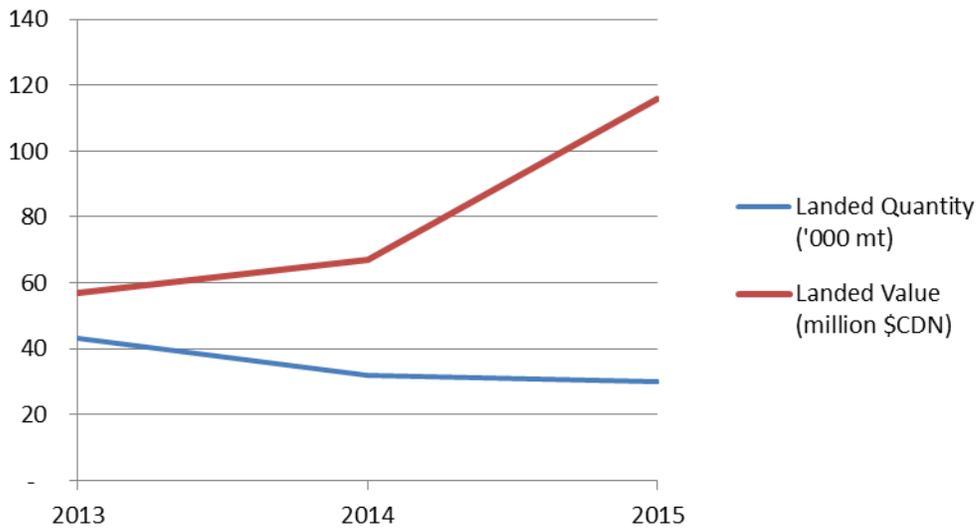
6

7 **Inshore Fleet Landings**

8 Annual landed quantities by the inshore fleet declined 30% between 2013 and 2015 in
9 parallel with TAC declines, while annual landed value more than doubled (Figure X).
10 Annual average landed prices for unprocessed shrimp increased by 191% from \$1.33/kg
11 in 2013 to \$3.87/kg in 2015. Cumulatively, from 2013 to 2015, the inshore fleet's landed
12 quantities accounted for 34% of the total taken from the Northern shrimp fishery.

³ Data source: Canadian Atlantic Quota Reports

1 *Figure X: Canadian Northern Shrimp Fishery, Inshore Fleet Landings, 2013-2015*

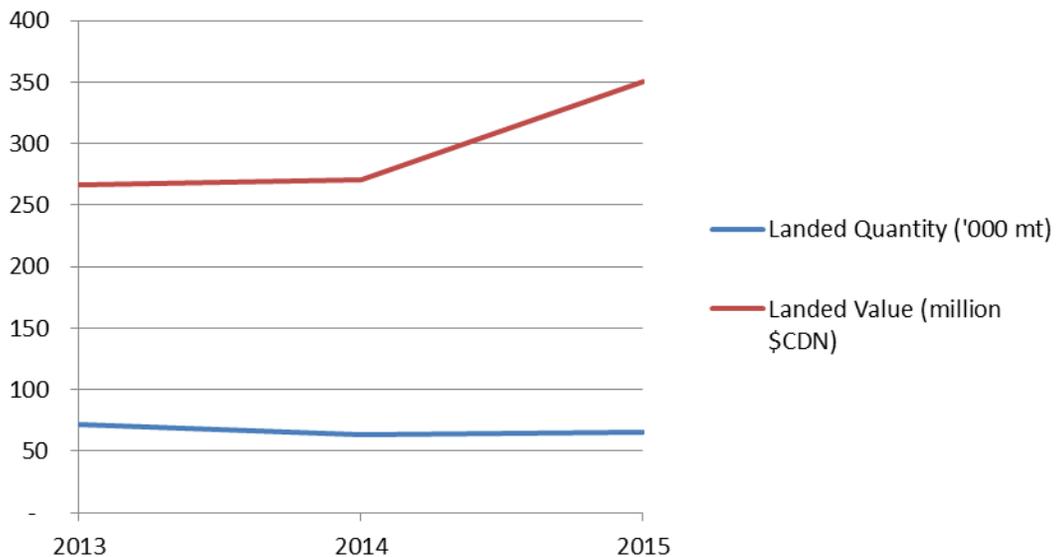


2

3 **100' Fleet Landings**

4 Annual landed quantities by the >100' fleet, which include quotas from special
 5 allocations, declined 10% from 2013 to 2015 in parallel with TAC declines, while annual
 6 landed values increased by 32% (Figure X). Increases in annual landed values were
 7 primarily driven by year-over-year increases in the annual average landed price. For the
 8 majority of landings, average landed prices for the >100' fleet product, which is
 9 processed at sea, increased 46% from \$3.69/kg in 2013 to \$5.38/kg in 2015.
 10 Cumulatively, from 2013 to 2015, the >100' fleet's landed quantities accounted for 66%
 11 of the total taken from the Northern shrimp fishery.

12 *Canadian Northern Shrimp Fishery, >100' Fleet Landings, 2013-2015*

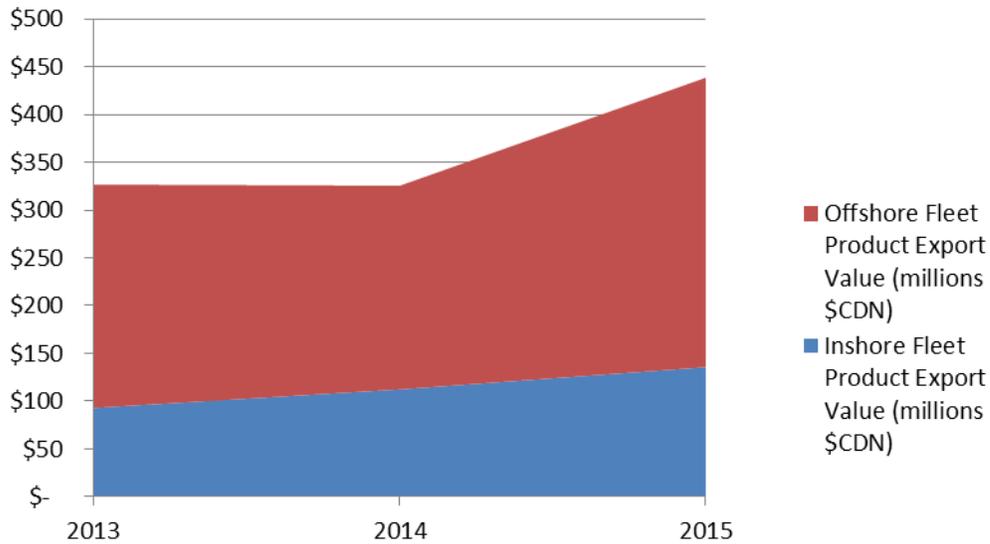


13

14

1 Exports⁴⁵

2 *Canadian Northern Shrimp Export Value 2013-2015*



3

4

5 **Inshore Fleet Exports**

6 The inshore fleet focuses on the cooked and peeled product, which is processed on shore.
 7 The market for this product is predominately Europe. Annual exports of Canadian cooked
 8 and peeled product of Northern shrimp averaged 11,000 mt from 2013 to 2015, with an
 9 annual average value of \$114M (Table 1). Canada’s main destinations for this product
 10 are the United Kingdom, Denmark, and the United States, accounting for 59%, 23% and
 11 9% respectively, of total cooked and peeled product shrimp export value in 2015.

12 *Northern Shrimp Inshore Fleet Product Exports, 2013-2015*

	2013	2014	2015
Quantity ('000 mt)	12	12	10
Value (millions \$CDN)	93	112	135

13

14 **100’ Fleet Exports**

15 The >100’ fleet focuses on a frozen at sea, shell-on product (cooked or raw). The product
 16 has strong markets in Asia and Western Europe. Annual export volumes of Canadian
 17 frozen shell-on Northern shrimp averaged 58,000 mt from 2013 to 2015, valued at
 18 \$250M annually (Table 2). The >100’ fleet’s product was largely exported to China,

⁴ Source: DFO EXIM Trade Database: Statistics Canada, International Trade Division.

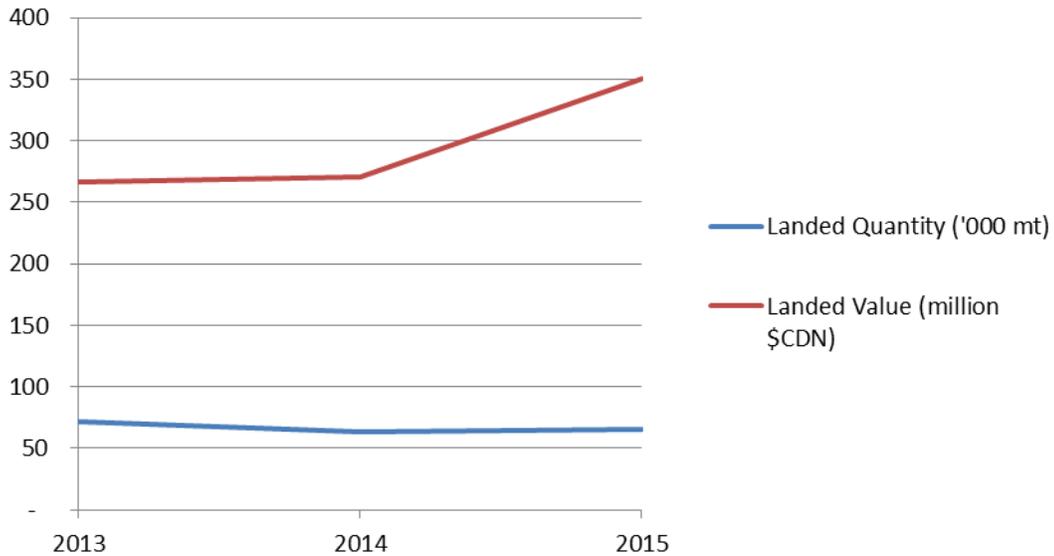
⁵ Export data presented in this section may include a small amount of Gulf of St. Lawrence shrimp exports since these are captured in the same Harmonized System (HS) export codes. Inshore fleet exports include products exported directly from Newfoundland and Labrador. A small amount of inshore exports may be excluded due to transprovincial shipment prior to international export.

1 Denmark and Iceland, accounting for 41%, 18% and 17% respectively of Canada's total
 2 frozen shell-on shrimp export value in 2015.

3 *Northern Shrimp >100' Fleet Product Exports, 2013-2015*

	2013	2014	2015
Quantity ('000 mt)	65	53	57
Value (million \$CAN)	234	213	303

4



5

6

7

Employment

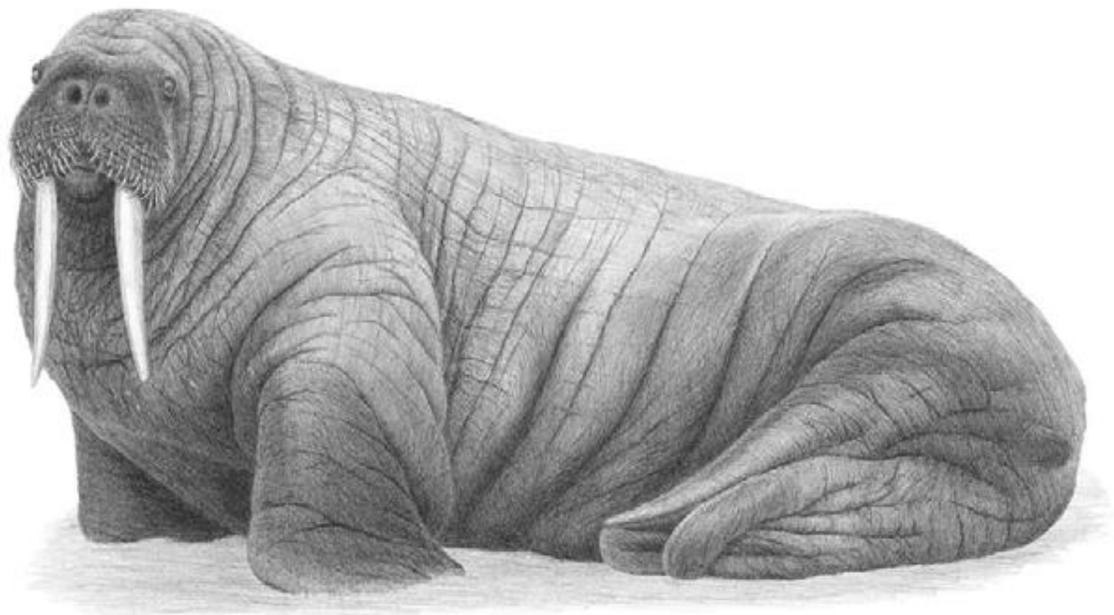
8

9 Approximately 200 inshore NL vessels harvest shrimp, with each vessel having at least
 10 five crew members plus the captain onboard. Additionally, between 2013 and 2015 the
 11 inshore fleet supplied shrimp to 10 processing plants, resulting in onshore employment to
 12 approximately 2,000 people. The >100' shrimp sector licence holders double-crew their
 13 vessels (24 to 28 crew depending on the size of the vessel) employing approximately 520
 14 crew for the entire fleet. The Northern shrimp fishery also provides indirect employment
 15 for goods and service providers that support harvesting, processing and distributional
 16 activities.

17



Integrated Fisheries Management Plan for Atlantic Walrus (*Odobenus rosmarus rosmarus*) in the Nunavut Settlement Area



WALRUS

GERALD KUEHL 2000

Foreword

The purpose of this Integrated Fisheries Management Plan (IFMP) is to identify the objectives and requirements for the Atlantic walrus (*Odobenus rosmarus rosmarus*) fishery in the Nunavut Settlement Area, and the management measures that will be used to achieve these objectives. This document also serves to communicate the basic information on the fishery and its management to Fisheries and Oceans Canada (DFO) staff, legislated co-management boards, Hunters and Trappers Associations (HTOs), Regional Wildlife Boards (RWOs), Inuit, communities and other stakeholders. This IFMP provides a common understanding of the basic “rules” for the sustainable management of the fisheries resource.

This IFMP is not a legally binding instrument which can form the basis of a legal challenge. The IFMP can be modified at any time and does not fetter the Minister of Fisheries and Oceans’ discretionary powers set out in the *Fisheries Act*. The Minister can, for reasons of conservation or for any other valid reasons, modify any provision of the IFMP in accordance with the powers granted pursuant to the *Fisheries Act*, and subject to the relevant terms of the *Nunavut Agreement*.

Where DFO is responsible for implementing obligations for any land claims agreements, the IFMP will be implemented in a manner consistent with these obligations. In the event that an IFMP is inconsistent with obligations under land claims agreements, the provisions of the land claims agreements will prevail to the extent of the inconsistency.

Dale Nicholson, A/Regional Director General, Central and Arctic Region
Fisheries and Oceans Canada

Date

Daniel Shewchuk, A/Chairperson, Nunavut Wildlife Management Board

Date

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Acronym List

BB- Baffin Bay
BNL- Basic Need Level
CITES- Convention on International Trade in Endangered Species
COSEWIC- Committee on the Status of Endangered Wildlife in Canada
DFO- Department of Fisheries and Oceans
FB- Foxe Basin
HBDS- Hudson Bay- Davis Strait
HTO- Hunters and Trappers Organization
IFMP- Integrated Fisheries Management Plan
IQ- Inuit Qaujimaqatuqangit
MMFL- Marine Mammal Fishing Licence
MMR- Marine Mammal Regulations
NA- Nunavut Agreement
NAMMCO- North Atlantic Marine Mammal Commission
NILCA- Nunavik Inuit Land Claim Agreement
NMRWB- Nunavik Marine Regional Wildlife Board
NQL- Non-Quota Limitation
NSA- Nunavut Settlement Area
NTI- Nunavut Tunngavik Incorporated
NWMB- Nunavut Wildlife Management Board
PSLS- Penny Strait- Lancaster Sound
PBR- Potential Biological Removal
RWO- Regional Wildlife Organization
SARA- Species at Risk Act
SEHB- South and East Hudson Bay
TAH- Total Allowable Harvest
TALC- Total Allowable Landed Catch
TEK- Traditional Ecological Knowledge
WJS- West Jones Sound

1. Overview

The following is an Integrated Fisheries Management Plan (IFMP) that will be used to provide direction in the management of Atlantic walrus (*Odobenus rosmarus rosmarus*) stocks in the Nunavut Settlement Area (NSA). Walrus in the *Areas of Equal Use and Occupancy*, as set out in Schedule 40-1 of the *Nunavut Agreement* (NA), will continue to be managed under applicable Acts, Regulations and land claims agreements, and are currently excluded from the management structure identified within this IFMP.

This IFMP was developed and will be implemented by the Government of Canada and co-management organizations through an adaptive co-management process. Working Groups comprised of Hunters and Trappers Organizations (HTO) from Arctic Bay, Grise Fiord, Hall Beach, Igloolik, Pond Inlet and Resolute, Qikiqtaaluk Wildlife Board (QWB), Nunavut Tunngavik Incorporated (NTI), the Nunavut Wildlife Management Board (NWMB) and the Department of Fisheries & Oceans (DFO) were formed to lead the development of the IFMP. The Working Groups have been instrumental in the development of the IFMP.

1.1 History

The walrus is one of the largest members of the seal family with two subspecies recognised. Pacific walrus inhabit the Bering, Chukchi, and Laptev seas. Atlantic walrus inhabit coastal areas of north-eastern Canada, Greenland and Svalbard (NAMMCO 2004).

Walrus have been harvested by Arctic indigenous peoples for thousands of years, providing valuable products such as blubber, bones, tusks and meat. The commercial harvesting of walrus in the 19th and 20th centuries resulted in a rapid decrease of walrus across their Arctic ranges, including the extirpation of the Northwest Atlantic population. By 1928, commercial harvesting of walrus was banned in Canada by the Walrus Protection Regulations. Currently walrus in the NSA are managed under the *Marine Mammal Regulations*, the *Fisheries Act* and the NA.

Walrus are a key species in the Arctic marine food web, are of high economic, social and cultural importance for Inuit, and are iconic to Canadians since they are so easily identified with the Arctic environment.

1.2 Type of Fishery and Participants

Atlantic walrus are primarily harvested by Inuit, and are highly valued as a traditional source of food and other products. The Inuit hunt provides an opportunity to maintain cultural traditions and for experienced hunters to pass on their skills and knowledge to younger generations. Walrus products also provide a secondary source of income for hunters. Walrus ivory is either sold raw, or carved into fine art pieces such as jewelry or sculptures. Some communities engage in a small-scale sport hunt conducted by non-Inuit hunters.

1.3 Location of the Fishery

Atlantic walrus are found across most of Nunavut, with the majority of harvests occurring in eastern Nunavut (Figure 1).

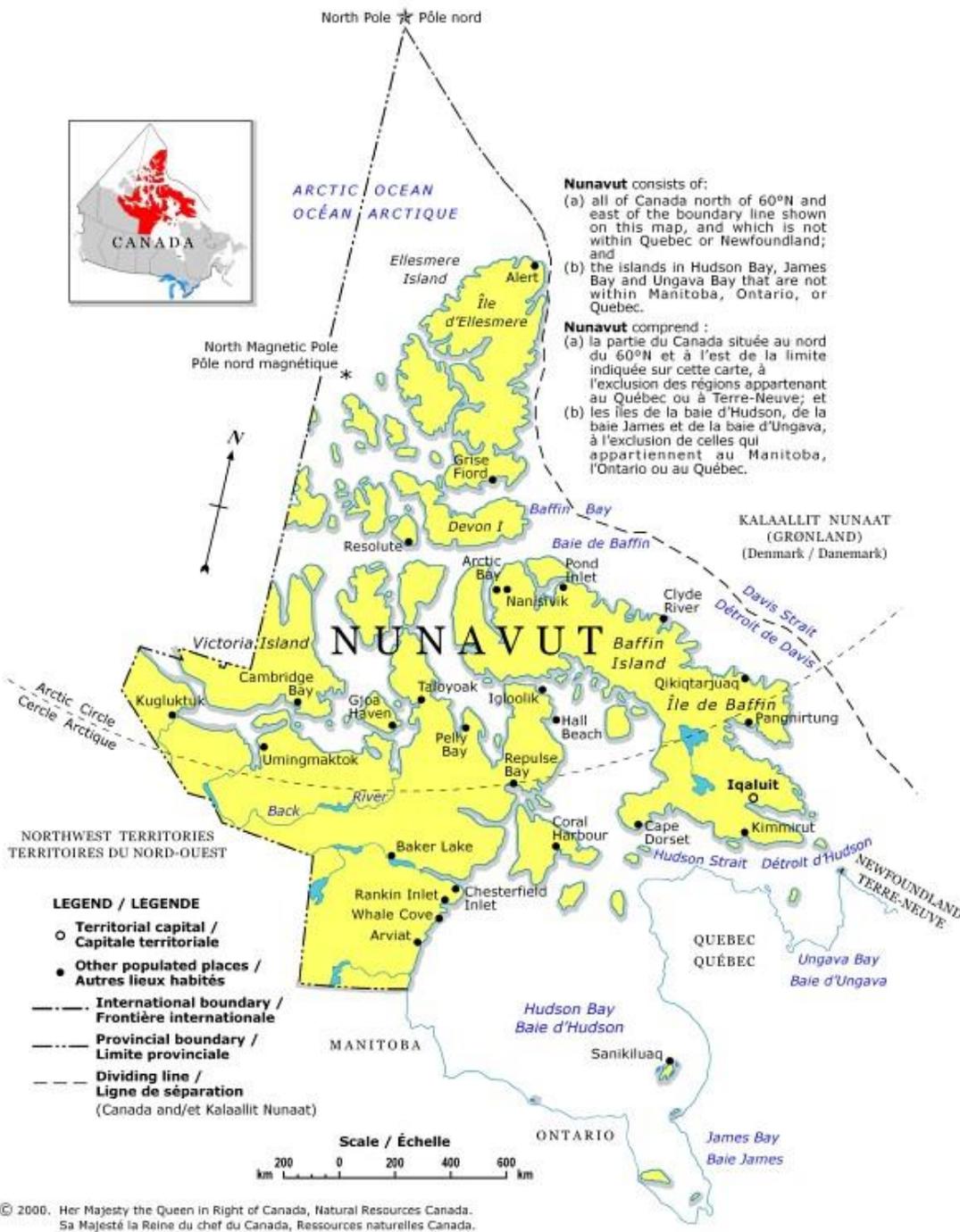


Figure 1. Map of the eastern Canadian Arctic, showing locations mentioned in the text.

1.4 Governance

The walrus fishery in the NSA is co-managed by DFO, the NWMB, RWOs and HTOs, in accordance with the Nunavut Agreement (NA or Agreement), and the *Fisheries Act* and its regulations. Under this co-management regime, the NWMB is the main instrument of wildlife management in the NSA, but the Minister retains authority and ultimate responsibility for wildlife management and conservation of fish, including marine mammals.

Fisheries Act, regulations, and policies

The walrus fishery is regulated by the *Fisheries Act* (R.S., 1985, c. F-14) and regulations made pursuant to it, including the *Fishery (General) Regulations* and the *Marine Mammal Regulations*. Where there is an inconsistency between the regulations and the Agreement, the Agreement shall prevail to the extent of the inconsistency.

DFO has adopted a Sustainable Fisheries Framework for all Canadian fisheries to ensure that objectives for long-term sustainability, economic prosperity, and improved governance for Canadian fisheries are met. The Sustainable Fisheries Framework contains policies for adopting an ecosystem based approach to fisheries management, including *A Fishery Decision-Making Framework Incorporating the Precautionary Approach*, and *Managing Impacts of Fishing on Benthic Habitat, Communities and Species*. This policy framework applies to the walrus fishery in the Nunavut Settlement Area.

These documents are available on the Internet at:

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

Nunavut Agreement

In 1993, Canada settled a comprehensive land claim agreement with the Inuit of the NSA. The NA created priority access and wildlife harvesting rights for Inuit and other Aboriginal groups who traditionally harvested within the NSA.

The NA also created an Institution of Public Government, the NWMB, to share decision making authority with the Federal Government. The NWMB and DFO Minister consider matters relating to the proper management and control of fisheries and the conservation of fish within the NSA. Under this co-management regime, the NWMB is the main instrument of wildlife management, but the Minister retains ultimate responsibility for wildlife management and may accept, reject or vary decisions made by the NWMB with respect to harvesting and other decisions related to the management and protection of wildlife and wildlife habitat.

The NA establishes wildlife management authority for the NWMB including the establishment, modification, and removal of levels of Total Allowable Harvest (TAH) or harvesting in the NSA, as well as Non-Quota Limitations (NQLs) on harvesting such as management units and harvesting seasons. Once a total allowable harvest has been established, the NWMB is also required to strike a Basic Needs Level (BNL), which is the portion of the TAH allocated to Inuit that constitutes the first demand on the TAH. Once established for a stock or population, the TAH replaces the existing regulatory quota.

The NL establishes wildlife management authority for RWOs and HTOs. The powers and functions of the RWOs (NA 5.7.6) include:

- Regulation of harvesting practices and techniques among the members of HTOs in the region, including the use of non-quota limitations.
- Allocation and enforcement of regional basic needs levels and adjusted basic needs levels among HTOs in the region.
- Assignment to any person or body other than an HTO, with or without valuable consideration and conditions, of any portion of regional basic needs levels and adjusted basic needs levels.
- Generally, the management of harvesting among the members of HTOs in the region.

The powers and functions of the HTOs (NA 5.7.3) include:

- Regulation of harvesting practices and techniques among the members, including the use of non-quota limitations.
- Allocation and enforcement of community basic needs levels and adjusted basic needs levels among members.
- Assignment to non-members, with or without valuable consideration and conditions, of any portion of community basic needs levels and adjusted basic needs levels.
- Generally, the management of harvesting among the members.

The NA establishes authority to Nunavut Tunngavik Incorporated (NTI) as the primary Designated Inuit Organizations (DIO) under the Agreement. It is responsible for ensuring that Inuit rights and obligations under the land claim are implemented, including the wildlife management provisions (Article 5) of the NA.

Under the NA, wildlife management and Inuit harvesting are guided by the principles of conservation (NA s.5.1.5).

The Nunavut Agreement is available on the internet at:

<https://www.aadnc-aandc.gc.ca/eng/1100100030601/1100100030602>

1.5 Fishery Characteristics

In Nunavut, Atlantic walrus are harvested year round. Inuit hunters use a combination of modern equipment, such as snowmobiles, boats with outboard motors, and rifles, as well as traditional sleds, harpoons and floats. Typically, walrus are hunted from boats when they are on ice floes or while they are swimming in open water. In most cases walrus are shot first and then harpooned. Hunters prefer to kill walrus on ice where they are easier to retrieve and process. Animals on the ice are shot from close range with the intention of killing them immediately before they can fall into the water. Loss rates can be high when walrus are killed in deep water because they sink quickly (NAMMCO 2004, COSEWIC 2006). To reduce losses, animals in the water may be harpooned before they are shot, wounded so they can be harpooned before being killed, or killed in shallow water where they can be retrieved with grappling hooks or at low tide (NAMMCO 2004, COSEWIC 2006). Harpooning a walrus is dangerous, since animals must be approached to within 10m and wounded walrus become very aggressive and can capsize canoes or small boats

(COSEWIC 2006). Floats made from seal skin are still heavily used, although hunters are finding that modern floats are more durable.

Some communities conduct walrus sport hunts. Individuals hunting under the authority of a marine mammal fishing licence issued by DFO must travel with local guides approved by the HTO. The licence stipulates when and where the hunt is authorized to take place, by whom, their country of origin, quotas, gear type to be used, as well as any specific conditions related to the hunt, such as the reporting of all hunts to the local DFO office, firearm muzzle velocity requirements, and the total number of strikes allowed. Individual HTOs may also have local by-laws. Licenced sport hunters report harvest information directly to DFO. See section 6 and Appendix 3 for more information on walrus sport hunts.

Table 1. Primary Harvesting Communities of Atlantic Walrus in the Eastern Canadian Arctic

Population	Stock	Nunavut Harvesting Communities	Nunavik Harvesting Communities	Greenland Harvesting Communities
High Arctic	Baffin Bay	Grise Fiord		Qaanaaq Avanersuaq
	West Jones Sound	Grise Fiord		
	Penny Strait-Lancaster Sound	Resolute Bay Arctic Bay Pond Inlet		
Central Arctic	Foxe Basin (northern and central Foxe Basin stocks)	Igloolik Hall Beach		
	Hudson Bay-Davis Strait	Clyde River Qikiqtarjuaq Iqaluit Pangnirtung Arviat Cape Dorset Chesterfield Inlet Coral Harbour Kimmirut Rankin Inlet Repulse Bay Whale Cove	Puvirnituq Akulivik Ivujivik Salluit Kangiqsualujjuaq Kuujjuaq Tasiujaq Aupaluk Kangirsuk Quaqtaq Kangiqsujuaq	Sisimiut
Unknown	South and East Hudson Bay	Sanikiluaq	Inukjuak Kuujjuarapik Umiujaq	

(COSEWIC 2006, Stewart 2008a)

1.6 Approval Process

This IFMP has been approved by the Minister of DFO and the NWMB pursuant to section 5.2.34 of the NA. It will be reviewed and amended as necessary in collaboration with co-management organizations to ensure it remains relevant and current with new science, Traditional Ecological Knowledge and Inuit Qaujimajatuqangit.

This IFMP will be translated to Inuktitut and made available from DFO.

2. Stock Assessment, Science and Traditional Knowledge

2.1 Biological Synopsis

The walrus is Canada's largest member of the seal family. It is a large animal with limbs that have developed into flippers, upper canine teeth that develop into long tusks (ivory) at about 2 years of age, and a moustache made of quill-like whiskers. Males and females are about 125 cm long at birth. As adults, males are significantly larger than females (Garlich-Miller & Stewart 1998). Adult males reach up to 1,100 kg in weight and 3.1 m in length and females can reach 800 kg and 2.8 m in length. Walrus can live to 40 years of age, and are considered to be long-lived animals. As walrus have a delayed sexual maturation, fairly low reproductive rates and specialized habitat requirements, they are vulnerable to over-harvesting and sensitive to environmental changes (COSEWIC 2006).

Mating occurs from February to April. Little is known about their reproduction because they mate in the water and in remote areas. Males mature between 7 and 13 years of age and compete intensely for females, defending access to them for up to five days. Females mature between 5 and 10 years of age and give birth on average every three years. Gestation lasts about 11 months and the young nurse for up to 27 months. Expectant mothers move onto land or ice to give birth. Protective care by mothers and the herd assures high calf survival (DFO 2007).

2.2 Ecosystem Interactions

The habitat requirements of the Atlantic walrus are very specific. They need large areas of shallow (100 m or less), open water that support an abundant clam community. In addition, there must be ice or land nearby to 'haul out'. Moving pack ice is ideal for this purpose; however, in the summer and fall if ice is scarce, large herds congregate and haul out on low, rocky shores with steep subtidal zones. In areas of deeper water without plentiful clams, some walrus will consume seals. These walrus tend to be more aggressive, and are usually solitary or found in smaller groups. Although some hauled out groups of walrus may contain animals of all ages and both sexes, walrus tend to segregate by age and sex during most of the year. It is thought that females and their young return to certain sites more faithfully than do adult males (DFO 2007). Following harvesting by humans, polar bears are thought to be the main predators of walrus, though it is believed they take few animals.

The full effects of climate change on Atlantic walrus are unknown. However, potential effects of a warming climate may include, but are not limited to:

- A reduction in winter and summer ice cover
- A rise in sea level
- An increase in sediment transport
- An increase in the frequency and severity of storms
- An increase in the presence of killer whales in the Arctic.

These may all be important factors for walrus, potentially impacting food supply and/or quality, ecosystem interactions, affecting their ability to access food and appropriate haulout sites, thereby influencing their health, distribution and abundance. These affects could also impact hunters' ability to access walrus.

2.3 Traditional Ecological Knowledge

Traditional Ecological Knowledge (TEK) of walrus throughout Canada's Arctic is extensive. Each community has hunters and elders that have knowledge in areas of distribution, seasonality, migration, birthing areas and haulout sites. Inuit have observed changes with respect to impacts from climate change, past and present disturbances and development/exploration. When shared, this information is considered with scientific knowledge to provide a more robust understanding of walrus distribution, movements and environmental interactions. TEK has also been used in assisting with the delineation of stocks and is used in the design of surveys by DFO Science to estimate population abundance. TEK is used with scientific data and observations to contribute to management decisions, as well as to identify information gaps, areas of uncertainty, and to set research priorities.

TEK has been recorded on unpublished maps, in meetings minutes, documented in a number of different published papers (DFO 2002a, DFO 2012a, NCRI 2014), and through consultations with experienced hunters and community elders.

Inuit Qaujimagatuqangit (IQ) consists of TEK, as well as Inuit beliefs about how the world works, and the values necessary to behave in an ethical manner in human interactions with the animals and the environment. The collaborative approach to developing this IFMP for walrus that includes representatives from HTOs and other co-management organizations has assisted in the inclusion of IQ, such as decision-making through consensus, working together for a common cause, and respect and care for the land, environment and animals (NWMB). This IFMP will allow for the continued inclusion of IQ, TEK and science as it becomes available.

2.4 Stock Delineation

Two populations of walrus have been identified in Canada based on analysis of microsatellite DNA (Shafer et al. 2013): the high Arctic population (comprised of the West Jones Sound, Baffin Bay and Penny Strait-Lancaster Sound stocks) and the central Arctic population (including the north and central Foxe Basin stocks and the Hudson Bay-Davis Strait stocks).

There are a number of factors used in delineating stocks, including ecological factors that determine distribution of walrus (ice cover, polynyas, shallow banks with suitable habitat, migration routes and availability of haulout sites), historical and current distribution, seasonal movements, age and sex composition, catch levels, composition of catches and hunting loss, hunter observations, harvest sites, survey observations, genetic information, satellite tagging data, heavy metal/ organochlorine data, lead isotope ratios and trace elements (Stewart 2008b).

Based on consultations with local communities, stock reassessment by the North Atlantic Marine Mammal Commission (NAMMCO) (2011), and Stewart (2008a), six stocks or management units of Atlantic walrus have been identified for management purposes in the NSA (Figure 2).

These include:

- Baffin Bay- Management Unit AW-01 (shared with Greenland);
- West Jones Sound- Management Unit AW-02;
- Penny Strait-Lancaster Sound- Management Unit AW-03;
- Foxe Basin- Management Unit AW-04;
- Hudson Bay- Davis Strait- Management Unit AW-05 (shared with Nunavik and Greenland);
- South and East Hudson Bay- Management Unit AW-06 (shared with Nunavik).

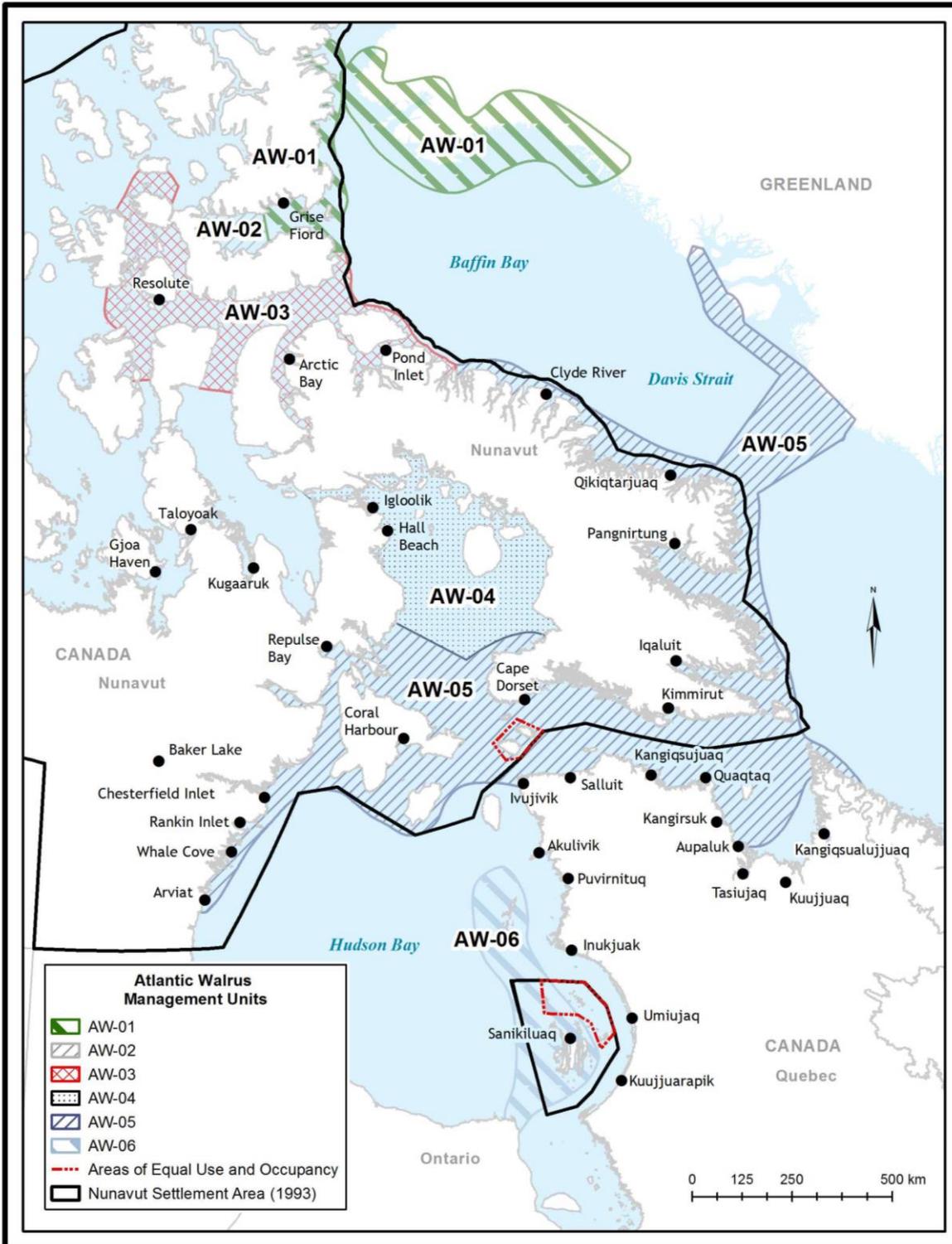


Figure 2. Location of Atlantic walrus management units in the eastern Canadian Arctic and the Nunavut Settlement Area.

Note: This version of the IFMP does not apply to the *Areas of Equal Use and Occupancy* as set out in Schedule 40-1 of the *Nunavut Agreement*.

2.5 Precautionary Approach

A precautionary approach to fisheries management links harvest level recommendations with stock assessment data. Lower harvest levels are recommended when stock assessments are uncertain to avoid serious harm to fish or marine mammal stocks or their ecosystem. A lack of stock assessment data should not be used as a reason to postpone, or fail to take, management actions. This approach is widely accepted as an essential part of sustainable fisheries management.

In accordance with the *Fisheries Act* and the NA, the best available information guides walrus management decisions made on behalf of the NWMB and the Minister. A management decision to restrict Inuit harvesting shall do so only to the extent necessary to affect a valid conservation purpose; to give effect to the allocation system outlined in the NA; or to provide for public health or public safety (NA s. 5.3.3).

The amount of information available for resource management varies among species and populations. For those species where information on abundance, mortality and reproductive rates may be limited, DFO uses the Potential Biological Removal (PBR) method to estimate the maximum number of animals that may be removed by all human activities without depleting the stock or population (DFO 2012b). This total amount of removals accounted for using PBR would include removals of harvested animals, animals shot at, but not harvested (called struck and lost), as well as losses to ship strikes, net entanglements and any other human activities. The PBR is calculated using a number of biological parameters (Stewart 2008b, Stewart and Hamilton 2013).

In calculating sustainable harvest levels, PBR results are multiplied by a Loss Rate (LR) to obtain Total Allowable Landed Catch (TALC) values. Loss rates represent all indirect human caused mortalities (struck and lost, ship strikes, net entanglements). At this time, only struck and lost rates are considered in the estimate of TALC; however, this may change if more information becomes available.

$$\text{TALC} = \text{PBR} (1 - \text{LR})$$

Struck and lost rates are incomplete for walrus and can vary with season, weather, location, hunter experience, hunting technique/equipment, and animal behavior. In Canada, struck and lost rates have been documented to range between 30% and 32% (Orr et. al 1986), although some hunters believe the rates to be as low as 5% (DFO 2002a). Inuit harvesters have noted that loss rates will vary depending on when and how the walrus is harvested. NAMMCO applies a struck and lost rate of 30% for those stocks lacking specific loss rate information (2006).

2.6 Stock Assessment and Trends

Most indicators of trends in stock size are based on distributional changes, differences in physical conditions of the animal, and harvest data. Whenever there is a local decrease in numbers, it may be that the animals have moved to another area, but until increases in other parts

of the range have been clearly documented, the possibility of a reduction in numbers should be considered.

Walrus are widely distributed in the eastern Canadian Arctic, and are most often found in aggregations, or groups, numbering from the tens, to thousands. In order to estimate walrus numbers, aerial surveys are conducted of walrus haulouts. Walrus haulouts are identified based on a number of factors including information from past surveys, existing scientific information, and local traditional knowledge. Data from satellite tags active during surveys are used to adjust the haulout counts to account for animals at sea, and therefore missed by the survey. If no active tags are in the survey area at the time of the survey, data from other walrus studies are used to estimate the numbers of walrus at sea, and determine an abundance estimate. Although aerial surveys combined with satellite telemetry are the standard methods used to estimate abundance of walrus populations across their range, new approaches, such as genetic capture-mark-recapture methods, should be investigated.

The most recent science advisory report on walrus abundance estimates can be found at:

ENGLISH: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_034-eng.pdf;
and: <http://waves-vagues.dfo-mpo.gc.ca/Library/365442.pdf>

INUKTITUT: http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2013/2013_034-inu.pdf; and http://www.dfo-mpo.gc.ca/csas-sccs/Publications/SAR-AS/2016/2016_007-inu.pdf

Baffin Bay (BB) - Management Unit AW-01

In Canada, the Baffin Bay stock extends from eastern Jones Sound to eastern Ellesmere Island and NW Greenland (Stewart 2008a). Analysis of aerial surveys conducted by DFO and Greenland Institute of Natural Resources in 1999, 2005, and 2009 resulted in population abundance estimates ranging from 1,249 to 1,251 and PBR estimates to range from 10 to 11 walrus (DFO 2013, Stewart et al. 2013a, Stewart and Hamilton 2013). See Figure 2.

West Jones Sound (WJS) - Management Unit AW-02

This stock is separated from the Baffin Bay stock by seasonal distribution and tag movements (Stewart 2008a). Aerial surveys by DFO were conducted between 1998 and 2009, resulting in an abundance estimate ranging from 470 to 503, and PBR estimates ranging from 7 to 17 animals (DFO 2013, Stewart et al. 2013b, Stewart and Hamilton 2013). There was no statistically significant evidence of population change between these surveys and the late 1970s, but there were differences in coverage and walrus distribution may have changed. See Figure 2.

Penny Strait- Lancaster Sound (PS/LS) - Management Unit AW-03

This stock is separated from the Baffin Bay stock by isotope data, and from the West Jones Sound stock by distribution and tag movements (Stewart 2008a). Aerial surveys were conducted between 1998 and 2008 and resulted in an abundance estimate of 727 walrus in 2009 and PBR estimates ranging from 10 to 24 animals (DFO 2013, Stewart et al. 2013b, Stewart and Hamilton 2013). There was no statistically significant evidence of a trend in population numbers when the recent surveys were compared to similar surveys in the late 1970s, although differences in coverage and possible changes in walrus distribution may influence comparisons. See Figure 2.

Foxe Basin (FB) - Management Unit AW-04

Stewart (2008b) delineated the Foxe Basin stock into 2 units: northern Foxe Basin stock and central Foxe Basin stock. In Foxe Basin, the two stocks share an overwintering area and breed as a single unit, but they may occupy different areas in the summer and may be susceptible to different hunting pressures. Lead isotope ratios and trace element profiles from teeth suggest two different stocks, and since isotope ratios are a reflection of the migratory patterns of the animals, they are useful in discriminating management units. Although there is evidence to delineate two stocks in the Foxe Basin area, currently there is not enough information (science or TEK) to visually or geographically separate the stocks within the larger Foxe Basin area. Therefore, until additional information is available to further partition this stock, the management of walrus will continue to occur at the larger Foxe Basin management unit. See Figure 2.

Analysis of surveys conducted in 2010 and 2011 resulted in a range of abundance estimates of 8,153-13,452 and PBR estimates ranging from 211-422 walrus (DFO 2016, Stewart et al. 2013c, Stewart and Hamilton 2013).

Changes in the distribution of walrus within Foxe Basin have been documented by local hunters and researchers, with many haulouts being abandoned on the west coast (Mansfield 1966, Brody 1976, Anderson and Garlich-Miller 1994, DFO 2002a). This may suggest declines in numbers of walrus, habitat availability, or both. Local Inuit have noted that ice conditions have changed in Foxe Basin resulting in a reduction of multiyear ice that walrus use for hauling out on.

Hudson Bay-Davis Strait (HBDS)- Management Unit AW-05

Walrus from the *Hudson Bay-Davis Strait* (HBDS) stock have been distinguished from the other five stocks based on distances, movements, differences in growth patterns, as well as differences in genetics, contaminants, and lead isotope ratios (DFO 2002b, COSEWIC 2006, Stewart 2008a). A comprehensive, systematic survey over the entire geographic area has not occurred for this stock. Currently, due to the limited amount of data over the stock's full range, it is not possible to determine the size or trend of this stock. See Figure 2.

South and East Hudson Bay (SEHB)- Management Unit AW-06

The *South and East Hudson Bay* walrus stock was originally delineated by Born et al. (1995) on the basis of distribution, but since then, lead isotope data has provided stronger evidence that supports the differentiation between this stock and the *Hudson Bay-Davis Strait* stock (Stewart 2008a). A complete or comprehensive survey of this stock has not been conducted. Based on a few walrus sightings in a large geographical area over a long period of time, Richard and Campbell (1988) and Born *et al.* (1995) estimated the population size to be a minimum of 410 and 500 animals, respectively (COSEWIC 2006). Currently, due to the limited amount of data, it is not possible to determine the size or trend of this stock. See Figure 2.

Table 2. Abundance Estimates and Potential Biological Removal Levels (PBR) for Atlantic Walrus in the Eastern Canadian Arctic

Population	Stock/Management Unit	Abundance Estimates	PBR
High Arctic	Baffin Bay (BB)/ AW-01	1249-1251	10-11
	West Jones Sound (WJS)/ AW-02	470-503	8-17
	Penny Strait- Lancaster Sound (PS-LS)/ AW-03	623-831	12-24
Central Arctic	Foxe Basin/ AW-04	8,153-13,452	211-422
	Hudson Bay-Davis Strait/ AW-05	No recent estimate.	---
Unknown	South and East Hudson Bay/ AW-06	No recent estimate.	---

(Stewart and Hamilton 2013, DFO 2013, DFO 2016)

PBR represents the total number of animals that can be removed from all human activities while allowing the stock or population to maintain or achieve its optimal sustainable level.

2.7 Research

The following research is required:

- Determine abundance estimates for Hudson Bay-Davis Strait and South and East Hudson Bay stocks;
- Apply new methods to determine walrus abundance, such as genetic capture-mark-recapture;
- Continue to research genetic diversity and stock discrimination;
- Continue to investigate and assess potential threats resulting from human activities (e.g., shipping routes, noise disturbance, tourism);
- Determine the extent of exchange between shared Canada/Greenland stocks;
- Determine changes in habitat availability (pack ice and food); and
- Continue to investigate distribution and abundance of stocks.

3. Social, Cultural and Economic Importance of the Fishery

For centuries, walrus have been used by Inuit as a traditional food source and for supplying important materials for day to day living. Walrus meat is eaten in raw, cooked or fermented (*igunak*) forms by Inuit. Molluscs found in walrus stomachs are considered a delicacy in some Inuit communities (Whitford 2008). Some communities now obtain their walrus meat and tusks from hunters in other communities rather than conduct their own hunts (DFO 2012a).

Historically, walrus products provided materials for numerous necessities required for arctic living such as bones used for carvings, tent poles, and walking sticks, tusks/ ivory used to construct harpoons, toggles, handles, and handicrafts, sinews used for sewing thread, and skin for tents and ropes. The tusk and baculum (penis bone) are valuable economic commodities and provide important sources of cash income, particularly, for the hunting communities. Ivory from

walrus is commonly used for carvings and crafts and is sold both inside and outside the NSA. Although not as much trade occurs with walrus products as some other arctic species, international and domestic trade does still occur, mostly via exporters in southern Canada. International export of walrus products includes carved and un-carved tusks, bones, teeth, skeletons and skulls. International markets for Canadian walrus products include France, India, China, Japan, Korea, Singapore, United States and Australia (Shadbolt et. al 2014).

The walrus sport hunt in some communities can provide a major source of cash income through the hiring of local guides, and sport hunters purchasing various goods and services (food, crafts, and accommodations). Sport hunters are permitted to keep the tusks, baculum and head of the walrus, but the meat remains within the community for community use.

Hunting walrus, especially at traditional summer hunting camps, helps foster interdependence both within and between communities, provides opportunities to share knowledge between generations and community members and strengthens kinship ties and community cohesion. These cultural values are difficult to measure in economic terms but are very important to help maintain the Inuit way of life. The walrus hunt itself, as well as the sharing of the products of the hunt, continues to be of great social, cultural and economic significance to Inuit and the economic value of the meat and the ivory is substantial (COSEWIC 2006).

4. Management Issues

IFMPs are required to cover all aspects of a fishery, in particular, those areas that are related to the sustainability of the target species, ecosystem considerations and monitoring. The following represent the main management issues for the Atlantic walrus in the NSA.

4.1 Fisheries Issues

Abundance Estimates

While recent estimates are available for four of the six walrus stocks or management units, abundance estimates are still required for the Hudson Bay-Davis Strait stock and the South and East Hudson Bay stock. Funding for surveys will be needed to obtain abundance estimates and recommend sustainable harvest levels.

Sustainable Harvest Levels

It is important to ensure the conservation of walrus and that the harvesting of walrus is sustainable. There is growing national and international pressure to demonstrate that walrus are being harvested at sustainable levels. This will require the establishment of sustainable harvest levels for all stocks.

Struck and Lost Rates

Accurate struck and lost rates are important for understanding the impacts of hunting and to maximize sustainable harvest levels. Struck and lost rates vary or are incomplete in the NSA. Determining appropriate struck and lost rates are required in order to estimate sustainable harvest levels.

Hunter Training/ Reducing Loss Rates

Training for harvesters and youth has been identified as an important component for the sustainable management of the walrus fishery. This would include training on the best harvesting techniques, when and where to harvest, hunter safety, preparation and preservation of meat, and how to minimize struck and lost rates. HTOs may develop plans or best management practices that set out practical measures for community hunters to reduce the number of struck and lost walrus while harvesting.

Monitoring and Reporting

Once a TAH/BNL is established for walrus, a method to control removals will be required to ensure walrus harvesting remains within regulated harvest levels.

Timely, accurate reporting of walrus harvesting is essential. Without complete and accurate estimates of local harvesting activity, co-managers must exercise caution when recommending harvest limits so that vital, healthy walrus populations/stocks that are capable of sustaining harvesting needs of Inuit can be maintained. The timeliness of the reporting allows managers to assess the harvest as limits are approached.

Sport Hunt

There is a need for all HTOs that pursue sport hunt opportunities to develop by-laws or guidelines that would identify the community rules or best management practices for the sport hunt.

Ship Traffic/Development/Tourism

There are a number of potential impacts and threats to walrus and walrus habitat resulting from increased development and shipping activities. These could include increased oil spills, ship strikes, disruption of migration, avoidance of ecologically or biologically important areas (e.g. birthing, mating or feeding areas), noise disturbance and the introduction of alien or invasive species through activities such as ballast water exchange. Tourism is increasing in the Arctic and concern with increased disturbance to important walrus areas (e.g. haulouts) has been expressed.

4.2 Oceans and Habitat Considerations

Under the Health of the Oceans Initiative, Ecologically and Biologically Significant Areas (EBSAs) in the Eastern Arctic were identified (DFO 2011). Experts from Canadian federal departments, academics, Inuit organizations and various environmental non-government organizations having expertise in a number of different areas were involved. EBSAs are intended to identify areas that have high ecological or biological significance and are useful in assisting with management decisions.

The EBSAs were evaluated based on set criteria for marine biogeographic regions. Of the 41 EBSAs identified in the Eastern Arctic, 14 included walrus as a component contributing to the EBSA criteria. The ecological functions identified as being important for walrus included known

distribution, presence of haulouts, migration corridors, presence of polynyas, calving areas and feeding grounds.

4.3 National and International Issues

Food Safety

Outbreaks of trichinosis have been reported in Nunavut over the years, most commonly from consuming meat that has been infected with a parasitic worm called *Trichinella nativa*, which lives inside the bodies of walrus and some other birds and mammals. The Government of Nunavut's department of health has responsibilities around food safety within the Nunavut Settlement Area and have established programs to test walrus meat for the parasite that causes the disease. Harvesters are asked to contact their HTO or a Government of Nunavut Environmental Health Officer for additional information on the Nunavut Trichinosis Prevention Program.

COSEWIC and SARA

COSEWIC (Committee on the Status of Endangered Wildlife in Canada) is an independent committee of government and non-government experts that assesses and designates the status of wildlife species that may be in some danger of disappearing from Canada. COSEWIC uses a process based on science, Aboriginal Traditional Knowledge and community knowledge to assess the risk of extinction for wildlife species. Wildlife species that have been designated at risk by COSEWIC may then qualify for legal protection and recovery or management under the Species at Risk Act (SARA).

The Species at Risk Act is a federal Act that was created to prevent Canadian species and their distinct populations from becoming extirpated or extinct, to provide for the recovery of Extirpated, Endangered or Threatened species, and to encourage the management of Special Concern species to prevent them from becoming further at risk. In the case of species listed as Special Concern, a management plan must be created which outlines the actions required to help prevent the species from becoming further at risk. For Extirpated, Endangered and Threatened species, a Recovery Strategy and Action Plan are developed which outline exactly what will be done to help recover the species to a larger, "pre-harm" population size. For Extirpated, Endangered and Threatened species, SARA also provides legal protection of their critical habitats and prevents any harm to the species, except under certain circumstances.

In 2006, COSEWIC designated Atlantic walrus as a species of Special Concern. However, the species is scheduled to be reassessed by COSEWIC and while the 'special concern' designation for a single population of Atlantic walrus could remain, it could be replaced with a higher designation of risk or multiple populations with multiple at risk designations. Once assessed by COSEWIC the Government of Canada will follow an established process to determine whether or not to recommend listing the species under the *Species at Risk Act*. This process includes biological, social and economic assessments of possible listing scenarios, as well as consultation with co-management organizations, stakeholders and interested individuals.

This IFMP could help inform any SARA-compliant documents that would be required if walrus was added to the List of Wildlife Species at Risk on SARA.

CITES

The Atlantic walrus is listed on Appendix III of the Convention on International Trade in Endangered Species (CITES). As such, anyone wishing to export walrus parts or derivatives from Canada must obtain an export permit from the Canadian CITES administration. A non-detriment finding (indicating that levels of export are not detrimental to the survival of the species in the wild) is not required for species on Appendix III of CITES.

In 2009 and 2012 the United States considered submitting a proposal to up-list walrus to Appendix II of CITES based on the lack of information around the management of the species (e.g. sustainable harvest levels) and population species information (e.g. population abundance estimates). If listed on Appendix II of CITES, a non-detrimental finding (NDF) decision from the DFO Scientific Authority would be required to obtain a CITES Export/Re-export permit to export walrus products internationally.

Shared Stocks: Nunavik

Harvesting of the Hudson Bay-Davis Strait and South and East Hudson Bay stocks occurs in both the Nunavut Settlement Area and Nunavik Marine Region. As there are no population abundance estimates for these two stocks, the existing regulatory regime and quotas identified in the *Fisheries Act* and the *Marine Mammal Regulations*, and provisions in the Nunavut Agreement and the Nunavik Inuit Land Claims Agreement would continue to apply.

Shared Stocks: Greenland

Some stocks of Atlantic walrus inhabit and are harvested in both Canadian and Greenland waters. As such, it is important that discussions on management and sustainable harvesting occur between the two countries.

5. Objectives

A number of objectives were established for the walrus fishery. Long term objectives guide the management of the fishery and may be categorized as stock conservation, ecosystem, shared stewardship and social, cultural and economic objectives. Each long term objective is supported by one or more short term objectives. Various co-management organizations may take the lead in developing specific actions to address certain objectives.

Table 3. Long and Short-Term Objectives for the Walrus Fishery in the Nunavut Settlement Area

Objectives	
<u>Long-term:</u>	<u>Short-term:</u>
<i>Stock Conservation</i>	
Maintain vital, healthy walrus stocks and populations through sustainable use and effective fishery management consistent with the wildlife harvesting and management provisions under the Nunavut Agreement.	<ul style="list-style-type: none"> • Improve knowledge of Atlantic walrus biology, abundance and distribution. • Conduct surveys of remaining walrus stocks to obtain abundance estimates. • Use local knowledge/TEK/IQ in aerial survey designs and use local community members in conducting the surveys • Develop training materials for Inuit harvesters to maximize harvest and minimize losses. • Develop communication materials to inform elders, harvesters and community members on research methods, activities and results. • Develop/enhance monitoring program to reduce struck and lost, including an assessment of harvesting methods and equipment, and collection of data on rates of struck and loss.
Take a precautionary approach to fishery decisions for walrus stocks or populations.	<ul style="list-style-type: none"> • Given uncertainties related to walrus stocks, take a precautionary approach to establishing TAHs and BNLs for each walrus stock or population.
<i>Ecosystem</i>	
Protection of walrus habitat.	<ul style="list-style-type: none"> • Continue to identify and document traditional ecological knowledge of important walrus habitats. • Investigate and assess threats resulting from human activities (e.g. shipping

	<p>routes, sonar, noise disturbance, and tourism).</p> <ul style="list-style-type: none"> • Support research into the effects of invasive species on walrus and walrus habitat.
<i>Shared Stewardship</i>	
Promote collaboration, participatory decision-making and shared responsibilities with resource users, co-management organizations and other stakeholders.	<ul style="list-style-type: none"> • Conduct IFMP evaluations with walrus working groups. • Develop sport hunt guidelines. • Develop appropriate guidelines for activities that could negatively affect walrus. Once TAH/BNLs are established for walrus stocks, co-management organizations to implement the shared responsibilities in accordance with land claims agreements, the <i>Fisheries Act</i>, and its regulations. • Develop and/or participate in more formalized discussions with Greenland on the management of shared stocks.
<i>Social, Cultural and Economic</i>	
Promote traditional Inuit harvesting techniques and practices within communities.	<ul style="list-style-type: none"> • Develop and/or enhance training programs for inexperienced hunters.
Promote and maintain vital, healthy, walrus populations capable of sustaining harvesting needs.	<ul style="list-style-type: none"> • Increase awareness of the importance of walrus to public, communities, and stakeholders. • Include IQ in all policies and program development. • Promote territorial health programs aimed at food safety.
Maintain access to international markets for the export of walrus products.	<ul style="list-style-type: none"> • Demonstrate harvest levels and practices are sustainable. • IFMP in place.
<i>Compliance</i>	
Support effective fisheries management through a defined compliance program.	<ul style="list-style-type: none"> • Conduct a risk assessment of compliance issues. • Develop a variety of compliance activities and tools to address the identified risks. • Support Communities in the development of by-laws related to walrus or activities that may affect walrus.

6. Access and Allocation

Upon ratification of the NA in 1993, all existing restrictions or quotas on the amount of wildlife that could be harvested within the NSA were retained and deemed to have been established by the NWMB.

6.1 Where a Total Allowable Harvest *has not* been established

Unless a TAH has been established, an individual Inuk may harvest up to four (4) walrus in a year without a licence (MMR s. 6(1) (c)), except where community quotas exist (MMR s.26). Annual quotas have been set for the communities of Coral Harbour (60), Sanikiluaq (10), Arctic Bay (10) and Clyde River (20).

6.1.1 Sport Hunt

Marine Mammal Fishing Licences may be issued for non-beneficiaries to participate in walrus sport hunts (MMR s.4) provided there is support from the local HTO and annual approval from the NWMB based on its *Interim NWMB Sport Hunt Policy*. Sport hunters must provide detailed harvest reporting directly to DFO. The full Walrus Sport Hunt Policy can be found in Appendix 3.

6.1.2 Harvest Reporting

Harvest information is provided by Inuit hunters to the HTOs, which is then relayed to DFO (MMR s. 17; *Fisheries Act* s. 61; NA s. 5.7.43). Appendix 1 provides information on annual quotas and landed catch for communities that have harvested walrus. These numbers are not corrected for hunting losses. A Fishery Officer will notify the community and HTO when the quota has been reached and will close the fishery (MMR s. 12, 26).

6.2 Where a Total Allowable Harvest *has* been established:

The NWMB is in the process of establishing Total Allowable Harvest (TAH) levels and Basic Needs Levels (BNL) for walrus. In 2013, the Minister of Fisheries and Oceans accepted the NWMB's decision to establish the BNL for beluga, narwhal and walrus in the NSA to be equal to the levels of TAH for those species. Therefore, since the BNL is the first demand on the TAH, Inuit will always have the right to the entire TAH. RWOs and HTOs are responsible for allocating this BNL/TAH, as well as regulating harvesting practices and techniques among their members, including the use of NQLs.

Article 40 of the NA will be considered for other Inuit or aboriginal groups that may demonstrate traditional use of walrus in the NSA.

6.2.1 Total Allowable Harvests

Total Allowable Harvest levels have been established for the following stocks:

Table 4. Total Allowable Harvests established for walrus stocks/management units in the eastern Canadian Arctic

Population	Stock/ Management Unit	Harvesting Community	TAH	Community Harvest Level
High Arctic	Baffin Bay /AW-01	Grise Fiord	To be established	
	West Jones Sound / AW-02	Grise Fiord	To be established	
	Penny Strait- Lancaster Sound /AW-03	Arctic Bay Pond Inlet Resolute	To be established	
Central Arctic	Foxe Basin / AW-04	Hall Beach Igloolik	To be established	

*see Figure 2 for a map of Atlantic walrus by stocks and management units.

6.2.2 Allocation of the TAH:

As identified in the NA, the RWOs will be responsible for allocating annual regional BNL, which in the case of walrus will be the TAH, to their respective community HTOs, regulating their members and fulfilling other wildlife co-management obligations in accordance with the NA. The community HTOs will be responsible for allocating and enforcing the community BNL (community harvest limit) among members, and generally the management of harvesting among members (see Figure 3).

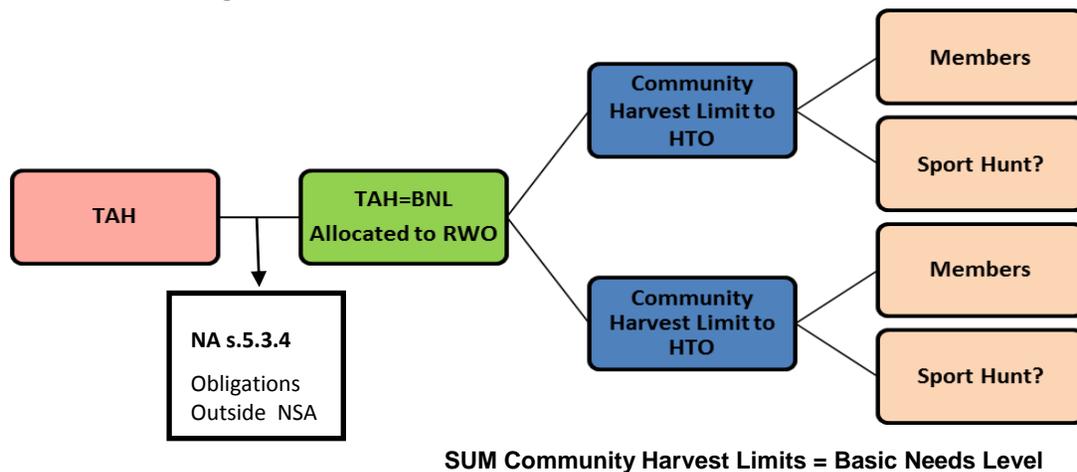


Figure 3. Allocation of the Total Allowable Harvest (TAH) and Basic Needs Level (BNL)

Where a TAH has been established for a walrus management unit, the combined annual community harvest limits for that management unit shall not exceed the TAH.

6.2.3 Sport Hunt

An assignment under section 5.7.34 (b) of the NA is used to authorize walrus sport hunts to a person qualified to harvest walrus under the laws of general application. Under this section, a person authorized to harvest walrus under a licence may be assigned part or all of a share of the total allowable harvest by an Inuk, RWO or HTO. Through the assignment provisions, an Inuk, an HTO or a RWO may assign its share of the TAH to a walrus sport hunt, if so desired, so long as the established annual total allowable harvest for that particular management unit is not exceeded.

An assignment under Article 5 of the NA must be evidenced by documentation containing information on both the assignor, and the assignee. Once the required documentation is received by DFO, the Minister may issue a Walrus Marine Mammal Fishing Licence (MMR s.4). The full Walrus Sport Hunt Policy can be found in Appendix 3.

6.2.4 Post-Harvest Walrus Tag

For management units where a TAH has been established.

The Post-Harvest Walrus Tag is an important management tool for RWOs and HTOs to be able to allocate and account for harvesting among their members. Where a TAH has been established, DFO will issue Post-Harvest Walrus Tag to the RWO and/or HTOs in the amount equal to the annual harvest level for the corresponding management unit. Post-Harvest Walrus Tags will be allocated by the RWO/HTO and will be proof of allocation to a share of one walrus from the walrus TAH for a particular management unit. This forms part of the walrus management system in which RWOs and HTOs decide on community allocations, in the form of community harvest limits.

The Post-Harvest Walrus Tag is not a licence to hunt and will be issued without fee or administrative charge. A Walrus Harvest Tag system will assist in:

- Evidencing a person's authority to harvest/possess wildlife appropriate to the particular Management Unit;
- Regulating the allocation of a share of TAH, including the BNL, as allocated by the RWO and/or HTO;
- Collecting information in relation to harvesting activities;
- Regulating harvesting activities in relation to sport hunt assignment.

6.2.5 Harvest Reporting and Monitoring

Hunters provide information on their hunts to their HTO. HTOs will provide the information to the RWO and DFO in a timely manner. A Fishery Officer will notify the community and HTOs when the harvest level has been reached for a management unit and will close the fishery (MMR s. 12, 26).

- Harvest information must be reported (MMR s. 17; Fisheries Act s. 61; NA s. 5.7.43):

7. Management Measures for the Duration of the Plan

The management measures identified in the IFMP outline the controls or rules adopted for the walrus fishery for the purposes of stock conservation and sustainable management. These measures are based on the *Fisheries Act*, *the Marine Mammal Regulations* and the NA.

The *Marine Mammal Regulations* (MMR) include provisions related to the hunting, movement, and sale of walrus products. These provisions include requirements for hunters to hunt a walrus in a manner that is designed to kill it quickly, to make reasonable efforts to retrieve a killed or wounded walrus without delay and to have all necessary equipment on hand to retrieve it. Abandoning, discarding or wasting edible parts of walrus is prohibited.

Domestic movement of walrus products requires a DFO Marine Mammal Transportation Licence. Indians or Inuit who land walrus in one jurisdiction and are returning to their home in another jurisdiction are exempted from this requirement. International trade of walrus products requires a CITES) Export/Re-export Permit.

A full list of the management measures can be found in Appendix 2.

8. Shared Stewardship Arrangements

The Atlantic walrus IFMP was initiated and developed by the Foxe Basin Walrus Working Group in 2007 and the High Arctic-Baffin Bay Walrus Working Group in 2009. Participation on the Working Groups includes representatives from each of the HTOs, the Qikiqtaaluk Wildlife Board (co-chair), NTI and DFO. Staff from the NWMB have attended Working Group meetings when possible. The Working Groups invite subject-matter experts to provide additional information in the development of the IFMP as required. This has included representatives from the mining industry and community elders.

The Walrus Working Groups produced Terms of References to help guide the development of the IFMP. Meetings have been held in the communities of Resolute, Grise Fiord, Arctic Bay, Pond Inlet, Hall Beach and Igloolik to obtain the views of elders and community members on issues related to walrus management, including the identification of fishery issues and long and short term objectives for the fishery.

There are a number of different ways that the objectives for the fishery may be achieved, such as the effective implementation of the management measures identified in Appendix 2. Other measures may be initiated by co-management organizations through the development of by-laws or guidelines. Once developed, these would be included as an Appendix of the IFMP.

9. Compliance Plan

The Conservation and Protection program promotes and maintains compliance with legislation and regulations implemented to achieve the conservation and sustainable use of Canada's aquatic resources, and the protection of species at risk, fish habitat and oceans. Conservation and Protection works closely with internal partners to evaluate risks to fish and fish habitat to ensure program delivery meets Departmental objectives.

Fishery Officers monitor fishing and related activities to ensure compliance with the *Fisheries Act* and its regulations as well as several other federal statutes. Fishery Officers investigate violations of these acts and regulations and resolve them by applying various compliance options.

Regional Compliance Program Delivery

Fishery Officers in the Eastern Arctic Area monitor the Atlantic walrus fishery and the trade of Atlantic walrus products for compliance with the MMR which are made pursuant to the *Fisheries Act*. Conservation and Protection works closely with internal and external partners to consult on and or resolve compliance issues.

Fishery Officers promote compliance with regulations by working with user groups (e.g. hunters and buyers) and other stakeholders to better understand the laws. Fishery Officers engage hunters and people involved in the marine mammal trade industry to provide information that increases awareness and helps address compliance and conservation concerns in the Atlantic walrus fishery. Increased education and awareness will help protect the legal market and trade of Atlantic walrus ivory and parts.

Current Compliance Issues

Specific concerns may arise from: failing to follow conditions of licence for the sport hunt, non-reporting or misreporting of harvest, wastage, illegal harvest or illegal trade and exporting of Atlantic walrus ivory and or parts. Patrols have been conducted in Atlantic walrus hunting areas and communities to monitor these concerns.

Compliance Strategy

Conservation and Protection collaborates with internal and external partners to identify and prioritize compliance issues and works with resource managers to address them.

Fishery Officers focus efforts on:

- compliance with legislation, including sport hunt licence conditions;
- tusk traceability / illegal trade of ivory tusks;
- licence inspections.

Operational Activities include:

- Monitoring of Atlantic walrus sport hunts;
- Education of user groups and stakeholders;
- Inspections of Atlantic walrus products from harvest to export;

- Cross reference of harvest data with trade data;
- Liaise with Nunavut Conservation Officers and other territorial or provincial law enforcement agencies.

Table 5. Compliance Focus and Strategies for Atlantic Walrus in the Nunavut Settlement Area

COMPLIANCE FOCUS		
Issue	Regulation	Strategy
Monitor harvest and enforce regulations	MMR: Sections 6, 7, 8, 9, 10, 11, 13, 15, 17, 25 and 26	<ul style="list-style-type: none"> • Hunt monitoring • Inspections • Licences
Harvest reporting and quota compliance	MMR: Sections 6, 12, 17 and 26 . Fishery (General) Regulations: Sections 6, 7, 9, 11, 15 and 22	<ul style="list-style-type: none"> • Inspections • Licence cross referencing and issuance • Variation Orders
Tusk traceability	MMR: Sections 15 and 16	<ul style="list-style-type: none"> • Inspections

10. Performance Review

This Atlantic walrus IFMP was developed through an extensive consultative process including the NWMB, NTI, RWOs, HTOs, walrus hunters and community members. DFO will continue to consult with these groups throughout the life of this IFMP as circumstances require.

Annual post season review sessions will be conducted with co-management organizations and as circumstances require. Progress on achieving the short term objectives and effective implementation of management measures identified in the Plan will be reviewed. Recommendations to improve management of the walrus fishery will be developed to meet the long term objectives of maintaining a sustainable walrus fishery.

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Glossary of Terms

Abundance: Number of individuals in a stock or a population.

Basic Needs Level (BNL): Means the level of harvesting by Inuit identified in Sections 5.6.19 to 5.6.25 of the Nunavut Agreement.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC): Committee of experts that assess and designate the conservation status of species that may be at risk in Canada.

Convention on International Trade in Endangered Species (CITES): An international agreement to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Harvest Limit: A maximum number of walrus permitted to be landed by a community or from a stock/ management unit in a given time period.

Inuit Qaujimajatuqangit: Is a body of knowledge and unique cultural insights of Inuit into the workings of nature, humans and animals.

Marine Mammal Regulations (SOR/93-56): Federal regulations under the *Fisheries Act* that govern the management and control of fishing for marine mammals and related activities in Canada or in Canadian fisheries waters.

Marine Mammal Fishing Licence: Licence required to fish for marine mammals under the Marine Mammal Regulations (s. 5).

Marine Mammal Transport Licence (MMTL): Licence required for transport of marine mammal parts and products from one province (or territory) to another.

Non-quota Limitation (NQL): Means a limitation of any kind, except a total allowable harvest, and may include a limitation on season of harvest, sex of wildlife, size of wildlife, age of wildlife or method of harvest.

Population: A reproductively isolated group of animals, sharing a habitat.

Potential Biological Removal (PBR): A statistical method currently used by DFO Science to provide recommendations on sustainable harvest levels.

Precautionary Approach (PA): Applying caution to management actions when scientific knowledge is uncertain and not relying on the absence of adequate scientific information as a reason to postpone action to avoid serious harm to wildlife stocks or their ecosystems.

Quota: The number of walrus that can be harvested by a community, as set out in Column 1, Section 26, or by an individual, as per Section 6. (1)(c) of the *Marine Mammal Regulations*.

Species at Risk Act (SARA): The Canadian Act to prevent wildlife species from becoming extinct and secure the necessary actions for their protection and recovery in Canada.

Stock: Refers to a resource management unit. For walrus, it refers to a geographically segregated group of animals that are subject to hunting.

Total Allowable Harvest (TAH): For a stock or population this means an amount of wildlife able to be lawfully harvested as established by the NWMB pursuant to Sections 5.6.16 to 5.6.18 of the NA.

Total Allowable Landed Catch (TALC): A sustainable harvest level recommendation for a stock or population developed by applying an estimate of harvest loss rates as a correction factor in the PBR calculation.

Traditional Ecological Knowledge (TEK): A cumulative body of knowledge handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment. Inuit hold traditional knowledge on walrus.

Appendix 1. Landed Catch (Subsistence Harvest and Licenced Sport Hunts) of Walrus in Nunavut 2000-2016

Area of Harvest (Stock and Management Unit)	Quota #	Settle-ment	Individual	2000/01		2001/02		2002/03		2003/04		2004/05		2005/06		2006/07		2007/08		2008/09		2009/10		2010/11		2011/12		2012/13		2013/14		2014/15		2015/16		2016/17			
				Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb	Sp	Sb		
Hudson Bay- Davis Strait (AW-05)																																							
Clyde River	20			--	0	--	1	--	0	--	0	--	2	--	NR	--	1	--	0	--	NR	--	NR	--	NR	--	0	--	0	--	0	--	0	--	3	--	0		
Qikiqtarjuaq		4		--	0	0	1	--	33	--	1	--	0	0	NR	NR	9	--	6	--	NR	--	NR	--	6	--	5	--	10	--	0	--	0	--	7	--	4		
Pangnirtung		4		--	15	--	19	--	9	--	15	--	NR	--	NR	--	15	--	NR	--	10	0	NR	--	NR	--	NA	--	7	--	0	--	4	--	NR	--	25		
Iqaluit		4		--	19	--	7	--	1	--	1	--	NR	--	10	--	9	--	11	--	NR	--	14	--	14	--	14	--	19	--	6	--	1	--	11	--	10		
Kimmirut		4		--	0	--	0	--	4	--	7	0	4	--	6	NR	2	--	NR	--	NR	--	NR	--	7	--	0	--	1	--	0	--	2	--	2	--	3		
Chesterfield In.		4		--	4	--	NR	--	NR	--	4	--	3	--	3	--	0	--	2	--	0	--	NR	--	NR	--	7	--	4	--	0	--	15	--	9	--	5		
Cape Dorset		4		0	46	1	10	0	5	--	1	0	NR	0	6	NR	25	--	NR	--	NR	--	NR	--	1	--	2	0	0	0	0	0	0	--	0	--	2		
Coral Harbour	60			0	1	2	NR	2	28	--	10	--	NR	2	15	3	15	NR	4	4	NR	9	6	8	NR	4	7	3	12	7	15	7	15	7	20	9	42		
Repulse Bay		4		--	1	--	NR	0	20	--	NR	--	3	--	6	--	6	--	12	--	NR	--	4	--	NR	--	0	--	5	--	0	--	0	--	12	--	12		
Arviat		4		--	1	--	NR	--	3	--	5	--	NR	--	1	--	0	--	0	--	0	--	NR	--	0	0	--	0	--	0	--	0	--	0	--	0	--	1	
Rankin Inlet		4		--	7	--	NR	--	12	--	2	--	2	--	3	--	13	--	6	NR	3	--	6	--	2	--	4	--	6	--	0	--	0	--	15	--	2		
Whale Cove		4		--	0	--	NR	--	1	--	NR	--	NR	--	NR	--	0	--	0	--	NR	--	NR	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0
TOTALS				0	94	3	38	2	116	0	46	0	14	2	50	3	95	0	41	4	13	9	30	8	30	4	39	3	64	7	21	7	37	7	79	9	106		
Total Reported Harvest (Sp + Sb)				94		41		118		46		14		52		98		41		17		39		38		43		67		28		44		86		115			
Baffin Bay (AW-01) and West Jones Sound (AW-02)																																							
Grise Fiord		4		--	4	--	2	--	3	--	7	--	5	--	2	--	5	--	4	NR	NR	--	7	--	2	--	4	--	NR	--	0	--	16	--	1	--	0		
TOTALS				0	4	0	2	0	3	0	7	0	5	0	2	0	5	0	4	0	0	0	7	0	2	0	4	0	0	0	0	0	16	0	1	0	0		
Penny Strait - Lancaster Sound (AW-03)																																							
Arctic Bay	10			--	2	--	2	--	0	--	0	--	1	--	NR	--	0	--	1	--	NR	--	0	--	1	--	0	--	0	--	0	--	0	--	0	--	0		
Resolute Bay		4		--	0	--	NR	--	1	--	6	--	4	--	1	--	0	--	1	--	NR	--	2	--	3	0	2	--	2	--	0	--	1	--	0	--	0		
Pond Inlet		4		--	5	--	3	--	0	--	1	--	0	--	1	--	0	--	0	--	NR	--	NR	--	3	--	0	--	NR	--	0	--	0	--	0	--	1		
TOTALS				0	7	0	5	0	1	0	7	0	5	0	2	0	0	0	2	0	0	0	2	0	7	0	2	0	2	0	0	0	1	0	1	0	1		
Foxe Basin (AW-04)																																							
Hall Beach		4		1	87	0	40	4	1	1	87	NR	66	3	75	4	100	--	35	--	33	NR	70	0	75	2	33	1	107	10	NR	2	92	11	36	6	110		
Igloolik		4		6	168	12	40	10	NR	14	97	10	NR	12	100	2	184	NR	54	74	--	89	--	141	6	95	4	107	0	NR	0	9	--	NR	--	129			
TOTALS				7	255	12	80	14	1	15	184	10	66	15	175	6	284	0	89	0	107	0	159	0	216	8	128	5	214	10	0	2	101	11	36	6	239		
Total Reported Harvest (Sp + Sb)				262		92		15		199		76		190		290		89		107		159		216		136		219		10		103		47		245			
Southand East Hudson Bay (AW-05)																																							
Sanikiluaq	10			--	1	--	0	--	15	--	3	--	NR	--	NR	--	2	--	NR	--	0	--	2	--	2	--	2	--	3	--	0	--	0	--	1	--	0		
TOTALS				0	1	0	0	0	15	0	3	0	0	0	0	0	2	0	0	0	0	0	2	0	2	0	2	0	3	0	0	0	0	0	1	0	0		
Kitikmeot Region																																							
Bathurst Inlet		4																																					
Cambridge Bay		4																																					
Gjoa Haven		4																																					
Kugaaruk		4																																					
Kugluktuk		4																																					
Taloyoak		4																																					
Umingmaktok		4																																					
TOTALS				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3									
NU Reported Totals				7	361	15	125	16	136	15	247	10	90	17	229	9	386	0	136	4	120	9	200	8	257	12	175	8	283	17	21	9	155	18	118	15	346		
NU Total Reported Harvest (Sp + Sb)				368		140		152		262		100		246		395		136		124		209		265		187		291		38		164		136		361			
Salluit ~																14		24		17	--	7	--	14		11	0	NR	0	NR	0	NR	0	NR	0	NR			

~ The Nunavik community of Salluit conducts licensed sport hunts within the Area of Equal Use and Occupancy described in S. 40 of the Nunavut Land Claims Agreement. Salluit's sport hunts are licenced by the Eastern Arctic Area office.

(Legend on following page)

Legend:

¥	see Marine Mammal Regulations (SOR/93-56) S. 6 (1)(c), S. 6 (2)(c), and S. 26.
Sp	Licensed Sport Harvest - a regulated sport hunt is conducted in some Nunavut communities. The NWMB reviews walrus sport hunt applications annually, and transmits its approval decisions to DFO. Approved sport hunts are conducted under DFO license and landings are reported to the DFO Eastern Arctic Area Office, Iqaluit. In cases where sport hunts were approved but not conducted, the landings are reported as '0'. 'NR' if information has not yet been received
Sb	Subsistence Harvest - 'NR' indicates the community has not reported its subsistence walrus harvest. DFO compiles information on subsistence walrus harvests by telephone calls to community Hunters and Trappers Organizations, or the local Government of Nunavut Wildlife Officers.
---	Community does not conduct sport hunts
Notes	
	Cresswell Bay is associated to Resolute Bay - there used to be hunt camps there
	Pangnirtung Subsistence harvest 2001 was originally reported as 19 +/- 1; this value was replaced with the average (19)
	Coral Harbour Subsistence harvest 2002 was originally reported as 25-30; this value was replaced with the average (28).
	Coral Harbour Subsistence harvest 2009 was originally reported as 5-6; this value was replaced with the average (6).
	Qikiqtarjuaq Subsistence harvest 2010 was originally reported as 5-6; the value was replaced with the average (6).
	Hall Beach Subsistence harvest 2010 was originally reported as 70-80; the value was replaced with average (75).
	Qikiqtarjuaq Subsistence harvest 2011 was originally reported as 4-5; the value was replaced with average (5).
	Hall Beach Subsistence harvest 2011 was originally reported as 30-35; the value was replaced with average (33).
	Igloolik HTA implemented a two year moratorium on walrus sport hunts and tourism. Decision was made November 30, 2007.
Harvest season runs from April 1 to March 31	

Appendix 2. Overview of Current Management Measures for the Atlantic Walrus Fishery in the Nunavut Settlement Area

Management Measure	Applicable Legislation/ Regulation
Harvest Levels	<ul style="list-style-type: none"> • Unless a TAH is in place, an Inuk may, without a licence, fish for food, social or ceremonial purposes for four (4) walrus in a year except where community quotas exist (Coral Harbour (60), Sanikiluaq (10), Arctic Bay (10) and Clyde River (20)). (MMR, s. 6 and 26). • Where a TAH has been established, annual harvest may not exceed the total allowable harvest level established for a particular management unit.
Monitoring and Reporting	<ul style="list-style-type: none"> • Harvest information must be reported (MMR s. 17; Fisheries Act s. 61; and the NA s. 5.7.43). • When the quota or total allowable harvest level is reached, the community will be notified and the fishery will be closed (MMR s. 12 and 26).
Licences	<ul style="list-style-type: none"> • The Minister may issue a marine mammal fishing licence (MMR s. 4). • The Minister may issue a licence for certain activities such as for tagging (satellite tracking), live capture, biopsies (MMR s. 11).
Post-Harvest Walrus Tag	<ul style="list-style-type: none"> • Where a TAH has been established, DFO will issue Post-Harvest Walrus Tags to the RWO and/or HTOs in the amount equal to the annual harvest level for the corresponding management unit. These tags will be issued without fee or administrative charge and are not to be considered a licence to hunt.
Humane Harvesting	<ul style="list-style-type: none"> • Hunters shall only kill a walrus in a manner that is designed to kill it quickly (MMR s. 8). • No person shall disturb a walrus except when hunting for walrus (MMR s. 7).
Reducing Loss Rates	<ul style="list-style-type: none"> • Hunters must have all necessary equipment on hand to retrieve a hunted walrus (MMR s. 9). • Hunters that kill or wound a walrus must make all reasonable efforts to retrieve it without delay, must not abandon or discard it, or waste any edible part of a walrus (MMR s. 10). • Hunters are to use a rifle or shotgun with the following restrictions: a) a rifle and non-full metal jacketed ammunition that produce a muzzle energy of not less than 1,500 foot pounds; or b) a shotgun and rifled slugs that produce a muzzle energy of

	not less than 1,500 foot pounds (MMR s. 25).
Sale and Transportation	<ul style="list-style-type: none"> • A Marine Mammal Transportation Licence is required to transport walrus or walrus parts from one province to another (MMR s. 16). • A CITES Export Permit is required to transport walrus products outside of Canada.
Habitat/Ecosystem Protection	<ul style="list-style-type: none"> • <i>Fisheries Act s. 35</i>: prohibits any person from carrying on any work, undertaking or activity that results in serious harm to walrus that are part of a commercial, recreational or Aboriginal fishery, unless authorized by the Minister.

Appendix 3. Walrus Sport Hunt Policy in the Nunavut Settlement Area

A. Where a Total Allowable Harvest has been established for a walrus stock or population

Where the Nunavut Wildlife Management Board (NWMB) and the Minister of Fisheries and Oceans Canada (DFO) establish a total allowable harvest (TAH) for a stock or population of walrus in the Nunavut Settlement Area (NSA), the assignment provisions of the Nunavut Agreement (NA) shall be used to assign part or all of the TAH to a walrus sport hunt.

In 2013, the Minister of DFO accepted the NWMB's decision to establish the basic needs levels (BNL) for beluga, narwhal and walrus in the NSA to be equal to the levels of total allowable harvest (TAH) established or modified by the NWMB. As per the NA, Hunters and Trappers Organizations (HTO) and Regional Wildlife Organizations (RWOs) are responsible for allocating their community's and regional TAH to their members and the assignment to non-members (e.g. walrus sport hunt) (s. 5.7.3 and 5.7.6).

An assignment under section 5.7.34 (b) of the NA is used to authorize walrus sport hunts to a person qualified to harvest walrus under the laws of general application, so long as the established annual total allowable harvest for that particular management unit is not exceeded.

Under sections 5 and 6 of the Marine Mammal Regulations, no person other than an Indian, Inuk, or beneficiary, may fish for walrus except under the authority of a licence.

If an HTO wishes to assign part or all of a share of their community's allocation of the TAH for walrus sport hunting purposes, the following process will be undertaken to obtain a valid Marine Mammal Fishing Licence prior to engaging in walrus hunting activities:

The HTO will:

1. Complete and submit the Sport Hunt Application package to DFO.
2. Upon receiving the completed documents and payment of fee, the Minister of DFO may issue a Marine Mammal Fishing Licence for walrus pursuant to section 4(1) of the Marine Mammal Regulations.
3. All conditions identified on the Marine Mammal Fishing Licence must be followed by the assignee (sport hunter). The Marine Mammal Regulations (MMR) include provisions related to the hunting, movement, and sale of walrus products. These provisions include requirements for hunters to report on harvesting activities, to collect biological samples, to hunt in a manner that is designed to kill the walrus quickly, to make reasonable efforts to retrieve a killed or wounded walrus without delay and to have all necessary equipment on hand to retrieve it. Abandoning, discarding or wasting edible parts of walrus is prohibited.

4. Any HTO by-laws that are in place governing walrus hunting will also be followed by the assignee (sport hunter).
5. A DFO Marine Mammal Transportation Licence is required to transport walrus or walrus parts from one province to another (MMR s. 16(1)). These are free and available from a DFO Fishery Officer or from the community's local Conservation Officer.
6. Anyone wishing to export walrus parts or derivatives from Canada must obtain an export permit from the Canadian CITES administration. These permits can take several weeks to obtain. For more information, contact the DFO CITES Permitting Officer at: (888) 641-6464.

B. Where a TAH has not been established for a walrus stock or population

Each year the Nunavut Wildlife Management Board (NWMB) requests applications (Request to Conduct Walrus Sport Hunts) from communities and individuals for walrus sport hunts. These applications are reviewed by the NWMB according to its Interim Policy for Walrus Sport Hunts. Decisions of the NWMB are forwarded to the Minister of Fisheries & Oceans Canada (DFO). If approved, and upon payment of fee, the Minister will provide the applicant with a Marine Mammal Fishing Licence under section 4(1) of the Marine Mammal Regulations. The process is detailed in the steps below:

1. Request to conduct walrus sport hunt:

Each fall, the NWMB seeks applications from individuals and communities who wish to conduct walrus sport hunts for the following walrus harvesting season (April 1-March 31). Applicants are required to submit a completed “Request to Conduct Walrus Sport Hunt” form that includes information on the hunt plan, outfitter information, a safety plan, and evidence of support from the local HTO.

2. NWMB review of applications:

The NWMB reviews the Requests to Conduct Walrus Sport Hunts against its Interim Policy for Walrus Sport Hunts. This Policy seeks to consider conservation concerns, health and safety, humane harvesting and minimization of waste, and long-term economic, social and cultural interests of Inuit harvesters, in making sport hunt decisions.

3. NWMB decision to DFO:

Decisions of the NWMB in relation to the walrus sport hunt are forwarded to the Minister of DFO as per the NA. Additional conditions may be included with the NWMB decision, such as the assignment of each walrus to a sport hunter is made in writing and that individuals applying for walrus sport hunts obtain written support from their local HTO.

4. DFO review:

The decisions of the NWMB are forwarded to the Minister of DFO for review. If approved, DFO will notify successful applicants. Upon receiving the completed “Assignment Document”, “Hunter Information Sheet”, and payment of fee, the Minister of DFO will issue a Marine Mammal Fishing Licence for walrus pursuant to section 4(1) of the Marine Mammal Regulations.

5. Marine Mammal Fishing Licence:

All conditions identified on a Marine Mammal Fishing Licence must be followed. Such conditions include: when and where the hunt is authorized to take place, by whom, their country of origin, quotas, gear type to be used, as well as any specific conditions related to the hunt, such as the reporting of all hunts to the local DFO office, firearm muzzle velocity requirements, the total number of strikes allowed, as well as biological sampling requirements.

6. Any HTO by-laws that are in place governing walrus hunting should be followed by the sport hunter.
7. A DFO Marine Mammal Transportation Licence is required to transport walrus or walrus parts from one province to another (MMR s. 16(1)). These are free and available from a DFO Fishery Officer or from a local Conservation Officer.
8. Anyone wishing to export walrus parts or derivatives from Canada must obtain an export permit from the Canadian CITES administration. These permits can take several weeks to obtain. For more information, contact the DFO CITES Permitting Officer at: (888) 641-6464.

Appendix 4. Geographic coordinates of boundaries for Atlantic walrus stocks within the Nunavut Settlement Area.

Population	Stock/ Management Unit	Point	x (Longitude)	y (Latitude)	
Marine waters enclosed by the following coordinates:					
High Arctic	Baffin Bay AW-01	1	-54.24297530150	74.03754489970	
		2	-54.24297530150	74.03754489970	
		3	-54.24297530150	74.03754489970	
		4	-54.24297530150	74.03754489970	
		5	-54.24297530150	74.03754489970	
		6	-54.24297530150	74.03754489970	
		7	-54.24297530150	74.03754489970	
		8	-54.24297530150	74.03754489970	
	West Jones Sound AW-02	1	-84.96233489570	75.30730634850	
		2	-84.96233489570	75.30730634850	
		3	-84.96233489570	75.30730634850	
		4	-84.96233489570	75.30730634850	
		5	-84.96233489570	75.30730634850	
		6	-84.96233489570	75.30730634850	
		7	-84.96233489570	75.30730634850	
		8	-84.96233489570	75.30730634850	
	Penny Strait – Lancaster Sound AW-03	1	-73.49375430420	71.86979037450	
		2	-73.49375430420	71.86979037450	
		3	-73.49375430420	71.86979037450	
		4	-73.49375430420	71.86979037450	
		5	-73.49375430420	71.86979037450	
		6	-73.49375430420	71.86979037450	
		7	-73.49375430420	71.86979037450	
		8	-73.49375430420	71.86979037450	
		9	-73.49375430420	71.86979037450	
		10	-73.49375430420	71.86979037450	
		11	-73.49375430420	71.86979037450	
	Central Arctic	Foxe Basin AW-04	1	-70.57925897140	67.49418275430
			2	-70.57925897140	67.49418275430
			3	-70.57925897140	67.49418275430
			4	-70.57925897140	67.49418275430
5			-70.57925897140	67.49418275430	
6			-70.57925897140	67.49418275430	
7			-70.57925897140	67.49418275430	
8			-70.57925897140	67.49418275430	
Hudson Bay – Davis Strait AW-05		1	-54.20362912320	71.39690545840	
		2	-54.20362912320	71.39690545840	
		3	-54.20362912320	71.39690545840	

Population	Stock/ Management Unit	Point	x (Longitude)	y (Latitude)
		4	-54.20362912320	71.39690545840
		5	-54.20362912320	71.39690545840
		6	-54.20362912320	71.39690545840
		7	-54.20362912320	71.39690545840
		8	-54.20362912320	71.39690545840
Unknown	South and East Hudson Bay AW-06	1	-79.90028974730	60.68356082350
		2	-79.90028974730	60.68356082350
		3	-79.90028974730	60.68356082350
		4	-79.90028974730	60.68356082350
		5	-79.90028974730	60.68356082350
		6	-79.90028974730	60.68356082350
		7	-79.90028974730	60.68356082350
		8	-79.90028974730	60.68356082350
		9	-79.90028974730	60.68356082350
		10	-79.90028974730	60.68356082350

COSEWIC
Assessment and Status Report

on the

Peary Caribou
Rangifer tarandus pearyi

in Canada



THREATENED
2015

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada



COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2015. COSEWIC assessment and status report on the Peary Caribou *Rangifer tarandus pearyi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xii + 92 pp. (http://www.registrelep-sararegistry.gc.ca/default_e.cfm).

Previous report(s):

COSEWIC. 2004. COSEWIC assessment and update status report on the Peary caribou *Rangifer tarandus pearyi* and the barren-ground caribou *Rangifer tarandus groenlandicus* (Dolphin and Union population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 91 pp. (www.sararegistry.gc.ca/status/status_e.cfm).

Gunn, A., F.L. Miller and D.C. Thomas. 1979. COSEWIC status report on the Peary caribou *Rangifer tarandus pearyi* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 40 pp.

Miller, F.L. 1991. Update COSEWIC status report on the Peary caribou *Rangifer tarandus pearyi* In Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 124 pp.

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COSEWIC would like to acknowledge Lee Harding (SciWrite Environmental Services) for writing the status report on the Peary Caribou, *Rangifer tarandus pearyi*, in Canada, prepared under contract with Environment Canada. This report was overseen and edited by Justina Ray, Co-chair of the COSEWIC Terrestrial Mammals Specialist Subcommittee.

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Également disponible en français sous le titre Évaluation et Rapport de situation du COSEWIC sur le Caribou de Peary (*Rangifer tarandus pearyi*) au Canada.

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Peary Caribou — Photo (Peary Caribou in Svartfjeld Peninsula, Ellesmere Island, 2015). Photo credit: Morgan Anderson, Government of Nunavut.

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COSEWIC Assessment Summary

Assessment Summary – November 2015

Common name

Peary Caribou

Scientific name

Rangifer tarandus pearyi

Status

Threatened

Reason for designation

This subspecies of caribou is endemic to the Canadian Arctic Archipelago, living on the edge of plant growth in polar desert and arctic tundra environments. The current population is estimated at 13,200 mature individuals. From a population high of 22,000 in 1987, the species experienced a catastrophic die-off in the mid-1990s related to severe icing events in some parts of its range. The population was ca. 5,400 mature individuals in 1996, the lowest since surveys first commenced in 1961. Of four subpopulations, two are currently showing an increasing trend, one is stable, and the fourth had fewer than 10 individuals at the last count in 2005, with no evidence of any recovery. The overall population has experienced an estimated three-generation decline of 35%, but has been increasing over the past two decades. The highest-impact threats derive from a changing climate, including increased intensity and frequency of rain-on-snow events negatively affecting forage accessibility in winter, and decreased extent and thickness of sea ice causing shifts in migration and movement patterns.

Occurrence

Northwest Territories, Nunavut

Status history

The original designation considered a single unit that included Peary Caribou, *Rangifer tarandus pearyi*, and what is now known as the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. It was assigned a status of Threatened in April 1979. Split to allow designation of three separate populations in 1991: Banks Island (Endangered), High Arctic (Endangered) and Low Arctic (Threatened) populations. In May 2004 all three population designations were de-activated, and the Peary Caribou was assessed separately from the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. The subspecies *pearyi* is composed of a portion of the former “Low Arctic population”, and all of the former “High Arctic” and “Banks Island” populations, and it was designated Endangered in May 2004. Status re-examined and designated Threatened in November 2015.



COSEWIC
Executive Summary

Peary Caribou
Rangifer tarandus pearyi

Wildlife Species Description and Significance

Peary Caribou are the smallest North American caribou. They are mostly white with a slate back and a grey stripe down the front of the legs. In winter, the slate back may turn a dingy brown, and some individuals appear almost entirely white. Antler velvet is slate-coloured instead of brown like deer and other caribou. The antlers tend not to spread as wide as those of other caribou but otherwise they are similar. The skull has a short rostrum and high cranium. The hooves are short and wide. They are genetically distinct from other caribou in Canada.

Peary Caribou are integral components of Inuit and Inuvialuit culture and economy. As the only source of caribou meat for several Arctic communities, they are important in the subsistence economy of local communities, and represented in traditional crafts that are marketed and collected throughout Canada and internationally. Persisting at the limits of plant and animal existence, Peary Caribou are an integral part of Arctic biodiversity and increasingly important in the scientific study of ecosystem response to climate change.

Distribution

Peary Caribou are endemic to Canada in the Northwest Territories and Nunavut. They have the northernmost distribution of all caribou in North America, situated almost entirely within the Canadian Arctic Archipelago, with the exception of Baffin Island. Peary Caribou move relatively long distances, including annual migrations across sea ice, regular movements within multi-island home ranges and erratic large-scale movements among islands during severe winters. Four subpopulations are recognized, based on genetic evidence, extent of inter-island movements, and scientific and local expertise: 1) Banks-Victoria islands, 2) Prince of Wales-Somerset-Boothia, 3) Eastern Queen Elizabeth Islands, and 4) Western Queen Elizabeth Islands.

Habitat

The habitat of Peary Caribou is treeless Arctic tundra primarily within High and Middle Arctic tundra ecoregions. Most of the range can be characterized as a polar desert with short, cool summers and long, cold winters. The growing season is brief (50-60 days) and variable. Snow cover is generally present from September to May (Banks Island) or mid-late June (Melville Island). Land dominated by dry vegetation covers about 36% of the ice-free area within Peary Caribou range while the terrain ranges from relatively flat (south and west) to mountainous (north and east). The climate is also strongly regionalized with east-west and north-south gradients in precipitation and temperature, affecting primary productivity and forage availability. Above-ground plant biomass ranges from $< 100 \text{ g/m}^2$ (Queen Elizabeth Islands and parts of the Prince of Wales-Somerset group) to some areas (Banks Island and Prince of Wales Island) having up to $500\text{--}2000 \text{ g/m}^2$. Peary Caribou have a broad/varied diet and are versatile feeders with diet varying seasonally in relation to available forage and corresponding nutritional content. Essentially all historical Peary Caribou habitat is available and has not been lost or fragmented by industrial or other anthropogenic developments.

Biology

Peary Caribou have several adaptations to their Arctic environment such as compact body size for conserving heat, hooves that allow them to walk on and dig through wind-driven snow, and pelage that provides camouflage. They are adapted to limited plant growth with a highly compressed growing season and long periods of snow-covered frozen standing vegetation.

Peary Caribou are polygynous, living in small groups and maintaining a wide dispersion across the landscape, even during calving and rutting. They are thought to live approximately 15 years in the wild, and have widely variable vital rates. Cows usually produce their first offspring by 3 years of age; under conditions of high forage availability cows can calve every year but this is rare. Peary Caribou cows cope with occasional years of restricted forage access either by not becoming pregnant, or by weaning a calf prematurely. The intergeneration period (the average age of parents of the current year's cohort) cannot be precisely calculated, but is estimated at 9 years.

Population Sizes and Trends

Evaluating trends in abundance for Peary Caribou since the first surveys were conducted in the 1960s is made difficult by irregular frequency in surveys (in time and space), as well as changes in survey design and methodology. From 1961 to 2014, government agencies conducted a total of 154 aerial surveys to estimate Peary Caribou abundance throughout the Canadian Arctic. There has been no single year when the entire range has been surveyed.

The current population of Peary Caribou is estimated at about 13,200 mature individuals. In the early 1960s, when the first population counts were made, there were ca. 50,000 Peary Caribou. The population in 1987 was ca. 22,000 mature individuals. It reached its lowest known point in 1996 at ca. 5,400 animals following die-offs related to icing events that affected the Western Queen Elizabeth Islands subpopulation in particular. Numbers have increased since that time, but have not fully recovered. The Prince of Wales-Somerset-Boothia subpopulation, which comprised almost half of the known Peary Caribou population in 1987, began to decline in the 1980s, for reasons that remain ill-understood. Although the last survey was in 2006, there is no evidence for any recovery today. Banks-Victoria numbers have been increasing in the past decade, but not on Victoria Island. The two northern subpopulations (Western and Eastern Queen Elizabeth Islands) have increased overall since the mid-1990s, although baseline levels are not well known. The overall three-generation population (27 years) decline for Peary Caribou is estimated at 35%, while the two-generation trend is positive (ca. 142%).

Threats and Limiting Factors

The overall calculated and assigned threat impact is Very High-Medium for Peary Caribou. This wide range rank of threat impacts is due to the combined effect of the high number of mostly low-impact threats, and the considerable uncertainty, unpredictability, and potential overlap and interaction of most individual threats.

The highest-impact threat to Peary Caribou arises from the myriad effects of a changing climate, including increased intensity and frequency of severe weather events negatively affecting forage accessibility in the winters, and decreased extent and thickness of sea ice causing shifts in migration and movement patterns. The extent to which such negative effects could be offset by increases in plant productivity is uncertain. Other threats that are known, suspected, or predicted to have negative impacts on reproductive success or survival of Peary Caribou under a warming climate include pathogens (especially *Brucella* and *Erysipelothrix*) and increased shipping. Lower-impact direct threats include hunting, energy production and mining, human intrusions from work (non-tourist) activities, year-round military exercises, increases in traffic from snowmobiles, helicopters, and airplanes, competition with Muskoxen and airborne pollution.

Protection, Status, and Ranks

COSEWIC most recently assessed this species as Threatened in 2015. Peary Caribou are currently listed under Schedule 1 as Endangered under the federal *Species at Risk Act* (2011) and were listed as Threatened under NWT's *Species at Risk Act* (NWT) in 2013. Peary Caribou are co-managed in Nunavut according to the Nunavut Land Claims Agreement and in NWT according to the Inuvialuit Final Agreement, which confer primary wildlife management authority on the Nunavut Wildlife Management Board and the Wildlife Management Advisory Council, respectively.

TECHNICAL SUMMARY

Rangifer tarandus pearyi

Peary Caribou

Caribou de Peary

Range of occurrence in Canada (province/territory/ocean): Northwest Territories and Nunavut

Demographic Information

Generation time	9 years
Is there an [observed, inferred, or projected] continuing decline in number of mature individuals?	No
Estimated percent of continuing decline in total number of mature individuals within 2 generations	Overall increase ca. 142%
[Observed, estimated, inferred or suspected] percent [reduction or increase] in total number of mature individuals over the last 3 generations.	Overall decline ca. 35%
[Projected or suspected] percent [reduction or increase] in total number of mature individuals over the next 3 generations.	Unknown
[Observed, estimated, inferred, or suspected] percent [reduction or increase] in total number of mature individuals over any [3 generations] period, over a time period including both the past and the future.	Unknown
Are the causes of the decline clearly reversible and understood and ceased?	No, for the 2 subpopulations in decline
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	1 914 910 km ²
Index of area of occupancy (IAO, 2x2 grid)	366 384 km ²
Is the population severely fragmented?	No
Number of locations	Unknown, but > 10
Is there an [observed, inferred, or projected] continuing decline in extent of occurrence?	No
Is there an [observed, inferred, or projected] continuing decline in index of area of occupancy?	No
<i>Past area of occupancy decline based on virtual extirpation of Prince of Wales-Somerset-Boothia subpopulation.</i>	
Is there an [observed, inferred, or projected] continuing decline in number of (sub) populations?	Possibly
<i>Number of subpopulations is stable unless Prince of Wales-Somerset-Boothia subpopulation is confirmed extirpated.</i>	
Is there an [observed, inferred, or projected] continuing decline in number of locations?	Unknown

Is there an [observed, inferred, or projected] continuing decline in [area, extent and/or quality] of habitat? <i>Sea ice is projected to decline and extreme weather events (projected to increase in frequency and perhaps severity in some places) may lead to decreases in habitat quality. On the other hand, habitat productivity may increase, especially for the two northern subpopulations.</i>	Possibly
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations?	No
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each subpopulation)

Subpopulations (at time of last survey)	
Banks-Victoria	~2,250
Prince of Wales-Somerset-Boothia	< 10
Eastern Queen Elizabeth Islands	~3,000
Western Queen Elizabeth Islands	~8,000
Total (sum of most recent surveys)	~13,200

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 5 generations (=54 years), or 10% within 100 years].	N/A
--	-----

Threats (actual or imminent, to populations or habitats)

<p>Was a threat calculator completed for this species: Yes</p> <p><u>Members:</u> Justina Ray (TM SSC Co-chair, moderator), Dave Fraser (BC, moderator), Dan Benoit (ATK SC Co-chair), Suzanne Carrière (NT), Nic Larter (NT)</p> <p><u>External Experts:</u> Tracy Davison (NT), Marsha Branigan (NT), Joanna Wilson (NT), Morgan Anderson (NU), Lisa-Marie LeClerc (NU), Andrew Maher (PCA), Renee Wissink (PCA), Peter Sinkins (PCA), David Lee (NTI), Cheryl Johnson (EC), Agnes Richards (EC), Donna Bigelow (CWS), Dawn Andrews (CWS), Lisa Pirie (CWS), Anne Gunn (Status Report writer for Barren-ground Caribou (DU3)), Karla Letto (NWMB), John Lucas (WMAC), Phillip Manik, Sr. (Resolute Bay HTO), Peter Qayutinuak Sr. (Spence Bay HTA - Taloyoak), Issiac Elanik (Sachs Harbour HTC), Bradley Carpenter (Olohaktomiut HTC - Uluhaktok)</p> <p><u>Overall threat impact:</u> Very High-Medium.</p> <p><u>High-Medium Impact:</u> Climate change: a) terrestrial habitat changes, sea ice loss, sea level rise and b) severe weather (rain on snow) events (icing).</p> <p><u>Medium-Low Impact:</u> Pathogens, shipping lanes</p> <p><u>Low impact:</u> hunting, competition (Muskoxen) and predation (Wolves), energy production and mining, human intrusions from work (non-tourist) activities and year-round military exercises, traffic from snowmobiles, helicopters, and airplanes, and airborne pollutants.</p>
--

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	None
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	N/A
Is there sufficient habitat for immigrants in Canada?	N/A
Is rescue from outside populations likely?	N/A

Data Sensitive Species

Is this a data sensitive species?	No
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Status History

COSEWIC: The original designation considered a single unit that included Peary Caribou, *Rangifer tarandus pearyi*, and what is now known as the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. It was assigned a status of Threatened in April 1979. Split to allow designation of three separate populations in 1991: Banks Island (Endangered), High Arctic (Endangered) and Low Arctic (Threatened) populations. In May 2004 all three population designations were de-activated, and the Peary Caribou, *Rangifer tarandus pearyi*, was assessed separately from the Dolphin and Union Caribou, *Rangifer tarandus groenlandicus*. The subspecies *pearyi* is comprised of a portion of the former “Low Arctic population”, and all of the former “High Arctic” and “Banks Island” populations, and it was designated Endangered in May 2004.

Peary Caribou was recognized as one of 12 caribou designatable units in Canada by COSEWIC (2011).

Status and Reasons for Designation:

Status: Threatened	Alpha-numeric code: A2a
Reasons for designation: This subspecies of caribou is endemic to the Canadian Arctic Archipelago, living on the edge of plant growth in polar desert and arctic tundra environments. The current population is estimated at 13,200 mature individuals. From a population high of 22,000 in 1987, the species experienced a catastrophic die-off in the mid-1990s related to severe icing events in some parts of its range. The population was ca. 5,400 mature individuals in 1996, the lowest since surveys first commenced in 1961. Of four subpopulations, two are currently showing an increasing trend, one is stable, and the fourth had fewer than 10 individuals at the last count in 2005, with no evidence of any recovery. The overall population has experienced an estimated three-generation decline of 35%, but has been increasing over the past two decades. The highest-impact threats derive from a changing climate, including increased intensity and frequency of rain-on-snow events negatively affecting forage accessibility in winter, and decreased extent and thickness of sea ice causing shifts in migration and movement patterns.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Threatened, A2a, because the decline over the past three generations (27 years) based on periodic aerial surveys is estimated to exceed 30%.
Criterion B (Small Distribution Range and Decline or Fluctuation): Does not meet criteria. Both the EOO and IAO exceed the thresholds for this criterion.
Criterion C (Small and Declining Number of Mature Individuals): Does not meet criteria. Total number of mature individuals exceeds 10,000 mature individuals.

Criterion D (Very Small or Restricted Population):

Does not meet criteria. The total number of mature individuals exceeds 1,000 and the number of locations is certainly more than the threshold.

Criterion E (Quantitative Analysis):

Not applicable.

PREFACE

This report incorporates information that became available after the last COSEWIC Status Update (COSEWIC 2004) for Peary Caribou *Rangifer tarandus pearyi*. In 1991, prior to the enactment of the *Species at Risk Act* (SARA), caribou throughout the Canadian Arctic Archipelago except for Baffin Island were considered to be Peary Caribou (Miller 1991). In 2004, COSEWIC assessed two entities: 1) Peary Caribou, which included all caribou in the Arctic Archipelago except for Baffin Island and central and southern Victoria Island and 2) Dolphin and Union Caribou, a genetically distinct population that occupies the remainder of Victoria Island, and migrates to the mainland in winter across the Dolphin and Union Strait. COSEWIC undertook an analysis of designatable unit (DU) structure of caribou in Canada as a special project (COSEWIC 2011) to define the units for future status assessments and reassessments of this species according to the latest guidelines. Recognition of Peary Caribou and Dolphin and Union Caribou as two of 12 DUs in Canada was affirmed by this special project.

Unlike COSEWIC (2004), this report considers Peary Caribou only. Since the last assessment, surveys have been conducted in all four Peary Caribou subpopulation ranges to provide updated information on abundance and trends. The most important of these took place in the eastern High Arctic where populations had not been surveyed since 1961. Other aerial surveys clarified trends or updated trends. Recent genetic analyses (McFarlane *et al.* 2014) based on nuclear (microsatellite) DNA has confirmed the genetic distinctiveness of Peary Caribou from other caribou, particularly their isolation and divergence from Barren-ground Caribou in the relatively recent past (end of Pleistocene/early Holocene).

Other significant contributions to this update include: 1) an assessment of the conservation status of Peary Caribou (SARC 2012), including Aboriginal Traditional Knowledge, undertaken by the Government of Northwest Territories; and 2) updates from traditional ecological knowledge on caribou collected and summarized from Aboriginal sources by the COSEWIC Aboriginal Traditional Knowledge (ATK) Subcommittee.

In 2011, Peary Caribou was listed under SARA as Endangered, following the results of the last COSEWIC assessment in 2004. Environment Canada is in the process of developing a recovery strategy for Peary Caribou (Environment Canada, in prep.). This report has benefited from ATK (including Inuit Qaujimaqatuqangit [IQ; Inuit traditional knowledge]), compilation of population data, various maps, and additional scientific information gathered through this process.



COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2015)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.



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The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Peary Caribou *Rangifer tarandus pearyi*

in Canada

2015

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Class: Mammalia; Order: Artiodactyla; Family: Cervidae; Subfamily: Capreolinae

Scientific name: *Rangifer tarandus pearyi* Allen, 1902.

Common names: Peary Caribou (English), Caribou de Peary (French), Tuktu (Plural: Tuktuk; Inuvialuktun), Tuktuinak (Inuinnaqtun), Tuktuaraaluit (Siglitun), Tuttunguluurat (Ummarmiutun).

The Peary Caribou (see cover), is a subspecies of caribou (*Rangifer tarandus*) that is primarily restricted to the Arctic Archipelago of Canada. It was first described by Allen (1902) as *Rangifer pearyi*, but Flerov (1952) later reduced it to subspecies rank. This designation was retained by Banfield (1961), who conducted the last formal taxonomic revision of *Rangifer*, relying on the account of Manning (1960) for Peary Caribou that was based on an examination of 60 skulls, hides and leg bones.

Morphological Description

In comparison with other caribou DUs in Canada, Peary Caribou have a whiter to greyer pelage in all seasons. They have smaller bodies with shorter legs and faces, blunter and wider hooves, and grey antler velvet (Manning 1960, Geist 1998; Ekaluktutiak HTA 2013; Gjoa Haven HTA 2013; Spence Bay HTO 2013). The pelage is long, silky and creamy-white in early winter, becoming shaggy and brown-tinged on the back by spring when dark brown eye and neck patches appear as a result of shedding. The summer coat is slate grey above, sometimes lacking a pronounced flank stripe, and white below; legs are white except for a narrow frontal stripe (see **Designatable Units**).

Peary Caribou was formally described in 1902 from skulls and skins collected on Ellesmere Island and nearby islands (Allen 1902, 1908). The skull has a short pointed rostrum but the molar tooth row is proportionally long (Banfield 1961; Manning and Macpherson 1961). Manning (1960) described a cline in skull size and proportions with increasing size from the southern islands (Banks, Prince of Wales) to the northern Queen Elizabeth Islands (QEI). Within the latter, size tends to increase from east to west and from north to south (Manning 1960; Thomas and Everson 1982). Inuit of Resolute Bay reported that the features that are unique to Peary Caribou become more pronounced on the islands north of Bathurst Island Complex (Taylor 2005).

Thomas and Everson (1982) worked with Inuit hunters to collect caribou measurements across the western QEI (WQEI) and Prince of Wales, Somerset and Boothia Peninsula and samples were later used for DNA analyses (McFarlane *et al.* 2009; 2014). The body measurements supported the cline in skull size noted by Manning (1960). Mean body length ranged from $146.1 \pm SE 1.3$ cm (n=27) for females from Prince Patrick Island, the western-most large island in the QEI, to $152.9 \pm SE 1.1$

cm (n=25) for Prince of Wales Island females (Thomas and Everson 1982; the series did not include animals from the eastern Queen Elizabeth Islands [EQEI], or Banks, or northwest Victoria islands). Unusually large-bodied caribou that were otherwise similar to Peary Caribou were collected on Prince of Wales Island in August 1958 and 1978 (Manning and Macpherson 1961; Thomas and Everson 1982), termed “ultra *pearyi*” (Manning and Macpherson 1961) or “super *pearyi*” (Banfield 1961). The measurements of those seven 1958 bulls were similar to five exceptionally large-bodied bulls collected on Prince of Wales Island (Thomas and Everson 1982).

Population Spatial Structure and Variability

Genetic Structure

North American caribou have been divided into two lineages using genetic analysis of mitochondrial DNA (mtDNA) sequences. The Beringian-Eurasian and the North American Lineages were each named for their ancestral sources in presumed Pleistocene refugia (COSEWIC, 2011; Klütsch *et al.* 2012; Yannic *et al.* 2014). Barren-ground, Peary, and Dolphin and Union Caribou are part of the Beringian-Eurasian Lineage. After the last ice age, as populations expanded and colonized (or re-colonized) northern lands, hybridization resulted in introgression of haplotypes from each group into the other at a low enough frequency to leave each lineage distinct and clearly separable (Klütsch *et al.* 2012). Eger *et al.* (2009) suggested that mtDNA analyses supported two refugia during the last ice age: Banks Island and High Arctic. The High-Arctic refugium was represented by caribou from Bathurst Island, which was isolated from other Peary Caribou. Within the Beringian-Eurasian Lineage, mtDNA patterns have not distinguished among subspecies (Eger *et al.* 2009).

Genetic analysis based on nuclear (microsatellite) DNA, on the other hand, supports the contention that Peary Caribou are genetically distinct from other caribou DUs, including the Dolphin and Union and Barren-ground DUs (COSEWIC 2011; McFarlane *et al.* 2014). Serrouya *et al.* (2012) used Peary Caribou from Bathurst Island (n=20) and Dolphin-Union Caribou (n=43), and two Barren-ground Caribou herds as outgroups in their examination of mountain caribou. They observed that Peary formed a distinct clade with significant differentiation ($F_{ST}= 0.07$) from their nearest neighbour (Dolphin and Union). McFarlane *et al.* (2009) analysed nuclear DNA for specimens from Melville, Banks, NW Victoria, Bathurst, and Prince of Wales islands. McFarlane *et al.* (2014) also included the earliest available specimens of Peary Caribou (1914-1958) as well as the contemporary samples to examine, in particular, the relationship of the ‘ultra-*pearyi*’ collected from Prince of Wales Island in 1958. The ‘ultra-*pearyi*’ bulls were not genetically distinct from other Peary Caribou, suggesting that they were not an intergraded form between Barren-ground and Peary Caribou, and that their large body size was most likely due to environmental conditions.

The overall allele frequencies significantly differed among the sample locations supporting subpopulation structure. The lowest diversity (heterozygosity and allele diversity) was from caribou inhabiting Melville Island, Bathurst Island complex, and Prince of Wales–Somerset islands, including the 1958 Prince of Wales samples. Variability was less than those from Banks Island and Boothia Peninsula, or Dolphin and Union and Barren-ground Caribou (McFarlane *et al.* 2009; 2014). The lower genetic diversity likely reflects periodic reductions in abundance, although the historical and contemporary samples were not distinct from each other. Peary Caribou from northern Ellesmere also had low variability, often an indication of a past genetic bottleneck (Petersen *et al.* 2010).

Subpopulation Structure

The wide distribution of Peary Caribou across multiple islands and habitats has led to various iterations of units being proposed for management purposes. COSEWIC (Miller 1991) gave separate status designations for four island groups within Peary Caribou, while COSEWIC (2004) separated Peary from Dolphin and Union for status designation purposes, while recognizing the same subpopulation structure within Peary Caribou. This structure has not been completely supported by subsequent genetic analyses. Early work identified significant genetic differentiation among samples from various islands (McFarlane *et al.* 2009), but wider sampling and the use of Bayesian analysis that does not rely on sampling location to cluster animals supported two clusters: 1) Prince of Wales, Somerset, and QEI and 2) Boothia Peninsula, Dolphin and Union and Barren-ground Caribou. Specimens from Banks and northwest Victoria islands did not strongly assign to either cluster. However, pair-wise comparisons revealed significant differences between sample localities (McFarlane *et al.* 2014). The analyses also revealed a genetic basis to the latitudinal cline in morphological measurements.

An examination of scientific and community information derived from the SARA recovery planning process (Johnson *et al.*, in prep.) used three lines of evidence to define four Peary Caribou subpopulations: 1) genetic analyses; 2) extent of inter-island movements, based on local knowledge and limited telemetry data; and 3) scientific and local expert input. The spatial structure used in this report refers to subpopulations inhabiting islands or island complexes that have defined locations of surveys and life history information (Table 1).

Banks-Victoria

There likely is restricted gene flow between caribou on Banks and Victoria islands and the rest of the range of Peary Caribou. Zittlau *et al.* (2009) found that samples from Banks Island and Minto Inlet (northwest Victoria Island) were not significantly different and cross-assigned a high proportion of the time (58% and 33%, respectively). These samples had low assignment to other samples suggesting some degree of isolation (Zittlau *et al.* 2009).

Table 1. Island groups and their associated islands included for each subpopulation of Peary Caribou (modified from Johnson *et al.*, in prep.). See Figure 1 for corresponding map.

Subpopulation	Island Group	Islands
Banks-Victoria	Banks and Victoria islands	Banks and Victoria islands
Prince of Wales-Somerset-Boothia	Prince of Wales-Somerset islands, Boothia Peninsula	Prince of Wales, Somerset, Russell, King William, Pandora, Prescott, Vivian, and Lock islands, Boothia Peninsula
Western Queen Elizabeth Islands	Bathurst Island Group	Bathurst Island complex (Cameron, Ile Vanier, Marc, Massey, Alexander, Bathurst islands), Cornwallis, Little Cornwallis, and Helena islands
	Melville Island Group	Melville, Prince Patrick, Eglinton, Emerald, and Byam Martin islands
	Devon Island Group	Devon, Baillie Hamilton, Coburg, Dundas/Margaret, and North Kent islands
	Prime Minister Island Group	Mackenzie King, Brock, and Borden islands
	Ringnes Island Group	Ellef Ringnes, Amund Ringnes, Cornwall, King Christian, Meighen, and Loughheed islands
Eastern Queen Elizabeth Islands	Ellesmere Island	Ellesmere, Graham, and Buckingham islands
	Axel Heiberg Island	Axel Heiberg, Stor, and Hevod islands

Scientific evidence and Inuvialuit ATK agree that before about 1980 when abundance was still relatively high, Peary Caribou made seasonal movements between Banks and northwestern Victoria islands, and so caribou residing on these two islands were recognized as a subpopulation by COSEWIC (2004). Notably, several aerial surveys since 1982 along with more recent satellite-tracking have failed to detect evidence of such travel, and Inuit hunters reported no evidence of movement in the past decade (Paulatuk HTC 2013).

Movements of satellite-collared cows during 1987–1989 (Gunn and Fournier 2000) and 1996–2006 (Poole *et al.* 2010; ENR unpubl. data 2011, cited in SARC 2012) showed a spatial and temporal separation of the northwestern Victoria Island subpopulation of Peary Caribou from Dolphin and Union Caribou. Although telemetry studies indicated that Peary Caribou cows have been mainly limited to the area north and west of a line between Minto Inlet and Wynniatt Bay, Inuvialuit ATK reveals that they can (albeit rarely) occur south to Admiralty Inlet and east to the Kagloryuak River (ATK in Poole *et al.* 2010; SARC 2012; Figure 1). Inuvialuit from Ulukhaktok and Inuit from Cambridge Bay recognize two kinds of caribou on Victoria Island that are different in size, colour and taste: those in the northwest (Peary Caribou) and others that summer on the central, southern and eastern parts (Dolphin and Union Caribou; Elias 1993; Gunn *et al.* 2011). Inuit from Victoria Island recalled both migratory and non-migratory caribou on Victoria Island before the 1920s (Manning, 1960; SARC 2013).

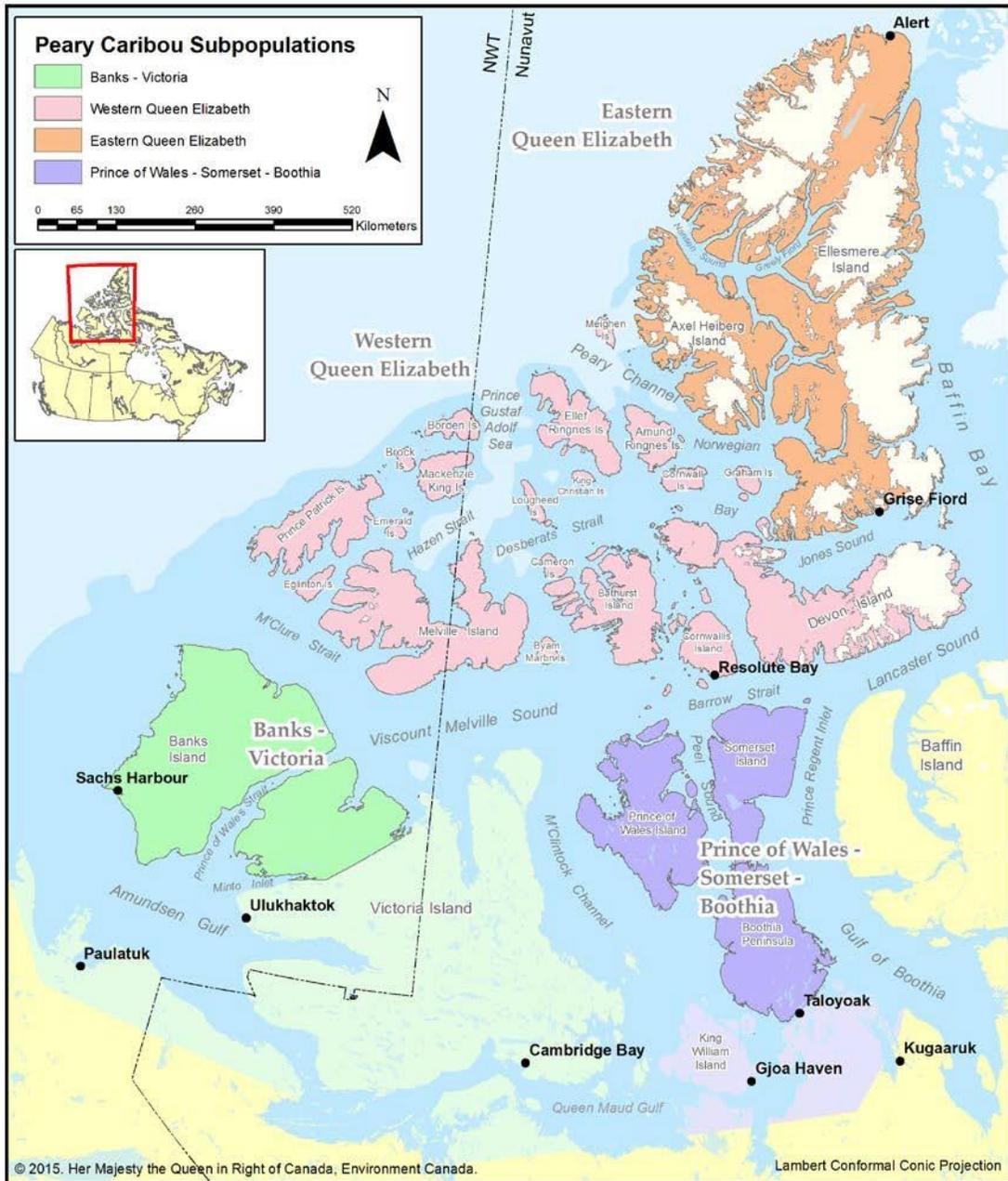


Figure 1. Subpopulations of Peary Caribou (Johnson *et al.* in prep.; see Subpopulation Structure; Table 1). Light green and light purple shading denotes areas of additional sightings of Peary Caribou outside core range for the Banks-Victoria and Prince of Wales-Somerset-Boothia subpopulations, respectively. Map prepared by Dawn Andrews (Environment Canada).

Prince of Wales-Somerset-Boothia

Movement data and community observations suggest that the island complex of Prince of Wales and Somerset islands served as an inter-island subpopulation with many caribou at one time migrating seasonally between islands and Boothia Peninsula (Johnson *et al.* in prep.). For example, large-scale (involving hundreds of caribou) east–west movements occurred between winter ranges on Somerset Island and calving and summer areas on Prince of Wales and Russell islands, as well as their satellite islands such as Pandora, Prescott, Vivian and Lock. Not all individuals undertook these movements, and use of the various islands varied among years (Miller 1990; 1991; 1995; 1997a; Miller *et al.* 2005a; 2007a, b). Boothia Peninsula was also part of winter range, and there were also calving areas identified on Somerset Island, and documentation of spring migration from southeast (Boothia/Somerset islands) to northwest (Prince of Wales/Somerset islands), returning across frozen Peel Sound in the fall (Gunn and Decker 1984, Gunn and Dragon 1998, Miller *et al.* 2005a; Gjoa Haven HTA 2013; Spence Bay HTO, 2013). Some movements of very few caribou were north-south between Prince of Wales Island and the nearby Mecham, Russell, Hamilton, Young and Lowther islands in Barrow Strait, inferred by tracks on sea ice and by changing densities of caribou on the smaller islands. After extensive searching by helicopter for caribou or caribou tracks crossing Barrow Strait to Bathurst, Cornwallis, or Little Cornwallis islands during 1977-1980, Miller (1990) concluded that no regular, large-scale movements occurred between the Prince of Wales-Somerset group and the QEI, although infrequent crossings may be made and have been noted by hunters in Resolute Bay (CWS 2015).

Skull and body measurements (Thomas and Everson 1982) and observations (Gunn and Decker 1984; Miller *et al.* 2007b) have confirmed both Peary and Barren-ground Caribou have occurred on the Boothia Peninsula. Satellite-tracking of five cows in 1991-92 demonstrated that both Peary and Barren-ground Caribou calved on west and east sides of northern Boothia Peninsula, respectively, but did not maintain spatial separation during the rut (breeding season; Gunn *et al.* 2000a), suggesting some possibility of infrequent interbreeding.

The status of caribou subspecies and numbers on King William Island and other islands near the Boothia Peninsula is uncertain. Historical accounts of caribou on King William Island refer to seasonal migration from Adelaide Peninsula by Barren-ground Caribou (summarized in Appendix G, Gunn *et al.* 2000a). Hunters in Gjoa Haven reported that some caribou came from Prince of Wales Island to King William Island in the early or mid-1970s (J. Keanik pers. comm. cited in Gunn and Dragon 1998). Miller (1991) cited Gunn's personal communication of 1989 that reported only a handful of "Peary-like" caribou there in 1989, and that Inuit hunters recognized both Peary-like and Barren-ground Caribou. Groves and Mallek (2011) recorded 204 ± 115 adult caribou on King William Island in 2009 as part of migratory bird surveys, but did not distinguish further. In this assessment, they are included as members of the Prince of Wales-Somerset-Boothia subpopulation for the purposes of the extent of occurrence calculation, but are not included in the subpopulation estimates.

Western Queen Elizabeth Islands

The WQEI comprise five island complexes within which several smaller island groups are identified and caribou exhibit regular, inter-island seasonal movements (Table 1): the Bathurst Island Group, Melville Island Group, Devon Island Group, Prime Minister Island Group, and the Ringnes Island Group. This division of WQEI and EQEI has been modified from Miller *et al.* (2005b), following recent information regarding inter-island movements from community meetings and expert opinion (Figure 2; Johnson *et al.*, in prep.).

Macpherson (1961) first hypothesized large-scale movements within the Prime Minister Group, based on his and Stefansson's (1921) observations of fluctuating caribou numbers. Tener (1963) confirmed inter-island movements after seeing caribou tracks crossing from Mackenzie King Island to Borden Island. Many caribou in the Melville-Prince Patrick complex winter on Prince Patrick Island and move in spring to Eglinton, Emerald, Melville and Byam Martin islands for the summer (Miller *et al.* 1977a). Seasonal inter-island movements are also known within the Bathurst Island complex based on observations and collared caribou (Miller 1990; 1995a; 2002; Poole *et al.* 2015). These patterns are supported by community information (Figure 2; Johnson *et al.* in prep.).

Eastern Queen Elizabeth Islands

Miller *et al.* (2005b) considered the EQEI to have 14 islands that are each > 130 km², including Ellesmere, Axel Heiberg, and those within the Ringnes and Devon Island groups. Johnson *et al.* (in prep.) modified this division to include Axel Heiberg (including Stor and Hevod Islands) and Ellesmere Islands only, following further technical and community information, assigning the remainder to WQEI. About 95 500 km² or 39% of the land area of Ellesmere and Axel Heiberg islands is covered with ice caps and permanent snow fields. Inter-island movements likely occur, but have received little documentation. ATK has reported winter migration across sea ice from southern Ellesmere to Smith and Cone islands (Taylor 2005).

Some habitat differences serve as an additional basis for the division between EQEI and WQEI. Specifically, there are some differences between the geomorphology, vegetation patterns, and climate, sharing a common classification as part of the Arctic Cordillera Ecozone (associated with ice caps) and Ellesmere Mountains Ecozone within the Northern Arctic Ecozone (Ecological Stratification Working Group 1996). The evidence base to support delineation of this as a subpopulation was less than that of the other three demographic units (Johnson *et al.*, in prep.).

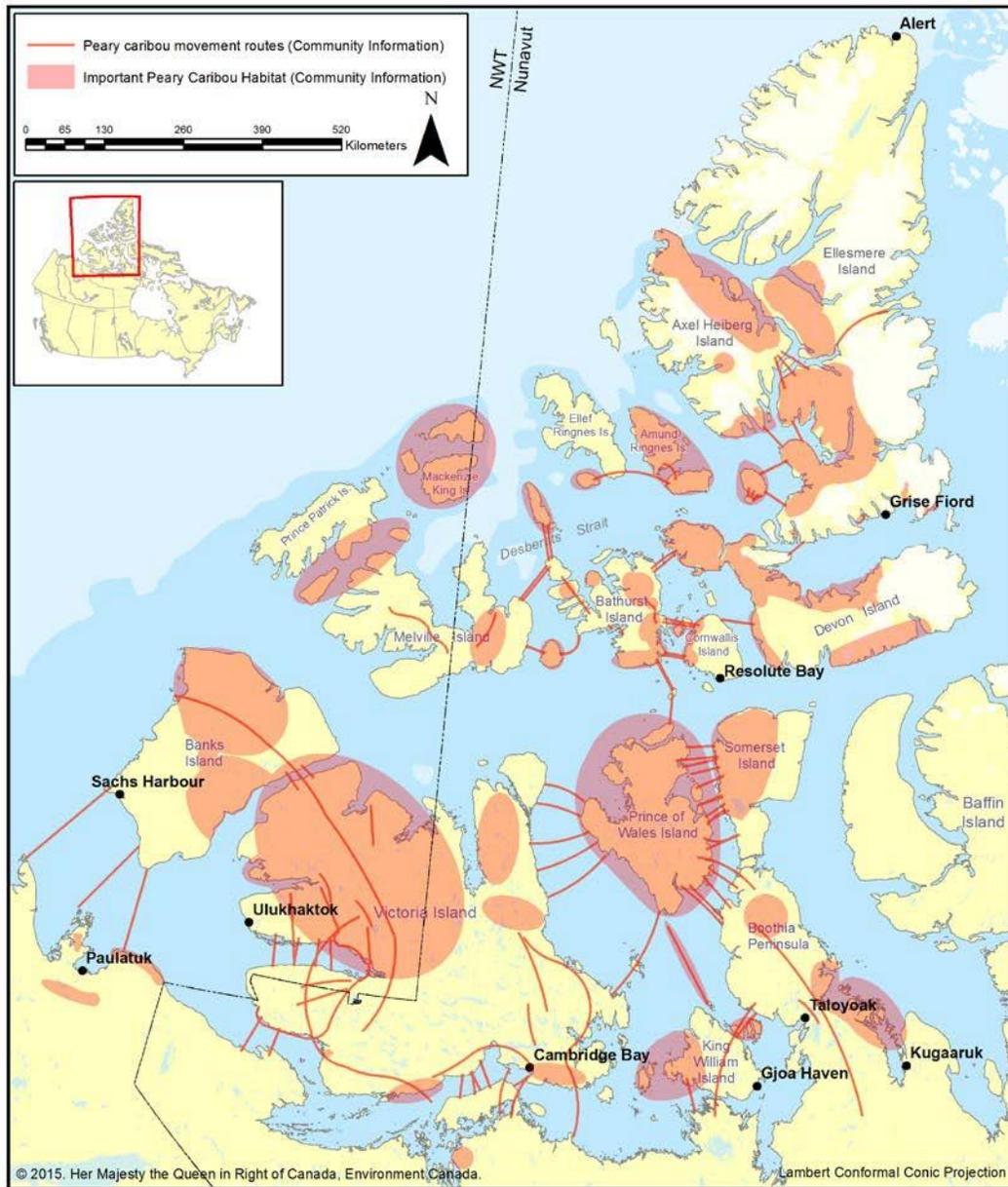


Figure 2. Community information on location of important habitat and movement routes for Peary Caribou. Map prepared by Dawn Andrews (Environment Canada; Johnson *et al.*, in prep.).

Designatable Units

COSEWIC (2011) recognized the subspecies of Peary Caribou with all of its subpopulations as one of 11 extant caribou DUs. Measures of genetic divergence among Peary and Barren-ground Caribou on the mainland, and also between Peary Caribou and the Dolphin and Union Caribou, support the discrete nature of Peary Caribou regardless of occasional overlap in annual distribution. New genetic information since the DU report was published reaffirms the unique nature of Peary Caribou (McFarlane *et al.*, 2014). Morphological specializations reflect adaptations for Arctic environments (e.g., shorter face and legs) (Banfield 1961). Unique behaviours include the use of several islands as part of their home range by some subpopulations (see **Population Spatial Structure and Variability**), and not forming large post-calving aggregations, in contrast to Barren-ground Caribou (Festa-Bianchet *et al.* 2011).

Special Significance

Peoples of the Canadian Arctic have hunted caribou for > 4,000 years (Manseau *et al.* 2004). Peary Caribou are important in the subsistence economy of communities where they occur and are integral to the cultures of Inuit and Inuvialuit. They are the only source of caribou meat for several arctic communities. They are frequently represented in the art of Inuit and Inuvialuit and their shed antlers are carved to produce traditional crafts. Persisting at the limits of plant and animal existence, Peary Caribou are an integral part of Arctic ecology and biodiversity. They can be an important prey for Wolves (*Canis lupus*) and are increasingly important in the scientific study of ecosystem response to climate change. Peary Caribou are an important symbol of the Canadian Arctic islands.

DISTRIBUTION

Global Range

Peary Caribou range is entirely within Canada, with the possible exception of animals on Greenland. Anderson (1946) suggested that caribou from northwestern Greenland north of Kane Basin may be Peary Caribou, and Banfield (1961) agreed. Miller (1991), citing Meldgaard (1986) who summarized reports of Greenland Inuit, confirmed that small caribou, possibly migrants from Canada, were regularly seen and taken by hunters there. The Inuit reported that normally up to 10 (but occasionally > 100 individuals) were taken annually and that caribou tracks were often seen crossing from Ellesmere Island to Greenland. Roby *et al.* (1984) surveyed the Inglefield Bay-Kane Basin area and did not see any live caribou, but found a caribou mandible in northwest Greenland (Renssalaer Bay, north of Cape Inglefield and on the southern edge of Kane Basin) that was 178 mm long, "...outside the range of [i.e., smaller than] Canadian Barren-ground Caribou... the mandible probably belonged to a specimen of Peary Caribou." They also reviewed the history of caribou declines from this area as a result of severe weather and excessive hunting. It seems probable, therefore, that the Kane

Basin caribou were *R. t. pearyi*, but are now extirpated from Greenland, although a few may rarely cross from Ellesmere Island (Taylor 2005).

Canadian Range

Peary Caribou have the northernmost distribution of all caribou in North America (Figure 1; Festa-Bianchet *et al.*, 2011). They are found across the Arctic Archipelago except for Baffin Island (which is occupied by Barren-ground Caribou). Peary Caribou also occur on northwestern Victoria Island with some evidence of movements to other parts of that island. A small number occur (or occurred) on Boothia Peninsula and possibly on King William Island (see **Subpopulation Structure**). Peary Caribou disperse across sea ice, either occasionally or as part of seasonal movements, and may be found on any island, although not all of the small islands have year-round inhabitants.

Because population surveys are usually conducted in spring and summer due to day length, winter distribution is less well documented. However, recent information collected in the context of recovery planning led by Environment Canada has indicated a broader-scale distribution than reported in COSEWIC (2004). Cambridge Bay members reported that Peary Caribou have been observed year-round all over Victoria Island, albeit in small numbers (Ekaluktutiak HTA 2013). They have been occasionally spotted on the mainland in two main areas: Pearce Point and Parry Peninsula (Paulatuk HTC 2013). They have been seen near Cambridge Bay, and on the mainland near Kugluktuk (Ekaluktutiak HTA 2013). There were reports (Banfield 1961; Manning and Macpherson 1958; Youngman 1975) of Peary Caribou as far west on the mainland as Old Crow (Yukon), Herschel Island (Yukon), Baillie Island (Northwest Territories), and Cape Dalhousie (Northwest Territories) in the early 1950s, which were linked with years with icing on Banks Island.

Extent of Occurrence and Area of Occupancy

The extent of occurrence for Peary Caribou is 1,914,910 km² based on the minimum convex polygon within Canada's extent of jurisdiction as shown in Figure 3 (map and area calculations by D. Andrews, Environment Canada). The index of area occupancy (based on 2 km x 2 km grid cells) as defined by survey observation data only (Johnson *et al.* in prep.) is 91,465 cells or 366,384 km² (D. Andrews, Environment Canada, in litt.).

The extent of occurrence polygon encloses all caribou observations, based on the most recent survey for each island (Appendix 1) combined with community information (see **Population Status and Trends**).

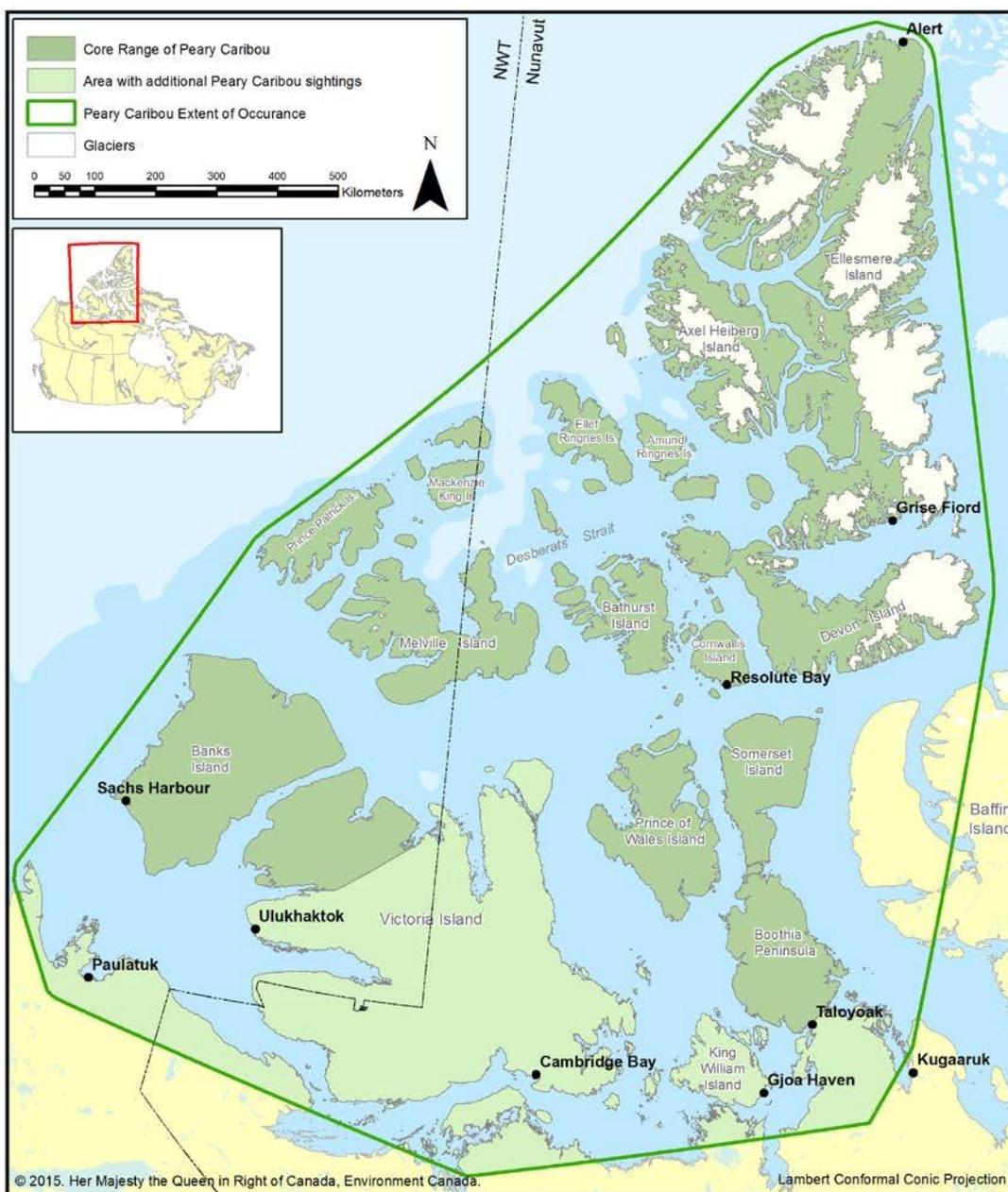


Figure 3. Peary Caribou distribution (with extent of occurrence polygon) based on most recent surveys and community information. Map prepared by Dawn Andrews (Environment Canada).

Banks-Victoria

Banks Island is the westernmost island of the Canadian Arctic Archipelago and covers an area of ca. 71,000 km². Historical records indicate that Peary Caribou occupy virtually all of the island, at least seasonally (Nagy *et al.* 1996). Based on summer survey distribution during the 1980s, Peary Caribou were most numerous in the northwest and the eastern side of the island with some caribou in the southern end (Nagy *et al.* 1996, Figure 4.). During the 1990s, caribou numbers were at their lowest. The summer 1998 survey showed that caribou were most numerous in the northwest and along the west coast; no caribou were found at the southern end and few on the eastern side (Nagy *et al.* 2013a). Caribou numbers have increased since the 1990s with the most recent survey showing a more widespread distribution on the island, although most occurrences remain concentrated in the northwest (Davison *et al.*, 2014).

Peary Caribou occupy an approximate 36,000 km² area of northwestern Victoria Island to the north of Minto Inlet (Nagy *et al.* 2009b). Although Peary Caribou numbers have fluctuated, they have always occupied the northwestern area of the island which, based upon satellite telemetry, remains separated from the area inhabited by Dolphin and Union caribou (Davison and Williams 2013).

Prince of Wales-Somerset-Boothia

Prince of Wales and Somerset islands cover more than 58,000 km² in area and, based on historical records (Gunn and Decker 1984; Miller and Kiliaan 1981; Gunn and Dragon 1998), were virtually all occupied, at least seasonally, when populations were high in the 1960s and 1970s. Annual migrations within this subpopulation are well documented by communities (Gjoa Haven HTA 2013; Resolute HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTO 2013). For example, during 1977–1980, caribou trails across the sea ice effectively joined these two main islands, several satellite islands and the northern part of the Boothia Peninsula (see below) for most of each year, making this complex essentially a single range of >93,000 km² (Miller *et al.* 2005b).

After caribou essentially vanished by the 1940s (summarized in Gunn and Ashevak 1990), Boothia Peninsula was re-occupied by caribou based on data from the first aerial survey in 1973 (Fischer and Duncan 1976) through the 1980s. Although both Peary and Barren-ground Caribou occurred there, the proportion of each was not quantified during the aerial surveys. Most Peary Caribou were resident on the Boothia Peninsula north of Taloyoak, but some seasonally migrated from Somerset Island or Prince of Wales Island in the fall and back in the spring (Gunn and Ashevak 1990). Caribou in this subpopulation have declined again to very low numbers (see **Fluctuations and Trends**).

Western Queen Elizabeth Islands

The WQEI cover an area of about 180,000 km²; the largest islands are Melville (42,776 km²) and Devon (38,764 km²), followed by Prince Patrick (16,316 km²) and Bathurst Island (16,042 km²). Much of the land area (with the exception of Devon Island) lies below 300 m elevation (Miller *et al.* 2005a), and most is usable habitat, not covered by glaciers. The sporadic nature of surveys and little-documented ATK restrict known distribution patterns mostly to the summer. There is some evidence that smaller islands tend not to be used by Peary Caribou during times of reduced abundance (Miller *et al.* 1977a). For example, although Peary Caribou had been consistently recorded on Brock, Eglinton and Emerald islands in 1961, 1972-74 and 1987-88, they were not seen in 1997 (Gunn and Dragon, 2002) when population numbers were very low in the region. They were once again confirmed present in 2012 (Davison and Williams 2012), corresponding with a population increase (Appendix 1).

The Bathurst Island complex and surrounding islands have been subjected to the most significant survey effort within the WQEI, with available data spanning a 50-year period. This provides a window into caribou spatial distribution across seasons and over periods of both high and low population abundance (Poole *et al.* 2015).

Eastern Queen Elizabeth Islands

The two largest islands that make up this subpopulation are ca. 240,000 km² in area. In contrast to WQEI, a majority of the area is above 300m elevation and covered by glaciers and ice caps, and hence unusable for Peary Caribou. Recent surveys (Jenkins *et al.* 2011; Anderson *et al.* 2014; Anderson and Kingsley 2015) have recorded Peary Caribou on Ellesmere and Axel Heiberg islands on all non-glacier-covered areas of both.

Search Effort

Peary Caribou distribution is known from aerial surveys that have covered most islands and the experience of local and traditional knowledge, mostly through hunting.

In areas accessible from the eight settled Inuit and Inuvialuit communities within Peary Caribou range (Figures 1-3), many families and individual hunters, trappers and fishers from Inuit and Inuvialuit communities spend weeks or months at all seasons out on the land. The widespread adoption of snow machines since the 1970s or use of bush planes to reach remote camp sites has made it possible for individual hunters to cover a greater distance searching for caribou or Muskoxen (*Ovibos moschatus*) (Condon, 1996). In areas that people visit regularly, the specific skills required to pursue cultural traditions results in a high overall level of awareness of caribou and other wildlife distribution, density, and condition (c.f. Dumond 2007; SARC 2012, 2013).

Information particular to wildlife management is also shared in meetings of local hunters and trappers associations, and between them and regional wildlife management boards. In this way, knowledge of status, movements, and condition of wildlife is accumulated and disseminated within and among villages. People in remote villages are, therefore, aware of wildlife events throughout the territories and beyond. Such knowledge may be variously understood, interpreted, or communicated by different individuals, but nevertheless becomes shared community knowledge.

The distribution patterns and trends of Peary Caribou are less known in areas that are remote from communities. Most incidental observations of Peary Caribou are derived from hunting trips (SARC 2012; CWS 2013). Frequency of individual hunting expeditions is also declining. For example, fewer hunters in Sachs Harbour and Ulukhaktok hunt for caribou than in the past (Condon 1996; Collings and Condon 1996; Nagy 1999; Pearce *et al.* 2011), and unreliability of snow and ice conditions has families preferring to travel along the coast rather than inland (Riedlinger 2001). Cambridge Bay residents remarked in community meetings that travel to the northern part of Victoria Island is uncommon (Ekaluktutiak HTA 2013). Similarly, Gjoa Haven residents travel too infrequently to Prince of Wales, Matty and Tennes islands to know when caribou are there or how numbers have changed over time (Gjoa Haven HTA 2013). Sachs Harbour members indicated that due to changes in hunting practices, people no longer spend long periods travelling on the land on Banks Island following caribou, and now seldom venture further than 50 miles north of town (Sachs Harbour HTC 2013).

Search effort to measure spatial distribution within each of the four subpopulations has also been based on aerial surveys of each island. The frequency and coverage of these surveys has been highly variable since the first systematic surveys in 1961 (see **Sampling Effort and Methods**; Table 2). It is, however, unlikely that there are unexplored areas within Peary Caribou range, given the nature of the systematic effort and extent of coverage in an overall sense. Nevertheless, distribution and abundance through time in most subpopulations is not well known, and even current distribution is unknown in parts of the range.

HABITAT

Peary Caribou live primarily in High Arctic and Middle Arctic tundra (Olson *et al.* 2001; Figure 4).

The climate of Peary Caribou range is unpredictably variable and severe, with short, cool summers and long, cold winters. The growing season (breaking dormancy to 50% leaf colouration) is relatively fixed within 50-60 days for plant species (Svoboda 1977). Snow cover is generally present from September to May (Banks Island) or mid-late June (Melville Island) (SARC 2012).

Climate data are available from only eight meteorological stations across the Peary Caribou range, and these are all coastal. Hence, they are more representative of conditions on QEI, and not the large continental island areas of Banks and Victoria islands. For example, summer temperatures in interior Banks Island can be as much as 10°C higher than those recorded by the Sachs Harbour weather station (N. Larter, pers. comm. 2015).

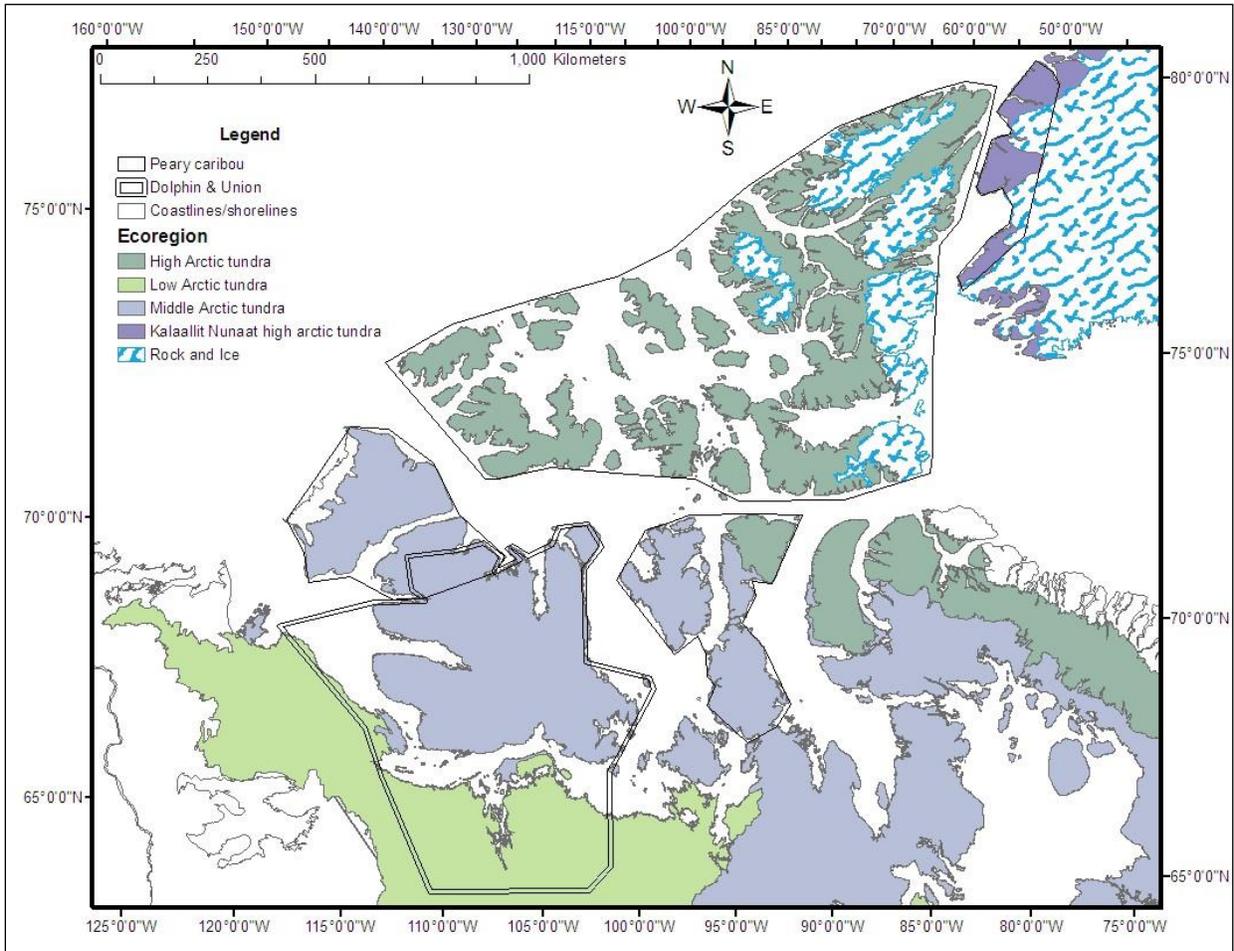


Figure 4. Terrestrial eozones in the Arctic Archipelago (based on Olsen *et al.*, 2001).

Since 1980, spatial climate data have become available at the scale of 1/2 degree latitude by 2/3 degree longitude from the Modern Era Retrospective Analysis for Research and Applications (MERRA) dataset. MERRA data from 1980 - 2014 for island or island groupings for Peary Caribou demonstrate how climate variables vary across Peary Caribou range with east-west and north-south gradients; there is also a high degree of annual variability, which itself varies regionally (Russell *et al.*, 2013). For example compared to Banks Island, Bathurst Island has fewer cumulative growing degree days (GDD) (the base temperature below which plant growth is zero) > 0 in June and July (230 ± 20.0 SE vs. 557 ± 34.0 SE). This result is best explained by its location further north, but also by its smaller landmass with an incised coastline. It also has a later onset of plant growth (up to a 10-fold mean difference on 15 June), which is characterized by higher annual variability than Banks Island.

The climate across the Arctic islands is strongly regionalized with east-west and north-south gradients in precipitation and temperature due to the influence of Pacific air masses in the west and Atlantic air masses in the east (Maxwell 1981). It is these intrusions that periodically cause warmer temperatures during snowstorms leading to icing and dense, deep snow (Rennert *et al.* 2009). Decadal-scale atmospheric pressure oscillations in the north Atlantic and north Pacific complicate trend analysis of weather patterns. Spatial diversity of climate regimes across the range of Peary Caribou creates a great diversity of vegetation types, with implications for how each subpopulation responds to climate variation.

Land dominated by dry vegetation covers about 36% of the ice-free area within Peary Caribou range. Above-ground plant biomass ranges from < 100 g/m² in much of the QEI and parts of the Prince of Wales-Somerset group with some areas having up to 500–2000 g/m² on Banks Island and Prince of Wales Island (Gould *et al.* 2003). Net primary productivity is 0–50 g/m²/yr over most of the range of Peary Caribou, with 150–250 g/m²/yr on parts of Banks Island and Victoria Island (Gould *et al.* 2003). Banks Island has the greatest extent of area with high plant biomass (>1000 g/m²), shrub cover and primary productivity of all Peary Caribou subpopulation ranges (Gould *et al.* 2003).

Permafrost is continuous throughout and only a thin (~40 cm—Callaghan *et al.* 2005) active layer thaws during summer, limiting dominant vegetation to flowering perennials such as saxifrage (*Saxifraga* spp.), Arctic Poppy (*Papaver radicum*), Moss Campion (*Silene acaulis*), louseworts (*Pedicularis* spp.), and Mountain Sorrel (*Oxyria digyna*), as well as mosses, rushes, grasses, sedges, and dwarf shrubs (e.g., *Salix* spp., *Dryas* spp.).

Habitat Requirements

Peary Caribou use a wide variety of habitats and are most commonly found on upland polar desert and tundra habitat types that are mesic-xeric with sparse-moderate vegetation cover at intermediate-high elevations (Parker and Ross 1976; Wilkinson *et al.* 1976; Miller *et al.* 1977a, b; Russell *et al.* 1978; SARC 2012). In the WQEI, Thomas *et al.* (1999) showed that the Peary Caribou did not use or select habitat types with the greatest vegetation cover and standing crop. The latter study demonstrated that caribou pellet densities in summer were greatest in sparsely vegetated upland ridges where lichens, willow, wood rushes (*Luzula* spp.), Arctic Poppy and Long-stalked Starwort (*Stellaria longipes*) were relatively abundant. Winter forage sites were typically characterized by high densities of *Luzula* spp. and lichens.

Studies have been conducted during snow-free periods on forage availability, plant standing crop, biomass, above-ground primary productivity, and abundance of plant species or groups (Larter and Nagy 2001a; Gould *et al.* 2003, Larter and Nagy 2003). Generally, these studies showed that there was more forage or available plant biomass than was necessary for adequate nutrition, although it may not be accessible during winter due to snow conditions.

The low densities of Peary Caribou, their relatively small group size and their mobility while foraging usually prevent overuse of forage sites despite the characteristically low productivity of such ranges (e.g., Parker 1978; Miller and Kiliaan 1981). Unfortunately, as noted by Miller *et al.* (1977a:46), "...we have no quantitative measures of range condition" associated with declines of Peary Caribou and this knowledge gap persists. Overall, studies have suggested that, while forage availability may not limit Peary Caribou populations, high densities could in theory affect vegetation and there is potential for competition among herbivores under certain conditions. Only limited research has been conducted on linkages between foraging and snow conditions in relation to subpopulation dynamics (Larter and Nagy 2000a; 2001b) and this research has not been conducted during all phases of high and low populations for all subpopulations (Tyler 2010; but see below for Banks Island).

Of importance to Peary Caribou is energy accumulation during the short plant growing season, which can drive fitness for the rest of the year. This implies some degree of behavioural plasticity to allow animals to respond to the variation in forage availability. Most evidence for such plasticity comes from Svalbard, a high arctic island group north of Norway where Svalbard reindeer (*Rangifer platyrhynchus*) increase movements when ground-fast icing restricts forage (Meland 2014). The Svalbard reindeer switch between selecting forage quality versus quantity depending on changes in abundance of lichen, moss/graminoids, and parasite avoidance strategies (Van der Wal 2006).

Diet

Peary Caribou diet has been relatively well studied in the western Arctic (Shank *et al.* 1978; Thomas and Kroeger 1980; Thomas and Edmonds 1983; Larter and Nagy 1997; Lenart *et al.* 2002). Peary Caribou have a broad/varied diet and are versatile feeders with diet varying seasonally in relation to available forage and corresponding nutritional content.

Diet on Banks Island has been described when Peary Caribou numbers were increasing (Shank *et al.* 1978) and decreasing (Larter and Nagy 1997) in the context of overlap with Muskox diet. Thomas and Kroeger (1980) examined the summer and winter digestibility of forage using caribou from Prince of Wales Island. Digestibility was greater for sedges in winter than summer; the digestibility of the White Worm Lichen *Thamnolia vermicularis* was 18% in summer in contrast to 62% in winter, but the digestibility of mosses was higher in summer than winter. Thomas and Edmonds (1983) reported on late winter diet from across the WQEI to Prince of Wales and Somerset islands. In that study, lichens comprised 2-15%, while sedges and mosses provided 15-57% and 13-58%, respectively. In summer, caribou select forage high in digestible protein by foraging on flowers especially Purple Saxifrage (*Saxifraga oppositifolia*), lousewort, and Arctic Poppies (Parker and Ross 1976; Parker 1978) and made high use of willow leaves on Melville and Axel Heiberg islands. During unusually severe winters caribou are restricted to a diet with highly indigestible forage such as willow twigs, which can result in malnutrition (Parker 1978).

Measurements of diet have shown that lichens comprise a relatively low proportion of winter and summer diet for Peary Caribou compared to Barren-ground (reviewed by Wilkinson and Shank 1974; Miller 1998; Larter and Nagy 2004). For example, in a study on Banks Island, lichen was of minor dietary importance, likely because of its low availability (standing crop 2.96 g/m²), whereas sedges, willows, legumes (*Astragalus* spp., *Oxytropis* spp.), and *Dryas integrifolia* dominated the diet (Larter and Nagy 1997; Larter and Nagy 2004). Inuvialuit TK reveals that Peary Caribou eat lichens (genera *Cladina* and *Cladonia*), known broadly as “tuktut niqait” (“tuttut niqingi” in Uummarmiutun), or ‘caribou food’; Snow Lichen (*Flavocetraria nivalis*) and White Worm Lichen known as “aqjarungat” or “akeagonak”; and various kinds of rock lichens, known generally as “qaviut” (Bandringa 2010). Caribou winter range is often correlated with the abundance of lichens *Cetraria delisei* and *Thamnolia vermicularis*, crustose lichens, and grasses (e.g., Alpine Foxtail [*Alopecurus alpinus*]) and rushes (e.g., Two-glumed Rush [*Juncus biglumis*]). On eastern Melville Island, Thomas *et al.* (1999) found that the amount of lichens in the winter diet of Peary Caribou depended on snow conditions, with lower occurrence of lichen in the diet in years with deeper, harder snow.

The low proportion of lichens in the diet measured either from rumen or fecal pellet samples may reflect that lichens are scarcer in Peary Caribou range than on the ranges of other caribou (Thomas *et al.* 1999, Russell *et al.* 1978). A likely reason is the underlying substrates are mostly alkaline and unfavourable to lichens. A possible parallel might be the low occurrence of lichens on Svalbard where the vegetation following reindeer grazing from 1978 to 2013 shifted from lichens to more productive and resilient moss-graminoids (van der Waal *et al.* 2001, Ronning 2014). However, where reindeer declined, fruticose lichens have recovered after 100-200 years (van der Waal *et al.* 2001).

Peary Caribou usually forage while walking, rather than by feeding in place as Muskoxen do (COSEWIC 2004 and references therein). Caribou can average 3-4 km of travel per hour while actively foraging (Miller *et al.* 1982). Under ideal conditions when the snow is soft and relatively shallow, caribou forage by simply pushing the snow off the vegetation with their noses. As snow density increases, they dig small individually scattered craters, unlike the large cratered areas often used by groups of Muskoxen and groups of Barren-ground Caribou. When snow cover becomes too hard and dense, Peary Caribou seek forage on snow-free sites or sites with only shallow snow cover (e.g., exposed wind-swept areas). On Banks Island, they often feed in winter by cratering in the snow of upland habitats (upland barrens, hummock tundra, and stony barrens) where it is softer and shallower than in wet meadows (Larter and Nagy 2001b).

Habitat Trends

Essentially all historical Peary Caribou habitat is available and has not been lost or fragmented by industrial or other anthropogenic developments. There is little potential habitat that is currently unoccupied, other than Prince of Wales-Somerset group of islands and Boothia Peninsula.

At community information meetings conducted during Environment Canada-led recovery meetings, members of the Cambridge Bay HTO (2013) expressed concerns that past activities have affected caribou habitat. There were also multiple comments about past exploration activities leaving contaminated sites and fuel drums from Gjoa Haven, Grise Fiord, and Resolute Bay community members (Gjoa Haven HTA 2013; Iviq HTA 2013; Resolute Bay HTO 2013).

Under a changing climate, habitat changes (e.g., vegetation changes [productivity and shrub growth] and snow conditions) for Peary Caribou have already occurred (SARC 2012) and the rate of these changes is projected to increase (see **Threats-Climate Change**).

BIOLOGY

Caribou and reindeer are polygynous (c.f. Holand *et al.* 2007), but little is known of the Peary Caribou mating system (Petersen *et al.* 2010). The small group size typical of Peary Caribou (Tener 1963; Miller *et al.* 1982; Nagy *et al.* 1996) suggests a harem-guarding mating system.

Life Cycle and Reproduction

Peary Caribou have widely variable vital rates. Productivity (the proportion of females with calves) in the WQEI has varied from 0 to 88%, and on Banks Island from 3 to 33% between 1970 and 2010 (SARC 2012). Overwinter calf survival on Banks Island from 1991-1999 varied from 23 to 86% (SARC 2012). Information on adult sex ratios is generally lacking, as are data on longevity and age at last reproduction. ATK indicates that Peary Caribou females in good condition can calve every year after sexual maturity is reached at 2 to 4 years of age, but hunters report finding no fetuses in harvested caribou after harsh winters (SARC 2012 and references therein).

Information regarding generation time is lacking for Peary Caribou. COSEWIC (2004) estimated the intergeneration time for Peary Caribou at 7 years, although no rationale was provided; this was also adopted by SARC (2012) for the NWT assessment. Females may live to 15 years in the wild (SARC 2012). They presumably are fecund for their whole adult lives (at least 13 years, the maximum age sampled—Thomas *et al.* 1976), although senescence has been observed in reindeer between the ages of 7 and 11.5 years (e.g., Weladji *et al.* 2010). Hence, the median age of Peary Caribou parents could be up to 8.5 to 9.5 years. Given the IUCN definition of generation length as the average age of parents of the current cohort, and reflecting the turnover rate of breeding individuals in a population (IUCN 2014), Peary Caribou generation time was established as 9 years for the purposes of this assessment.

Physiology and Adaptability

Peary Caribou are adapted to limited plant growth with a highly compressed growing season and long periods of snow-covered frozen standing vegetation (see **Habitat**).

Despite their modest genetic differentiation, behavioural and morphological differences between Peary and Barren-ground Caribou are assumed to result from strong selection pressure in their high Arctic environment (Manning 1961). Given that shorter body extremities minimize external surface area and heat loss, it may be that the adaptive value of a shorter broader muzzle of Peary Caribou also prevents heat loss while maintaining a long enough molariform tooth row to forage effectively.

Tener (1963) and others noted the small group size of Peary Caribou (typically a dozen or fewer) and widely dispersed aggregations relative to Barren-ground Caribou (often in herds of 1,000 or more). Group size increases slightly prior to calving, stabilizes or decreases during calving and then increases into post-calving aggregations as they move inland from coastal areas (Nagy *et al.* 1996). However, the post-calving aggregation is a relative term as the group sizes are tens of individuals not the hundreds to thousands typical of Barren-ground Caribou. The underlying mechanisms may differ; small group size and dispersion may be an adaptation to an environment with thin and patchy forage (relative, to mainland caribou ranges), avoidance of predation, and/or lack of insect harassment.

The forage biomass of some Peary Caribou habitats (e.g., Banks Island—Larter and Nagy 2001a), and the relatively low prevalence of mosquitoes and warble flies, which allows for uninterrupted foraging (Gunn and Skogland 1997), can lead to accumulation of substantial fat stores. The accumulation of fat reserves in the summer and autumn is critical to survival and reproduction in severe winters (Thomas 1982; Nagy *et al.* 1996).

Dispersal and Migration

Peary Caribou move relatively long distances, including annual migrations across sea ice, regular movements within multi-island home ranges and erratic large-scale movements among islands during severe winters (see **Population Spatial Structure and Variability**; Figure 3).

The islands of the Canadian Arctic Archipelago are surrounded by ice for ≥ 9 months each year (Miller *et al.* 2005b); most inter-island crossings by Peary Caribou occur during the period of highest quality and concentration of fast ice, corresponding with travel to winter and spring/summer ranges (Jenkins and Lecomte 2012). However, there are also observations of Peary Caribou swimming between islands during seasonal movements (Miller 1995a).

There are many records of Peary Caribou crossing the sea ice in seasonal migrations among the islands and between the mainland and Arctic Islands. These are not necessarily fixed migration routes that are used habitually, but rather broad migration zones that individuals use to travel from winter ranges to calving areas and summer ranges (Miller *et al.* 2005b). For example, Miller *et al.* (2005b) documented 73 crossing sites representing 850 Peary Caribou trails on northeastern Franklin Strait (between Boothia Peninsula and Prince of Wales Island) and Peel Sound (between Somerset and Prince of Wales Islands) in three years (1977-1980). These crossings were also relatively evenly distributed, regardless of the length of the sea-ice crossing site or the elevation at its origin or terminus. There is also some evidence to support forced dispersal during winters characterized by icing events or above average snow fall (see SARC 2012).

Little is known about dispersal except that mtDNA analyses showed a low frequency of recent (“within the last several generations”) unidirectional dispersal from WQEI into Banks Island, Northwest Victoria Island, and the Prince of Wales-Somerset islands; and from the latter to Banks Island and the Boothia Peninsula (McFarlane *et al.* 2014).

Interspecific Interactions

Muskoxen

There has been substantial concern, particularly at the community level, about interspecific interactions between Muskoxen and Peary Caribou. ATK and community knowledge has emphasized this issue (see SARC 2012). Inuit from Resolute Bay and Grise Fiord reported that “a large abundance of Muskoxen is often followed by the decline in the population of caribou in a specific area” (Taylor 2005). In Environment Canada recovery meetings, community participants have identified competition with Muskoxen as a major threat to Peary Caribou, as would be suggested by evidence of displacement of the latter by the former, or contrasting population trends (Olohaktomiut HTC 2013; Paulatuk HTC 2013; Spence Bay HTO 2013).

Historically, on Banks Island, northwestern Victoria Island, and Prince of Wales-Somerset islands, Peary Caribou and Muskoxen have had opposite trajectories in abundance (Gunn *et al.* 1991; Gunn and Dragon 1998; Nagy *et al.* 2009e; Davison *et al.* 2013). By the late 1980s, concurrent with a major decline of Peary Caribou on Somerset Island, hunters noted that areas previously occupied by caribou were now occupied by Muskoxen (cited in Taylor 2005). Recent disease-associated declines of Muskoxen on Banks and Victoria islands (Kutz *et al.*, 2015) have not been accompanied by as rapid an increase in Peary Caribou as historically observed (see **Threats and Limiting Factors**). The bacteria isolated from Muskoxen as a disease-causing agent is a generalist and also able to infect caribou; however, its role in the current Peary Caribou population dynamics is uninvestigated. Concurrent declines in both Muskoxen and Peary Caribou have also been observed, for example, on WQEI, although there were differences in the rates of recovery (Miller *et al.* 1977b; Gunn and Dragon 1998; Anderson 2014). Weather-related events are often implicated in these concurrent declines.

The frequent comments in recorded Inuvialuit ATK (e.g., Peter Esau quoted by Berger 1976) suggest that Peary Caribou and Muskoxen are competitors for forage. On the other hand, Parker (1978) concluded that in winters with average snow conditions on Bathurst Island, there is no interspecific competition with Peary Caribou and Muskoxen. However, he suggested that in severe winters there could be competition as both species sought willows on exposed slopes and ridges. During the 1973-1974 severe winter when many individuals of both species died on Bathurst Island, a retrospective analysis suggested there was no interspecific competition between them because the fecal pellet densities were negatively associated with one another and relationships with certain forage species contrasted significantly (Thomas *et al.* 1999).

Investigators have largely compared habitat use or forage overlap between the two species as a means of indirectly assessing competition. On Banks Island, Wilkinson and Shank (1974) and Vincent and Gunn (1981) found no evidence to suggest competition between Peary Caribou for forage or space. As abundance of Muskoxen increased during the 1990s, studies did, however, reveal that diets overlapped (Larter and Nagy 1997; 2004), but this is not in and of itself indicative of competition. The potential for apparent competition under certain conditions cannot be ruled out. Jenkins (2006) suggested that caribou may avoid Muskoxen to avoid predation by Wolves. Gunn *et al.* (2011) also speculated that "...the increasing Muskox abundance supported increased Wolf numbers which, in turn, could increase predation rates on Peary caribou."

Several observers have noted that the spatial segregation between Peary Caribou and Muskoxen may have a deeper, behavioural basis than habitat preferences. Segregation has been reported on Banks Island (Kevan 1974 and others; Wilkinson and Shank 1974), Melville Island (Thomas *et al.* 1999), Axel Heiberg (Tener 1963), Bathurst Island (Ferguson 1987) and Ellesmere Island (Jenkins 2006; Manseau *et al.* 2004; Tener 1963). People in Ulukhaktok suggested that the caribou had moved toward Cambridge Bay to escape the Muskoxen at Minto Inlet (Gunn 2005). Inuvialuit and Inuit ATK has many references to caribou avoidance of Muskoxen because they dislike their smell, or simply because "caribou don't like Muskox" (Ulukhaktok residents quoted by Kassam 2009; Ekaluktutiak HTO 2013; Iviq HTA 2013; Palaulatuk HTC 2013). ATK suggests that caribou may avoid areas of high Muskox use because they trample the vegetation and pack the snow, which impedes feeding by caribou (SARC 2012).

Predation

Sachs Harbour residents have previously linked the high Wolf numbers with the increasing Muskox numbers and declining Peary Caribou on Banks Island (Sachs Harbour Community Conservation Plan 1998 cited in SARC 2012). On Banks and northwestern Victoria islands, Muskox populations greatly increased in the 1960s after a 1955–1959 poisoning program reduced the number of Wolves (Heard 1984). Nagy *et al.* (1996) noted that Wolf populations had increased "dramatically" on Banks Island during a period of Muskox increase/caribou decline, that Wolf predation on caribou had been observed, and that "Peary caribou on Banks Island may be in a situation ... where a high bio-mass of Muskoxen supports an increasing Wolf population... Even if predation rates on caribou are low, the impact may be significant especially given their recent low numbers." Nagy *et al.* (2013) noted that 1998 was the first time in 20 years that the Muskox population on Banks Island showed signs of decreasing while the number of Wolves seen during ungulate surveys continued to increase.

Similarly, on northwestern Victoria Island, a survey of local knowledge showed that Wolves had increased from the 1970s through the 1990s, coincident with the increase of Muskoxen and decline of Peary Caribou (Gunn 2005). Gunn (2005) suggested that higher numbers of Muskoxen could maintain high numbers of Wolves and lead to relatively high predation on the remaining caribou.

Other predators include Grizzly Bears (*Ursus arctos*) and Wolverines (*Gulo gulo*). Arctic Foxes (*Vulpes lagopus*) sometimes attack juvenile caribou (SARC 2013). Community members within the two southern Peary Caribou subpopulations report increasing numbers of recent sightings of Grizzly Bears and/or Wolverines (Ekaluktutiak HTA 2013; Gjoa Haven HTA 2013; Sachs Harbour HTC 2013; Spence Bay HTO 2013).

Pathogens

The prevalence and intensity of parasite infections and diseases in Peary Caribou is little known. One caribou parasite that is relatively easily tracked is the warble fly but the prevalence of warbles parasitizing caribou on Banks or northwestern Victoria islands is not known. On Melville and Prince Patrick islands, 11 and 16% of Peary Caribou, respectively, collected in 1974-79 had warbles (Thomas and Kiliaan 1990). Almost the only information on other parasites and diseases is from Banks Island where Inuvialuit report tapeworm cysts in the muscle of Peary Caribou: the primary hosts of the tapeworms are wolves or foxes (*Vulpes* spp); numbers of cysts in the caribou vary and may be related to fox cycles (Nagy *et al.* 1998).

More is known about diseases in Muskoxen on Banks Island, but it is unknown whether Muskox diseases and parasites are a threat for Peary Caribou. Some parasites and diseases recorded for Muskoxen have not been found in Caribou, including Yersiniosis, which is prevalent among muskoxen (Larter and Nagy 1999). *Giardia* is found in Muskoxen but not in caribou although another protozoan parasite, *Cryptosporidium*, was in 22% of Peary Caribou fecal samples from Banks Island in the 1990s (Nagy *et al.* 1998).

Barren-ground Caribou and Muskoxen share several parasites, including gastrointestinal helminths and a species of lungworm (Kutz *et al.* 2012), and are susceptible to a number of the same pathogens, including the bacteria *Brucella suis* and *Erysipelothrix rhusiopathiae* (see **Threats and Limiting Factors**). Parasite-mediated competition between caribou and Muskoxen has been postulated with respect to the abomasal nematodes (Hughes *et al.* 2009). The abomasal nematodes, *Teladorsagia boreoarcticus* and *Marshallagia marshalli*, are associated with poorer body condition (both) or protein indices in Muskoxen and caribou, respectively (Steele 2013; Kutz *et al.* unpubl. data). These species are common in Muskoxen, and the relative abundance in caribou appears to increase where they are sympatric with Muskoxen (Hughes *et al.* 2009; Kutz *et al.* 2012; Steele *et al.* 2013). In the Kangerlussuaq area, west Greenland, Barren-ground Caribou have a parasite fauna dominated by parasites also found in the introduced Muskoxen. *Marshallagia marshalli* is associated with lower protein and kidney fat indices in barren-ground caribou in Greenland (Steele *et al.*, 2013). Studies to date have been inadequately designed to assess the effect of *T. boreoarcticus* on caribou; however, this parasite negatively impacts body condition in Muskoxen (Kutz, Nagy, Checkley unpubl. data) and the related nematode of caribou, *Ostertagia gruehneri*, negatively impacts body condition and pregnancy in caribou and reindeer (Irvine *et al.*, 2001; Steele 2013).

A parallel with Peary Caribou may be the documented sub-clinical effects of parasitic nematodes on Svalbard reindeer. In Svalbard reindeer, gastro-intestinal nematodes affected body weight sufficiently to reduce pregnancy rates (Irvine *et al.*, 2001), which does suggest that parasites may have sub-clinical effects. Those effects include changes in foraging behaviour to avoid the risk of infection (Van der Waal *et al.* 2000).

POPULATION SIZES AND TRENDS

Sampling Effort and Methods

Survey design in the Arctic Archipelago has to account for low densities and a widespread distribution of animals (Gunn and Poole, 2014). The enormous size (7% of the total area of Canada) and remoteness of the area, which has few operational bases, are logistical constraints. As a result, surveys have been infrequent, with each covering only one or a subset of islands at a time. Evaluating trends in abundance for Peary Caribou since the first surveys were conducted in the 1960s is made difficult by irregular frequency in surveys (in time and space), as well as changes in survey design and methodology (Gunn and Poole, 2014).

Most surveys were aerial strip transects and extrapolated densities observed within the strips to off-transect areas, under the assumption that Peary Caribou are evenly distributed within strata. Most surveys have been stratified, applying higher effort in areas of known or suspected high relative densities, and less effort spent in other areas. Not all investigators have differentiated age classes; those who did have reported “non-calves” or yearlings plus adults, or “short yearlings” (the previous summer’s calf crop at about 10 months old) plus adults, depending on the time of the survey. Increasing survey accuracy (i.e., by reducing survey altitude and transect width) with the same survey effort results in decreases in precision, because coverage is less (Gunn and Poole, 2014). Precision is usually, but not always (especially in earlier years), a measure of variance (i.e., 95% confidence interval [CI] or standard error [SE]). Otherwise, population numbers are minimum counts, which are also sometimes generated from unsystematic aerial searches or surveys for other species (e.g., Muskoxen). Telemetry by VHF radio or satellite transmitters was applied on Banks, Bathurst and Ellesmere islands, which increased description of seasonal movements for Bathurst Island (Poole *et al.* 2015) but elsewhere the telemetry remains unreported.

Bias through sightability of animals (pelage relative to background, lighting conditions, etc.) and observer experience is likely high and typically unmeasured (Gunn and Poole, 2014).

The first systematic aerial surveys for Peary Caribou (and Muskoxen) were led by J.S. Tener in 1961 across the QEI (Tener 1963). The researchers applied stratification but did not allocate survey effort by caribou density as prior information was unavailable. Bias was likely similar to other surveys given the narrow strip width and survey altitude. While Tener did not calculate the variance of the estimate, a subsequent recalculation of the estimates conducted by Miller *et al.* (2005b) included confidence limits. Consequently, the coefficient of variation (CV) for western and eastern portions of the study area was 8% and 22%, respectively, which reflects the coverage and is similar to the precision of subsequent estimates. Tener's (1963) surveys resulted in a provisional Peary Caribou abundance estimate of 25,845 individuals on the QEI (two of four subpopulations recognized in this assessment). This included 12,799 caribou on Melville Island alone (Tener 1963).

Concerns were raised by Inuit in Grise Fiord and Resolute Bay that the Peary Caribou population could not have been as high as reported by Tener (Ferguson *et al.* 2001), and these doubts have persisted in recent Environment Canada-led technical community meetings during recovery planning for this species (e.g., Iviq HTA 2013; Resolute Bay HTO 2013). On the other hand, Tener's (1963) estimated abundance for Bathurst Island in 1961 was similar to the estimates recorded in 1993 (Miller 1995b) and 2013 (Anderson, 2014). The recent surveys since the last status report include Jenkins *et al.* (2011) who reported population numbers in Nunavut (with the exception of Byam Martin, eastern Melville, eastern Mackenzie King, and Borden islands) during 2001-2008. They used a combination of spring aerial and winter snowmobile surveys and distance sampling (Buckland 2001), using line-transect methods to estimate density and abundance of adults and short yearlings.

Most surveys used transects on individual islands or groups of islands, which is advantageous for comparing estimates between years. In other areas, as has been shown with reindeer on Svalbard (Norway), even slight differences in consecutive survey areas can lead to underestimates and inter-annual variations in abundance (Lee *et al.* 2015). Because most recent aerial surveys have been conducted during summer, only summer surveys are presented here for those islands that had multiple surveys in a single year so as to maintain consistency across years. Densities (number of caribou per area surveyed) were calculated from caribou counts along transects, and in turn were used to estimate caribou abundance for a given survey area (usually island).

Abundances reported from various surveys were not consistently extrapolated to the same area for all the surveys over the past several decades. To ensure consistency, Johnson *et al.* (in prep.) recalculated island areas (after Nagy *et al.* 2009) using a land mask that was generated from the CanVec dataset, an open source digital cartographic reference product produced by Natural Resources Canada (Government of Canada 2015). They used the Canada Albers Equal Area Conic projection to generate area estimates, which are used consistently in this assessment to establish area-corrected abundance estimates. Area-adjusted estimates assume uniform density within each surveyed island, which although unlikely, facilitates comparisons across years (Johnson *et al.* in prep.). Precision was not accounted for in those area-corrected estimates (Appendix 1).

From 1961 to 2014, government agencies conducted a total of 154 aerial surveys to estimate Peary Caribou abundance throughout the Canadian Arctic (Table 2; Appendix 1). Survey frequency and spatial extent have been highly variable across this geography over these 53 years. The most frequently surveyed islands have been Banks Island (Banks-Victoria subpopulation) and Bathurst Island (Western QEI subpopulation). Gunn and Poole (2014) calculated coverage (the percentage of the total area that was surveyed) and precision (Coefficient of Variation; CV) on an island-by-island basis. On average, across the four subpopulations, coverage was between 14-33% and precision 17-33% (Table 2).

Table 2. Summary of the number of surveys by subpopulation of Peary Caribou, from 1961-2014. Source: Gunn and Poole (2014).

Subpopulation	Precision (CV) (%)	Coverage (%)	Number of Surveys	Time Period
Banks-Victoria	31	18	39	1970 to 2014
Prince of Wales-Somerset-Boothia	17	15.5	26	1974 to 2006
Western QEI	26	33	79	1961 to 2013
Eastern QEI	22	14	10	1961 to 2007

Where possible, number of adults (> 1 year) was used to approximate number of mature individuals. Some surveys did not report calf estimates. The number of mature individuals was estimated for each subpopulation by summing the abundances across major islands with relatively frequent surveys during the same time period; a rough estimate of total abundance was derived from summed abundances across the four subpopulations.

There has been no single year where the entire range has received full coverage, nor has this been attempted since Tener's 1961 survey (Tener 1963). Overall three-generation and two-generation trends for Peary Caribou and those for each of the main subpopulations are estimated here through comparisons of area-corrected survey estimates for each of the main islands in each subpopulation (see **Abundance**).

These abundance and trends estimates have much compounded uncertainty owing to factors ranging from errors in survey estimates (discussed above), later onset of reproductive capability for Peary Caribou yielding overestimates of mature individuals (see **Life Cycle and Reproduction**), variable survey methods, variable ranges of the time span among islands to approximate 3-generation or 2-generation population trends, lack of precision in the land area, and unmet assumptions associated with the area-corrected estimates (see above).

Abundance

The most recent surveys for Peary Caribou across the subspecies' High Arctic range yield an estimated total of about 13,700 adult and yearling Peary Caribou (Table 3). However, this estimate is derived from a subset of all islands, some of which were not surveyed within the last decade. Hence, the certainty associated with this estimated population is low.

Fluctuations and Trends

The summed abundances across islands serve as average estimates of Peary Caribou population size through time (Table 3; Figure 5). Periodic stochastic (and unpredictable) die-offs are a feature of Peary Caribou ecology as described in following subpopulation sections (Miller *et al.* 1977a; Parker 1978; Harding 2004; Festa-Bianchet *et al.* 2011). These events may not all be known, because the long periods between surveys may have resulted in missing some abrupt declines and subsequent recoveries. Neither die-offs nor periods of increase appear to be synchronous across Peary Caribou range based on available information. The following section describes abundance patterns derived from scattered surveys within each subpopulation over the past five decades.

Banks-Victoria

The most recent surveys from Banks Island (2014; Davison *et al.*, 2014) and northwestern Victoria Island (2015; Davison and Williams 2013), respectively, indicated a total of about 2,252 mature individuals for this subpopulation (Table 3; Appendix 1). Surveys from the late 1980s point to a considerably higher population (> 8,000), with an overall decline in three generations (27 years) of approximately 68% for both Banks and Victoria Islands combined. The latest surveys have indicated a modest increasing trend in numbers of mature individuals on Banks Island, whereas numbers on Victoria Island may have declined again more recently (Figure 5; Appendix 1).

According to local community knowledge (cited by Usher 1971), caribou numbers had fluctuated with severe winters in the early 1950s, causing deaths and desperation movements off Banks Island. Early estimates by quantitative surveys on Banks Island were 4,000 adults and calves in 1952–1953 (Manning and Macpherson 1958), 2,351 caribou in 1959 (MacPherson 1960), 5,000-8,000 in 1970 (Kevan 1974), and 12,098 in 1972 (Urquhart 1973). The 1970 and 1972 estimates were from systematic aerial surveys although Kevan (1974) only surveyed the northern half of Banks. Before 1972, observers said that most or all caribou were concentrated on the north end of the island. By 1972 the subpopulation had spread throughout the island (Urquhart 1973). Urquhart (1973) commented that an unusually heavy snowfall in the fall of 1970 had caused some caribou to leave Banks Island for the mainland, while others died from malnutrition. Hunters reported that many caribou died during that winter (cited in Gunn and Dragon 1998) and Urquhart (1973) extrapolated from 39 carcasses counted in June 1971 to estimate that 879 caribou died.

Table 3. Area-corrected abundance and trend (3-generation [27y] and 2-generation [18y]) estimates for four Peary Caribou subpopulations. Complete survey data can be found in Appendix 1.

Subpopulation	Island (group)	Earliest survey within 3 generations	Earliest 3-gen area-corrected estimate	Earliest survey within 2 generations	Earliest 2-gen area-corrected estimate	Most recent survey	Most recent area-corrected estimate	Years of monitoring data (3-gen)	Approx. % 3-gen change	Years of monitoring data (2-gen)	Approx. % 2-gen change
BANKS-VICTORIA	Banks	1987	4296	1998	454	2014	2248	27	-47.67%	16	395.15%
	NW Victoria	1987	2790	1998	137	2015	4 ²	28	-99.86%	17	-97.08%
PRINCE-OF-WALES-SOMERSET BOOTHIA	Boothia	1985	4738	1995	3265	2006	1 ²	21	-99.98%	11	-99.97%
	Prince of Wales	1980	4212	1995	5 ²	2004	1 ²	24	-99.98%	9	-80.00%
	Somerset	1980	577	1995	115	2005	4 ²	25	-99.31%	10	-96.52%
	Russell	1980	605	1995	0	2004	0	24	-100.00%	9	
EASTERN QEI	Axel Heiberg	1995	94 ¹	1995	94 ¹	2007	2255	12		12	2298.94%
	Ellesmere	1989	396 ¹	1995	149 ¹	2015	918	26	132.81%	20	516.11%

Subpopulation	Island (group)	Earliest survey within 3 generations	Earliest 3-gen area-corrected estimate	Earliest survey within 2 generations	Earliest 2-gen area-corrected estimate	Most recent survey	Most recent area-corrected estimate	Years of monitoring data (3-gen)	Approx. % 3-gen change	Years of monitoring data (2-gen)	Approx. % 2-gen change
WESTERN QEI	Melville	1987	955 ¹	1997	797	2012	2740	25	186.91%	15	243.79%
	Prince Patrick	1986	156 ¹	1997	87	2012	2746	26	1660.26%	15	3056.32%
	Eglinton	1986	79 ¹	1997	0	2012	181	26	129.11%	15	
	Emerald	1986	14 ¹	1997	0	2012	45	26	221.43%	15	
	Byam-Martin	1987	100 ¹	1997	0	2012	121	25	21.00%	15	
	McKenzie King	1974	60 ¹	1997	36	1997	36	23		0	
	Borden	1973	16 ¹	1973	16 ¹	1973	16	0		0	
	Brock	1973	24 ¹	1997	0	1997	0	24		0	
	Devon	2002	110 ¹	2002	110 ¹	2008	17	6	-84.55%	6	-84.55%
	Lougheed	1985	0	1997	103	2007	375	22		10	264.08%
	Danvers Is. Complex	1988	1070 ¹	1997	81	2013	1463 ¹	25	36.73%	16	1706.17%
	Cornwallis	1988	52 ¹	2002	2	2013	4 ²	25	-92.31%	11	100.00%
	Little Cornwallis	1988	0	2002	0	2013	1 ²	25		11	
	Helena	1988	26 ¹	1997	0	2013	2 ²	25		16	
OVERALL (approx.)			21,637		5,451		13,178		-35.31%		141.75%

¹Survey counts that include calves; ²minimum counts.

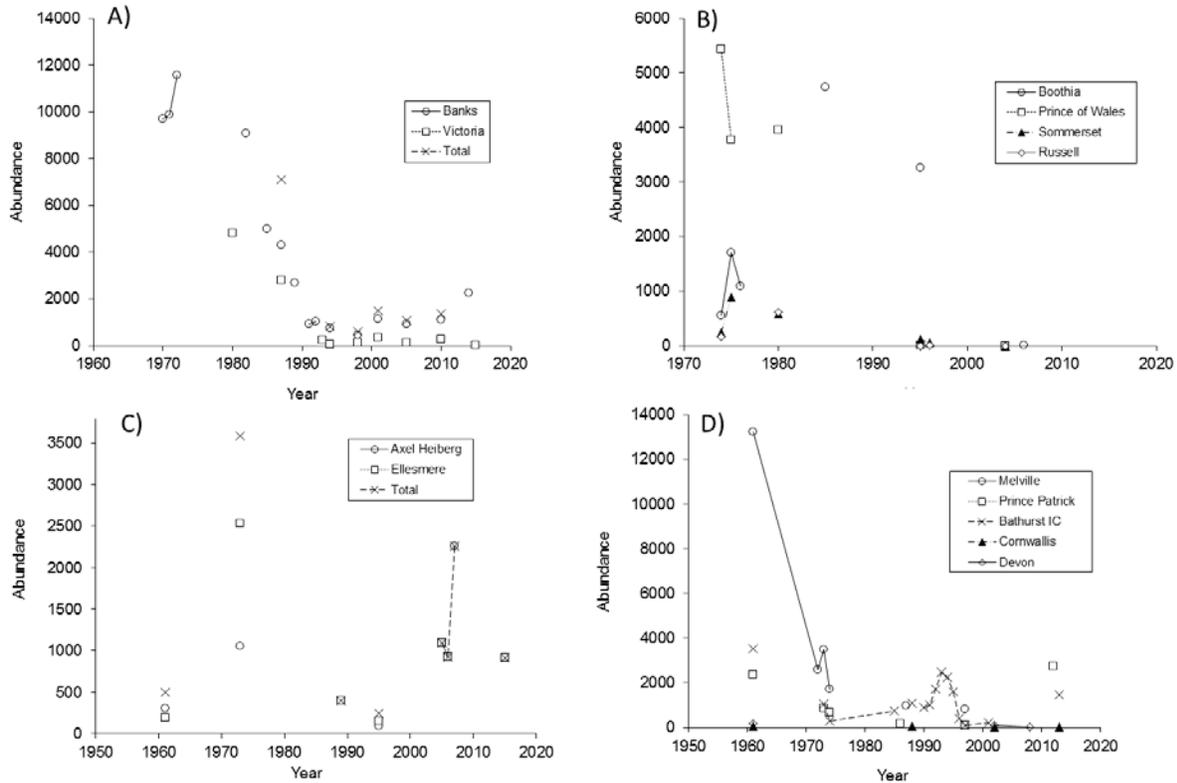


Figure 5. Abundance estimates from various island surveys for four Peary Caribou subpopulations: (A) Banks-Victoria; (B) Prince of Wales-Somerset-Boothia; (C) Eastern Queen Elizabeth Islands; (D) Western Queen Elizabeth Islands. Estimates are extrapolated from study areas to whole islands to aid in comparison across years and some earlier estimates (especially from WQEI) include calves. Totals were computed only when abundance estimates were available for each island in a group within a particular year. Standard errors are available for some surveys in Appendix 1. Figure produced by J. Bowman.

Available estimates from aerial surveys on Banks Island suggest steady declines from 1982 and relative stability at a low level from 1992 to 2010 (Gunn 2005; Davison and Williams 2013). The increase from 2,351 in 1959 (MacPherson 1960) to 12,098 in 1972 (Urquhart 1973) implies an average finite rate of increase (λ) of 1.14, or 14% per year. It declined more or less consistently, reaching a low of $451 \pm \text{CI } 60$ in 1998 (Nagy *et al.* 2013a). However, Nagy *et al.* (2006) suggested that the 1998 estimate was low for unspecified reasons. Abundance then increased to an estimated $1,142 \pm \text{CI } 324$ in 2001 (Nagy *et al.* 2006; a finite rate of increase of 30% for 3 years) and increased again to 2,234 in 2014 (Davison *et al.* 2014), the most recent estimate (Appendix 1).

The overall trend of Peary Caribou on northwestern Victoria appears more variable than Banks Island although survey frequency has been less. Historical information gathered for the Olokhaktomiut Community Conservation Plan (Anonymous 2008) related to northwestern Victoria Island stated that from 1900 to around 1920, Peary Caribou were increasing; however, a freezing rain event in about 1920 caused extensive mortality. Numbers fluctuated from then through the 1970s. Hunters from Ulukhaktok had difficulty finding Peary Caribou in the winters of 1991-1992 and 1992-1993 (Ulukhaktok, Wildlife Management Advisory Council (NWT), and Joint Secretariat 2008). Between 1980 and 1993, Peary Caribou from northwestern Victoria Island were surveyed five times, revealing a rapid decline from a high of 4,512 caribou in July-August 1980 (Jakimchuk and Carruthers 1980) to an estimated 159 in 1993 (Gunn 2005). A 2015 survey (April-May) recorded only one group of two individual Peary Caribou, while the most recent survey prior to that (July-August, 2010) yielded an estimate of 150 ± 104 adults. Reasons for the continued decline on northwestern Victoria Island are unknown, but are not thought to be related to disease and/or hunting (Davison and Williams 2013).

Prince of Wales-Somerset-Boothia

Current numbers of Peary Caribou in the Prince of Wales-Somerset-Boothia subpopulation are suspected to be close to zero at present, although the most recent survey was conducted almost 10 years ago. Surveys flown in 1980 and 1985 for this subpopulation yielded estimates of as many as 10,000 mature individuals, which plunged to a handful of individuals in the most recent surveys, suggesting close to 100% decline. Local hunters continue to observe occasional Peary Caribou or their tracks on the islands (Ekaluktutiak HTA 2013; Resolute Bay HTO 2013), but only at very low densities, and predicted a long slow recovery for the subpopulation (Campbell 2006).

An Inuk elder remembered his father saying that caribou were present in large numbers in the 1920s on Somerset Island and were hunted there until 1928–1930 when many caribou died; caribou persisted in small numbers there and on Prince of Wales Island until the late 1960s when they began to increase (Taylor 2005). Hunters from Taloyoak also reported that caribou numbers on Prince of Wales, Somerset, and Russell islands and Boothia Peninsula were low from the 1940s to the early 1970s and then increased (Gunn *et al.* 2006 and references therein). By the late 1970s there were "...lots of caribou, enough for winter clothing" on both islands (ATK in Taylor 2005).

The peak abundance recorded for Prince of Wales-Somerset islands was 5,682 total caribou in 1974 (Fischer and Duncan 1976), and 4,831 ± 543 on Boothia Peninsula in 1985 (Gunn and Ashevak 1990; Gunn and Dragon 1998). In the 1980s, during a period with high caribou numbers on Somerset Island and the small islands surrounding it, Inuit began seeing evidence of disease or parasites in caribou. Some caribou found dead had not died of old age or Wolf predation and caribou numbers began declining (ATK in Taylor 2005). The Resolute Bay hunters also said that by the early 1990s, the decline was so severe that they stopped hunting on Somerset and Prince of Wales islands. A 1995 survey, using the same methods and survey coverage as in 1980, found only 7 caribou on the three islands (Gunn and Dragon 1998). Because only two of those seen in 1995 were “on-transect”, no quantitative estimate was possible. A non-systematic survey looking for caribou and tracks in April-May 1996 reported two caribou on Somerset Island (Miller, 1997). In 2004 no caribou were seen during aerial surveys of the islands, and only four were seen on Somerset Island by ground crews (Jenkins *et al.*, 2011). There have been no surveys conducted in the area since 2006, when Dumond (2006) spotted one caribou during a Muskox survey. Although tracks and individuals are spotted on occasion (Ekaluktutiak HTA 2013; Resolute HTO 2013), there is no evidence that numbers have recovered.

Gunn *et al.* (2006) examined factors explaining the near-total loss of Peary Caribou on Prince of Wales, Somerset, and Russell islands, and concluded that the decline from the mid-1980s to the mid-1990s resulted from long-term reduction in survival rates of calves and reproductive females associated with continued hunting and increased Wolf predation. Caribou declines in this subpopulation also coincided with an increase and range expansion of Muskoxen (Campbell 2006; Gunn *et al.* 2006), although there was no scientific evidence for or against deteriorating range condition. Miller *et al.* (2007a) put forward a combination of factors could limit population growth rates including Wolf predation, extreme weather, hunting, and disease.

Despite scientific uncertainty, the decline of Peary Caribou in the Prince of Wales-Somerset-Boothia subpopulation had been foretold: Simon Idlout recalled his father, Timothy Idlout, predicting in the early 1980s that the caribou would drastically decline, based on a die-off under similar conditions that the elder Idlout had observed in the 1920s (cited in Taylor 2005). Hunters in Gjoa Haven have reported that some caribou came from Prince of Wales Island to King William Island in the early or mid-1970s (J. Keanik pers. comm. cited by Gunn and Dragon 1998). Campbell (2006) also stated: “IQ indicates that the decline was a natural and predicted occurrence caused by the impacts of overabundance in the 1970s and early 1980s. According to IQ the major mechanism of the decline was emigration.” Gunn *et al.* (2006) examined this factor, concluding that there was no known severe and prolonged environmental stimulus sufficient to cause so many caribou to abandon their ranges, nor was there any evidence of population increases on neighbouring islands to make up for these losses.

In 1974, 1975 and 1976, Thompson and Fischer (1980) estimated Peary Caribou on the Boothia Peninsula to number 561-626 (June and August surveys), 1,109-1,739 (March and June surveys), and 1,120 (a March survey), respectively; they interpreted the sudden increase from 1974 to 1975 as a large-scale immigration from Prince of Wales Island. They pointed out (citing Fischer and Duncan 1976) that Prince of Wales Island experienced a concurrent population decrease of similar magnitude, and suggested that because the Prince of Wales population did not increase in 1976, while the Boothia population stayed the same or increased that year, the large number of immigrants from Prince of Wales had stayed on Boothia. Gunn and Dragon (1998) estimated $6,658 \pm 1,728$ (SE) on the Boothia Peninsula in 1995, but did not distinguish between Peary and Barren-ground Caribou, although both types were seen. The migration of Peary Caribou from Somerset Island apparently stopped with their near-extirpation by the mid-1990s.

Western Queen Elizabeth Islands

Two Peary Caribou subpopulations are recognized in the QEI, with the majority of islands belonging to the WQEI (Table 1; Figure 1). Most of the largest islands were last surveyed in 2012 and 2013 (Anderson, 2014), together comprising almost half the total area of WQEI (179,648 km²). Bathurst Island has received the most regular attention with ten estimates over a 41-year interval (Gunn and Poole, 2014). Surveys have recorded two die-offs and recoveries during this period. Miller and Barry (2009) examined population data during the 20 years between crashes on the southcentral QEI, where Peary Caribou experienced an average annual rate of increase of 13.2% from 1974 to 1994, which accelerated to 20.5% for the last six years from 1988 to 1994. Following the first crash, Miller *et al.* (1975) calculated subpopulation declines of 92% on Bathurst Island, 87% on Melville Island and 72% on Prince Patrick Island. Aerial surveys in spring 1975 confirmed that the decline continued (or a second decline occurred) during 1974–1975 (Gunn *et al.* 1981). Surveys confirmed another “catastrophic die-off” (or two, if individual years are counted) in the WQEI: in 1994–1995, when the south-central subpopulation (Bathurst and adjacent islands) crashed from 3,155 (based on another recalculation—Miller and Barry 2009) to 542 and again in 1996–1997 (Gunn and Dragon 2002), leaving only 78 caribou (no calves were seen) in the seven main islands of the subpopulation.

Some islands have received relatively little survey attention; the most recent survey in the Prime Minister Group was in 1997 (Mackenzie King, Brock) with Borden Island having been surveyed only in 1973 (Table 3; Appendix 1).

The most current combined population estimate (2012-2013) from Melville, Prince Patrick, Eglinton, Emerald, Byam-Martin, Bathurst Island complex, Cornwallis, Little Cornwallis, and Helena islands is about 7,300 adults. Surveys that were conducted in the same areas in 1986-1988 totalled 2,500 individuals (including calves). This implies a 232% increase in the overall population over the past three generations.

Miller and Barry (2009) asserted that the primary factor controlling Peary Caribou numbers on the QEI has been infrequent, isolated, stochastic weather events, namely exceptionally severe snow or ice conditions, causing reduced or failed reproduction, poor early calf survival, and/or high adult mortality. They found no evidence of range deterioration or limits to the abundance of aboveground annual plant production to suggest any direct density-dependent responses.

Bathurst Island complex: The earliest surveys (Tener 1963) estimated 3,509 individuals, including calves (recalculated by Miller *et al.* 2005) on the Bathurst Island complex in 1961. Subsequent surveys in 1973-1974 recorded precipitous declines, after which the population increased by ca. 4% per year over the first seven years after the crash (1974–75 to 1980–81; Miller and Barry 2009). By 1994, it had recovered to just about the same level as in the early 1960s (Appendix 1). Having suspended hunting after the 70s crash, hunters began returning to Bathurst Island in the late 1980s until another crash in mid-1990s that followed a fall rain/icing event, after which they again saw many carcasses of Peary Caribou and Muskoxen (ATK in Taylor 2005). Three successive single-year winter crashes from 1994–95 to 1996–97 resulted in a population of ca. 2–3% of its 1961 or 1994 size (Miller and Barry 2009; Appendix 1). Only two surveys have been conducted since that time, with the latest (2013) demonstrating an increase to $1,482 \pm 387$ (SE) individuals (including calves; Anderson, 2014).

As discussed in detail in COSEWIC (2004), available evidence clearly implicates density-independent weather events as the cause of both population crashes, with the chief cause of death being starvation as a result of prolonged snow or ice conditions hindering access to forage on a prolonged basis. Reproductive success and calf survival was poor during these periods; emigration was ruled out because of the number of carcasses. Resolute Bay elders recall similar die-offs in the 1930s (Resolute Bay HTO 2013).

Regarding recovery from population crashes, the infrequent nature of systematic surveys makes comparing and interpreting increases difficult, even in the relatively well-studied Bathurst Island complex. From 1975 to 1994, caribou on Bathurst and adjacent islands increased at an average finite rate of increase of about 13% per year ($\lambda=1.13$; Miller and Gunn 2003b), although from 1988 to 1993 it was 20% per year and from 1998 to 2001, after the mid-1990s die-offs, 36% per year. After 2001 through 2013 they grew at a more modest rate of $\lambda = 1.18$, or 18% per year. High levels of annual reproduction, early calf survival, and low mortality among adults was evident from 1988 to 1994, when the population tripled in size and weather was favourable (Miller and Barry 2009).

Caribou appear never to have been numerous on Cornwallis Island and surrounding, smaller islands which are mostly calcareous rock with very little vegetation cover.

Melville-Prince Patrick Group and Prime Minister Group: While not nearly as frequently monitored as the Bathurst Island Group, the islands of the Melville-Prince Patrick group and the Prime Minister Group do not appear to have had as many or as severe die-offs. Surveys in 1973 (4,323 caribou) and 1974 (2,418 caribou) documented a decline or die-off previous to 1973 and a die-off during 1973–1974, based on carcass counts and low (almost zero) percentage of calves (Miller *et al.* 1975). However, the severity was “...dissimilar between islands and [was] most marked on north-western islands”; declines were also less severe than on Bathurst and adjacent islands (Miller *et al.* 1975:20).

Long-term trends for the Melville-Prince Patrick-Prime Minister Group of islands show a decline from the 1970s to 1997 (although Borden Island was not surveyed), and an increase to ca. 6,000 adults and yearlings reported by Davison and Williams (2012) for July 2012 (although the Prime Minister Group was not surveyed). The 2012 survey also documents re-colonization of formerly occupied islands.

The infrequent surveys may conceal abrupt population crashes, as in the winter of 1996–1997, when numerous caribou carcasses were observed (Gunn and Dragon 2002). Because the subpopulation estimates were similar in 1986–1987 compared to 1997 (see above), Gunn and Dragon (2002) suggested that this also implied an undocumented increase between 1987 and 1996.

Early explorers commented on the abundance of caribou and other wildlife in the two westernmost groups of islands (e.g., Parry 1821; M'Dougall 1857; Henessey cited in Bernier 1910; Stefansson 1921). In 1958–1959, MacPherson (1961) surveyed Emerald Isle, Eglinton Island, Melville and Prince Patrick islands, and the Prime Minister Group and estimated a total population of 6,898 (there were none on Brock or Eglinton islands). Tener's (1963) 1961 estimate was 12,799 total caribou for Melville Island, extrapolated from his counts of 769 caribou in 3 strata on Melville Island; he noted that they were distributed widely across the island, as opposed to the clumped coastal distribution he had seen on Bathurst Island. While admitting uncertainty in some assumptions in his calculations, Tener (1963:22) asserted that “...there is little doubt, however, that the total caribou population is in the thousands, far more than hitherto believed.”

Miller (1987, 1988) surveyed Prince Patrick, Eglinton and Emerald islands in 1986 (181 ± SE 59 caribou) and Melville Island (943 ± SE 126) and Byam Martin Island (98 ± SE 37) in 1987; the combined estimates for the two years total 1,222 (Appendix 1). In 1997, Gunn and Dragon (2002) found 907 adult and yearling caribou on three islands: Melville Island (787 ± SE 97), Prince Patrick Island (84 ± SE 34), and Mackenzie King Island (36 ± SE 22), with no live caribou on Eglinton, Byam Martin, Emerald, or Brock islands. Borden Island was not surveyed. In summer 1997, dead caribou made up 43% of the 1+ year old caribou surveyed in summer 1997 on the WQEI, although mortality rates varied by island (30% for Melville Island, 84% for Bathurst, 22% for Loughheed, 40% for the Prime Minister Group; Gunn and Dragon 2002).

Lougheed, Ringnes and Devon islands: Tener's (1963) 1961 estimate was 566 caribou on the Amund Ringnes and Ellef Ringnes islands (13% calves), 269 on King Christian and Cornwall islands (30% calves), and 1,325 caribou on Lougheed Island (22.1% calves). Ground surveys by Stefansson (1921) estimated 300 caribou, which was also Macpherson's (1961) extrapolation from a geologist who counted 56 caribou from a high hill where he could observe about a quarter of the island. Resolute Bay hunters reported that Lougheed Island had "plenty of healthy caribou" in the early 1970s (Tony Manik in Taylor 2005). After the 1973–1974 crash, no caribou were documented (although surveys were infrequent) until Gunn and Dragon (2002) estimated $101 \pm \text{SE } 73$ adults and yearlings living on the island in 1997. Like the other island groups in WQEI, Lougheed was affected by the mid-1990s die-offs, with about 22% of the population represented by dead caribou in 1997 (Gunn and Dragon 2002). The most recent estimate was $372 \pm \text{CI } 234$ adults plus "short yearlings" on Lougheed Island and the four smaller islands extending south of it (collectively the Findlay Group) in 2007 (Jenkins *et al.* 2011). Caribou were only seen on Lougheed Island.

On western Devon Island, Jenkins *et al.* (2011) counted 35 caribou (no calves), mostly off transect in 2002, and gave a rough estimate of 40 caribou. In a more extensive survey (7,985 km) of all non-glaciated areas of Devon Island and small proximal islands in 2008, they found just 17 Peary Caribou.

Eastern Queen Elizabeth Islands

At 239,413 km², the EQEI occupy a larger area than WQEI and are made up of only two large remote islands: Ellesmere and Axel Heiberg. There have only been a few surveys since Tener (1963), with the most recent published accounts in 2005-2007 (Jenkins *et al.*, 2011) and 2015 for southern Ellesmere Island (Anderson and Kingsley 2015). Available information suggests that numbers have increased since the 1990s, but it is important to note that recent surveys have covered more areas than in the past (Table 3).

In 1961, Tener (1963), acknowledging uncertainty based on low coverage and other factors, gave "provisional" estimates of 300 (14% calves) on Axel Heiberg Island (which he characterized as an "intuitive guess") and 200 on Ellesmere Island (11% calves), the latter based on very low coverage, particularly in the north. Miller *et al.* (2005b), recalculated the 1961 estimates from Tener's original maps and field records, almost doubling the total number of Peary Caribou. Hendrigan (in MacPherson 1963) estimated 150 caribou on Axel Heiberg in 1960, more than half in the north from Cape Stallworthy to Nansen Sound, which is also where Tener recorded animals in 1961. Since that time, a few partial surveys were completed. For example, Riewe (1973) estimated 35 caribou around Skaare and Wolf fiords on southeast Axel Heiberg in 1973, Zoltai *et al.* (1981) saw no caribou in their study area on the east slopes of Axel Heiberg in 1980, while Gauthier (1996) reported a minimum count of 25 caribou in June 1995 on Axel Heiberg (Skaare Fiord to Mokka Fiord and west to Li Fiord). The island was not completely surveyed until 2007, with an estimate of 2,291 caribou of ≥ 1 year, mostly along the eastern slopes (Jenkins *et al.* 2011). However, reconnaissance flights in

summer 2014 along eastern and southeastern Axel Heiberg only reported sightings of three bulls and a cow-calf pair at Skaare and Wolf fiords (M. Anderson, pers. comm. 2015). This island is too remote for hunters to access, with the most frequent access being researchers at Expedition Fiord who report seeing caribou occasionally in the limited ground they cover (M. Anderson, pers. comm. 2015).

Since Tener's survey on Ellesmere, several surveys have covered parts of the island, particularly in the south. Riewe (1973) estimated 150 caribou in 1973 on southern Ellesmere. Case and Ellsworth (1991) estimated 89 ± 31 (SE) caribou on southern Ellesmere Island. Gauthier (1996) counted 38 caribou on southern Ellesmere in June 1995. Southern Ellesmere was surveyed in 2005, along with Graham Island, with an estimate of 219 adults (109-442 95% CI). A survey was flown in March 2015 in the same area, with an estimate of 183 ± 128 (SE) indicating stability at a low density on southern Ellesmere Island (Anderson and Kingsley 2015). Central and northern Ellesmere were last flown in 2006, with an estimate of 802 adults (531-1207 95% CI) (Jenkins *et al.* 2011).

IQ emphasized the continued presence but general scarcity of caribou on southern Ellesmere Island until the early 2000s when they began to increase; Grise Fiord residents also reported fluctuations in numbers and more particularly in distribution, on southern Ellesmere Island (Taylor 2005). Peary Caribou have also been reported on Axel Heiberg Island by residents of Grise Fiord and Resolute when they (rarely) visit the island, and by the pilots and researchers working there in the spring and summer. The evidence could also suggest that caribou are re-colonizing areas that have been unoccupied for 15-25 years (Campbell 2006).

Summary

In light of the inconsistent surveys (different islands in different years, which may not accurately reflect subpopulations), large data gaps, and variable survey techniques and coverage, overall trends for Peary Caribou and each of its four subpopulations must be considered approximations and interpretations should be made with caution.

COSEWIC (2004) provided a rough total estimate of 50,000 Peary Caribou in the 1960s-70s when the first counts were made; in 1987, roughly three generations ago, the population was ca. 22,000 mature individuals (including some calves, especially from WQEI). Peary Caribou were at their overall lowest in 1996 at ca. 5,400 mature individuals (Table 3). The population estimate for the last COSEWIC assessment was 7,000 (COSEWIC 2004), while the current estimate is 13,700. In spite an increasing overall two-generation population trend of ca. 150%, the three-generation decline is just over 35% (Table 3).

WQEI experienced profound declines in the mid-1990s, related to icing events, whereas declines of both the Banks-Victoria and Prince of Wales-Somerset-Boothia subpopulations commenced almost a decade earlier and took place more gradually and for reasons that are less understood. One subpopulation (POW-Somerset-Boothia), which comprised almost half (10,000 mature individuals) of the estimated Peary Caribou population in 1987, has shown no signs of recovery. Banks-Victoria numbers have been increasing in the past decade, but not on Victoria Island. The WQEI subpopulation has increased overall since the mid-1990s, but with some fluctuations. EQEI numbers appear to be increasing as well, although baseline numbers are highly uncertain (Table 3).

Peary Caribou does not meet the IUCN definition of “extreme fluctuations” (IUCN 2014) because the magnitude of the population changes has been less than 10-fold, they are not synchronous for the four subpopulations, and are more reflective of population reductions (followed by some recovery) in response to threatening processes, rather than naturally recurring patterns of increases and decreases. However, ATK does indicate a tendency for population numbers to fluctuate over time over the past century (Ekaluktutiak HTA 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTO 2013), and many island surveys indicate considerable variability around the mean (Appendix 1).

Rescue Effect

The only potential source for rescue of Peary Caribou from outside Canada would have been from northwestern Greenland at one time, but there is little evidence of a present-day extant population (see **Global Range**).

THREATS AND LIMITING FACTORS

Direct threats facing Peary Caribou assessed in this report were organized and evaluated based on the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (Master *et al.* 2009). Threats are defined as the proximate activities or processes that directly and negatively affect the Peary Caribou population. Results on the impact, scope, severity, and timing of threats are presented in tabular form in Appendix 2. The overall calculated and assigned threat impact is Very High-Medium for Peary Caribou. This wide range rank of threat impacts is due to the combined effect of the high number of mostly low-impact threats, and the considerable uncertainty, unpredictability, and potential overlap and interaction of individual threats.

Narrative descriptions of the threats are provided below in the general order of highest to lowest overall impact threats.

High-Medium Impact

Climate Change and Severe Weather (IUCN Threat #11)

The highest-impact threat to Peary Caribou arises from the myriad effects of a changing climate. Climate change has already affected the Arctic, and is occurring at higher rates than in other global ecosystems (ENR 2011; IPCC 2013; Stern and Gaden 2015). Measurable signs of a warmer Arctic and observed and predicted ecological consequences are commonly reported (Hinzman *et al.* 2005; Lim *et al.* 2008; Post *et al.*, 2013). Inuit of the Kitikmeot region reported for the mainland a variety of changes, including longer summers, unusual freeze-thaw cycles in the spring, earlier spring break-up and open sea-ice, later fall freeze-up, thinner ice (both lakes and sea-ice), lower water levels, and less snowfall (Golder Associates Ltd. 2003). For the Arctic islands, community representatives reported effects similar to those in the Kitikmeot region, plus icebergs having disappeared north of King William Island, the extent of multi-year ice reduced, harder and rougher snowpack, and altered prevailing wind direction and causing altered orientation of snowdrifts (Golder Associates Ltd. 2003 and sources therein).

For Peary Caribou, changes in three Arctic climate (abiotic) variables – temperature, precipitation and severe weather events – account for most population-level effects of climate change (reviewed in Johnson *et al.* in prep.). This leads to both negative and positive changes in forage accessibility and decreased extent and thickness of sea ice. The primary population-level impacts range from shifts in migration and movement patterns to periodic mortality events, including population crashes. Climate change may also have a positive effect through extension of the growing season and increases in forage biomass. The accessibility of caribou to hunters will also be influenced by ice conditions and snow cover.

Habitat Shifting and Alteration (#11.1)

Annual average temperatures have increased across the Canadian Arctic from 1950 to 2007, with implications for the timing and amount of plant growth and diversity (Zhang *et al.* 2011). Arctic surface air temperatures since 2005 have been higher than for any five-year period since first measured in the 1880s, and evidence from lake sediments, tree rings, and ice cores suggest that recent summer temperatures have been higher than at any time in the past 2,000 years (AMAP 2012). Other documented changes include higher inflows of warm water entering the Arctic Ocean from the Pacific, declines in the extent and duration of snow cover, with the Arctic land area covered by snow in early summer reduced by 18% since 1966, and Arctic sea-ice decline at a rate that has been faster during the past ten years than averaged over the previous 20 years. Sea-ice thickness is also decreasing and sea-ice cover is increasingly dominated by younger, thinner ice (AMAP 2012).

Future temperatures in the Arctic are difficult to model because of uncertainties regarding extent of snow cover and retreat of sea ice, which are already accelerating much faster than previously predicted (see below). Nevertheless, experts agree that by 2100, mean projections for Arctic winter air temperatures under various CO₂ concentration scenarios will be an increase of 2–9 °C above the 1986–2005 average; the highest projections range up to about 15 °C above the 1986–2005 average (IPCC 2013b). By 2035, Christensen *et al.* (2013) predicted mean annual surface temperature in the Arctic to rise by 1.5°C, with mean winter (December to February) temperature expected to increase more than mean summer (June-August) temperature (+1.7°C winter vs. 1°C summer). Mean projections for sea surface temperatures will be an increase from 4 to 14 °C under reasonably foreseeable CO₂ concentration scenarios, with estimates for the highest CO₂ concentration scenario at about 23 °C above the 1986–2005 average (IPCC 2013).

From 1951 to 2008, mean annual precipitation increased by 0.63-5.83 mm/yr/decade across the Arctic (IPCC 2013). Records from NWT climate stations indicate an increase in snowfall by 20-40% in the Arctic tundra (GNWT 2014). Mean annual precipitation is projected to further increase by 6% in 2035, more in winter than summer (Christensen *et al.* 2013).

This threat category is made up of three principal components: terrestrial habitat changes, sea ice loss, and sea level rise. Collectively, these are expected to affect most if not all of Peary Caribou range, with overall impact ranging from moderate to serious, depending on many competing factors.

Terrestrial habitat changes:

Temperature increases (and other climate changes such as increased CO₂) have increased plant biomass. Ahern (2010) used analysis of the satellite-sensed normalized-difference vegetation index (NDVI) to show that plant growth has increased in southern and western parts of the range of Peary Caribou over the past 30 years. In short, “the Arctic is getting greener and primary productivity is increasing” (Eamer *et al.* 2013). These changes include plants leafing out and blooming earlier, which correlates with the general warming over the same time period (Oberbauer *et al.* 2013). With greening due primarily to increased shrub biomass (especially evergreen shrubs), however, the extent to which it will improve habitat or forage, and be of sufficient nutritional content for Peary Caribou is unknown. A spatially explicit modelling effort by Tews *et al.* (2007a) concluded that under scenarios where the frequency of extreme weather events did not change during this century, a projected 50% increase in biomass might alleviate the severity of population die-offs during disturbance years. However, when forage inaccessibility in poor winters increased by more than 30% over the same time period, as might be expected if the frequency and severity of disturbance events increases (as has been predicted to be a result of climate change; Larsen *et al.* 2014), models suggested net negative effects for Peary Caribou population dynamics.

Several authors have suggested that a phenological mismatch could threaten Peary Caribou if climate change were to alter the current synchrony between calving and lactation on one hand, and plant greening and blooming on the other (Festa-Bianchet *et al.* 2011; Gunn 1995, 1998; Gunn and Skogland 1997; Oberbauer *et al.* 2013; Parks Canada 2010; Tews *et al.* 2007b). This may have already occurred in other Arctic caribou ranges: in West Greenland, advancement of the plant-growing season during a period of temperature increase led to increased calf mortality, and a fourfold drop in calf recruitment over about a ten-year period (Kerby and Post 2013; Post and Forchhammer 2008).

Sea ice loss:

Sea ice decline is occurring at a faster pace than predicted by earlier modelling efforts (Overland and Wang 2013). In 2012, seasonal ice shrank to its lowest extent ever, continuing a trend that accelerated after 2000. The 2012 extent was about half that of the average summertime extent from 1979 to 2000, while the maximum winter extent was the fifth lowest in the past 35 years (Vinas 2013). September sea ice extent could shrink another 43%–94% by 2100; “a nearly ice-free Arctic Ocean in September before mid-century is likely” for the highest CO₂ emission scenario (IPCC 2013). The extent of Arctic perennial and multi-year sea ice decreased between 1979 and 2012 and the thickness of average winter sea ice within the Arctic Basin decreased by between 1.3 and 2.3 m between 1980 and 2008 (IPCC 2013). Relevant to Peary Caribou sea ice crossings (Figure 2), declines of total sea-ice concentration that occurred from 2001-2010 were 50% for the M’Clintock Channel and 38% for the Eastern Arctic Channel (Stern and Gaden 2015). A general trend is for freeze-up to be occurring later and thawing events to happen more frequently during winter today than in the past (Ekaluktituiak HTA 2013).

The extent to which loss of sea ice could interrupt the inter-island migrations and other movements in parts of the range of Peary Caribou with population-level impacts is unknown. Hunters reported drowning events in the 1950s of Peary Caribou crossing between islands, and some suspected such events to be responsible for local declines (William Kagyut in Elias 1993; Kassam 2009). The nature of the impact to Peary Caribou populations would relate to the timing of the sea-ice freeze up in fall and break up in summer. This can affect migration patterns and the ability of individuals to move from island to island safely on time. Higher mortality rates can result from drownings that occur when animals fall through the ice as they seek to reach more suitable winter foraging areas. Because multi-island range rotation is known to enable recovery and growth of forage plants on summer ranges (Miller *et al.* 2005b; Resolute Bay HTO 2013), if Peary Caribou are forced to remain on any one island, there may be consequences to forage quality and nutritional state of stranded animals.

Sea level rise:

Sea level has risen about 0.19 m in the last 110 years (IPCC 2013). In the next 90 years, sea level is likely to rise further between 0.26 to 0.82 m (IPCC 2013). Such an

increase could inundate large areas of Prince of Wales Island, Prince Patrick Island and islands in the Prime Minister and Ringnes groups (Pelletier and Medioli 2014) where isostatic rebound does not counter sea level rise.

Storms and Flooding (11.4)

Several high-mortality incidences following severe weather events have been recorded over the past four decades. Peary Caribou die-offs in the WQEI were linked to unusually warm weather in early winter, which caused the upper few centimetres of snow to melt and then subsequently freeze solid, preventing access to forage (COSEWIC 2004 and others). This resulted in 46% (1973-74) and 30% (1996-97) mortality in one winter, and >90% when there were three successive years of severe weather. An event such as this tends to occur as an ice crust on top of the snow, or the melted snow, percolates through the snowpack and refreezes at depth or on contact with the ground. In support of this, IQ reported up to 5 cm of ice in some years (Jenkins *et al.* 2010a;b; Taylor 2005). Similar ATK observations on Banks Island were reported: “in the fall, we get freeze-up on the whole island. Then, before the snow is really deep, we get our mild weather and rain. Then it’s cold enough for the rain to freeze on top the snow and that’s when the caribou try to leave the island, even go out into the ocean.... they were eating mostly ice” (Frank Carpenter quoted in Nagy 1999:163).

How much of a threat climate change may be to Peary Caribou will depend on the frequency and severity of icing (rain-on-snow and melt-freeze) events. Although severe weather events are predicted to increase in frequency and severity, there is considerable uncertainty with respect to location and timing of such events, and the consequent effects on population dynamics within the next three generations. There have been many reports that the frequency of rain-on-snow icing events have increased within Peary Caribou range (Festa-Bianchet *et al.* 2011; Gunn 1998; Gunn and Skogland 1997; Harding 2004; Miller and Gunn 2003a; Sharma *et al.* 2009; Tews *et al.* 2007b, 2012; Vors and Boyce 2009), and are predicted to continue increasing into the future (Hansen *et al.* 2011; IPCC 2013). Erratic weather is linked to the prevalence of freezing rain, and indications are that stochastic weather events are becoming more common on Banks Island due to climate change (Riedlinger 2001).

Miller and Barry (2009) argued that major population declines in Peary Caribou have followed severe winter weather due to forage inaccessibility bringing about starvation, and Arctic community members also consider this to be a major threat to Peary Caribou (Resolute Bay HTO 2013; Sachs Harbour HTC 2013; Spence Bay HTO 2013). The negative effects of severe weather events such as icing on populations appear to be predominantly through increased mortality from reduced forage in winter (“locked pastures”; Hansen *et al.* 2011) or reduced production of calves (Miller *et al.*, 1977; Miller, 1991a; Gunn and Dragon, 2002; Miller and Gunn, 2003; Tews *et al.*, 2007b). Contrastingly, Tyler (2010) argued that the effect of above-zero temperatures when snow is on the ground depends on snow depth: while warm weather may cause melting and a hard crust in deep snow, in shallow snow it could improve forage availability by melting the snow and baring the foliage.

Medium - Low Impact

Pathogens (IUCN Threat # 8.1 [Invasive non-native alien species])

The potential role of disease in Peary Caribou population dynamics is not well understood. ATK on Prince of Wales-Somerset indicated that increased observations of disease were accompanied by population declines in the 1980s (ATK in Taylor 2005). The literature on disease in Peary Caribou is sparse, thus potential issues are extrapolated from what is known in other caribou ecotypes and Muskoxen.

Known pathogens of potential concern that have impacts on reproductive success or survival in caribou include *Brucella suis* biovar 4, *Erysipelothrix rhusiopathiae*, Cervid herpes virus, parapox virus, *Neospora*, *Besnoitia*, and gastrointestinal parasites. Of these, the most important threats may be *Brucella* and *Erysipelothrix*.

Brucella suis biovar 4 is a bacterium that can cause arthritis, bursitis, and infertility. It has been associated with substantial population decline of the Southampton caribou since 2000 (Campbell, 2013). *Brucella* has not previously been reported in Peary Caribou and a serological survey on Banks Island in 1993-94 did not detect antibodies to this disease (e.g., serum samples were negative for brucellosis—Larter *et al.* 1996). However, clinical cases were detected in Muskoxen on Victoria Island near Minto Inlet and Ekalluk River between 1996-1998 (B. Elkin pers. comm. 2015), and more recently (2014) in a sport-hunted Muskox near Cambridge Bay (M. Tomaselli pers. comm. 2015). The bacteria is well known in mainland Barren-ground Caribou with fluctuating prevalence (Leighton 2011; Curry 2012), and was reported as an emerging disease issue in the 1980s by hunters near Taloyoak, Kugaaruk, and Gjoa Haven, Nunavut, but presumably from Barren-ground Caribou (Gunn *et al.*, 1991). There is no reason to think that this bacterium will not, if it has not already, invade Peary Caribou populations. The population-level impacts will depend on transmission dynamics; low densities of Peary Caribou may limit spread.

Erysipelothrix rhusiopathiae is a bacterium recently identified as a significant cause of widespread mortality in Muskoxen on Banks and Victoria islands, and likely at least in part responsible for the observed declines approaching 70% on Banks Island since 2010 (Kutz *et al.*, 2013). This is a generalist and opportunistic pathogen, and is often found infecting domestic animals that are considered 'stressed'. In Muskoxen and caribou it can cause sudden death, and in Muskoxen this is of all age classes. Several Barren-ground Caribou herds have tested positive for exposure to this bacterium (S. Kutz pers. comm. 2015) and it was considered the cause of death for Mountain Caribou in British Columbia (Forde 2015). While there remain many uncertainties about the origin and ecology of this bacterium in the Arctic, early data suggest that it should be considered a pathogen of interest for all arctic ungulates, including Peary Caribou (Forde 2015).

In general, under current climate warming scenarios, range expansion of several other pathogens is anticipated, and has already occurred for at least one parasite, the lungworm, *Varestrongylus eleguneniensis* (Kutz *et al.*, 2013). In 2010 this parasite, which affects both caribou and Muskoxen, was detected for the first time on Victoria Island. It was probably introduced by the migrations of the Dolphin and Union caribou, and sporadic movement of Muskoxen to the island from the mainland. The recently permissive climatic conditions appear to have allowed this parasite to now be maintained, and expand its geographic range as far north as Surrey River area (P. Kafle pers. comm. 2015). The parasite requires slug or snail intermediate hosts, so its distribution may be limited by the abundance of these hosts. However, a related lungworm of Muskoxen has also expanded its range onto the island and occurs near Ulukhaktok; thus further range expansion of the lungworm into Peary Caribou range is anticipated. Although *V. eleguneniensis* is not considered to be particularly pathogenic, this recent range expansion highlights that climate change is already driving changes in distribution and abundance of pathogens of caribou.

Climate warming may also act by increasing susceptibility of caribou to infectious disease and insect harassment. Inuit have confirmed that hot weather can cause caribou to lose body condition and they have noted an increase in deaths from heat-related and insect-induced exhaustion that they attributed to climate change (ATK in Dumond 2007; Thorpe *et al.* 2001).

Summer weather influences the activity of warble flies. There has been an increase in suitable weather and a longer fly season from 1957–2009 on Barren-ground Caribou ranges (Gunn *et al.* 2011 and references therein). Warble flies are considerably less common on the High Arctic islands (e.g., 97% to 100% of Beverly herd caribou had warbles, but only 14% of Peary Caribou; Thomas and Kiliaan 1990), but the adult fly as the infective stage could be prolonged with warmer summers their prevalence could increase with continued global warming.

On the other hand, warmer temperatures may not favour all parasites, i.e., gastrointestinal worms (Hoar *et al.* 2012). A warmer climate will not only affect the existing parasites and diseases but also increase the likelihood of invasive species (Kutz 2007; Davidson *et al.* 2011).

Shipping Lanes (IUCN Threat # 4.3)

The projected decline of sea ice extent increases the possibility of year-round shipping routes within the Canadian Arctic Archipelago, particularly the opening of the Northwest Passage (NWP). It is assumed that increasingly lighter ice conditions will allow the navigation season to lengthen and shipping traffic to increase. In 1990-2011 shipping increased by 75%, reaching a maximum of 19 transits in 2010 (NORDREG in ENR 2011, updated to 2012 by SARC 2012), with some large icebreakers taking the northern route between Melville and Banks islands (McClure Strait: 6 times from 1993-2011; SARC 2012). Passages of cruise ships have already increased more than threefold between 1993 and 2007 (Judson, 2010, cited in Gunn *et al.* 2011). Shipping

traffic experienced a 75% increase in Canadian Arctic waters from 1990 to 2012, while extent of sea ice declined, and is expected to increase further. Increased icebreaker-supported shipping would exacerbate the climate-induced effect of thinner ice and more lengthy ice-free periods (Gunn *et al.* 2011; Poole *et al.* 2010).

Shipping as a potential threat is a consideration for Peary Caribou due to seasonal migrations between islands (Paulatuk HTC 2013; Resolute Bay HTO 2013). In addition to potential population consequences of changes to ice thickness (discussed above), opening of shipping channels during winter would curtail certain island crossings altogether. The severity of impact to the overall population will depend on which island crossings are affected, how consistently across years, and the sizes of the populations. Shipping channels (Figure 6) could open between Prince of Wales and Somerset islands (Prince of Wales-Somerset and QEI-Prince of Wales crossings) and Bathurst-Cornwallis, but are less likely to affect Ellesmere, Axel Heiberg, or the Ringnes group, all of which are largely in pack ice (Figure 3) and not on any trade route.

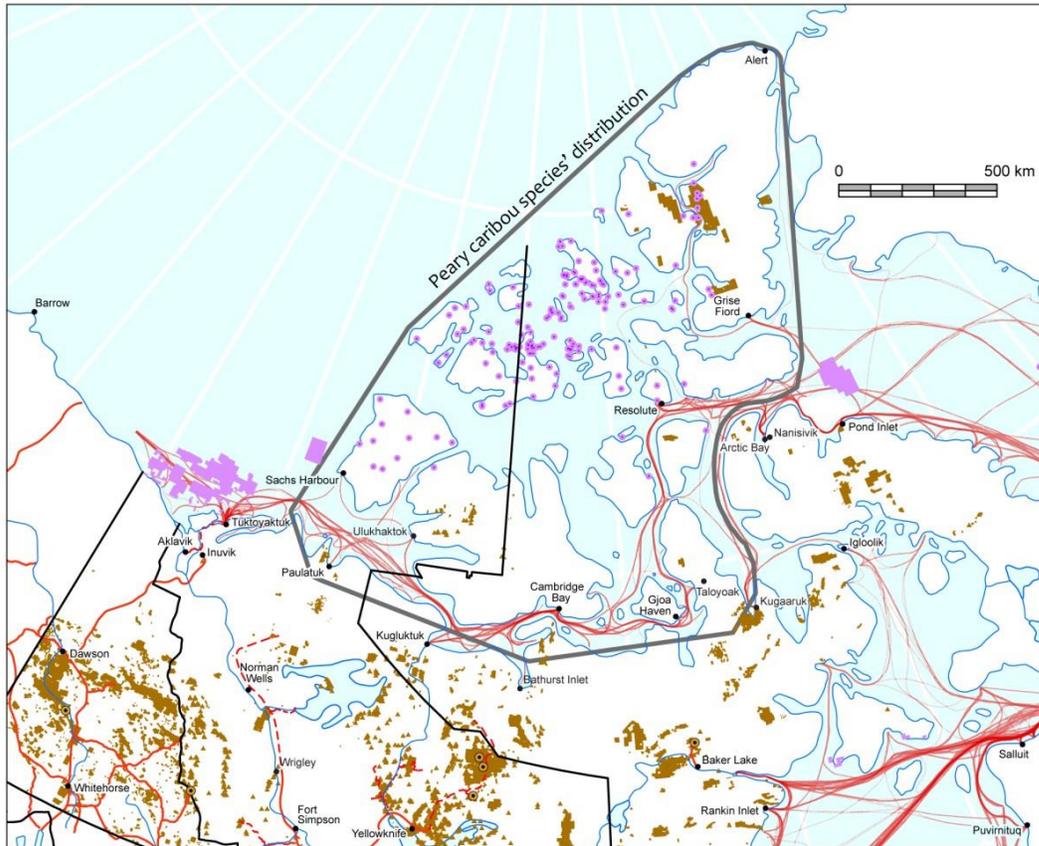
Mine and energy exploration and development (discussed below; Figure 6) could also precipitate increases in shipping traffic in the region. Overall, shipping traffic is expected to increase in the Canadian Arctic Archipelago in the near future.

Low Impact

Hunting (IUCN Threat # 5.1)

Modern Inuit and the cultures that preceded them, including the Thule from whom Inuit are descended, and the unrelated Dorset and pre-Dorset cultures have been hunting caribou in the region for at least 4,000 years (Fitzhugh 1976; Friesen 2013; Howse 2008; Manseau *et al.* 2005; Meldgaard 1960). Large-scale hunting and purchase of caribou meat by European explorers, and their introduction of firearms to Inuit (e.g., by Peary in the 1890s; Roby *et al.* 1984), caused or accelerated some declines, for example on Ellesmere Island (Petersen *et al.* 2010).

Much of Peary Caribou range is too inaccessible from settlements for resident hunters to reach by snow machine. There are no settled communities in the Melville-Prince Patrick group, Prime Minister Group, Ringnes group, Axel Heiberg Island or northern Ellesmere Island (with the exception of the Alert military base). Mould Bay (Prince Patrick Island) and Isachsen (Ellef Ringnes Island) weather stations are currently uninhabited. Therefore, modern-day Peary Caribou hunting takes place in areas accessible from settlements in and adjacent to the population's range.



Mining

- Active Mines¹
- Mineral and Coal licensing² and "Future Mineral Potential"³

Oil & Gas

- Exploratory Wells⁴
- Oil & Gas rights⁵

- Roads
- - - Winter Roads
- Shipping Routes⁶

1. Active Mines:
Canada Northern Economic Development Agency (http://www.cannor.gc.ca/DAM/DAM-CANNOR-CANNOR/STAGING/texte-text/nat_res_dev_project_map_1380647429535_eng.pdf) [accessed 15 Dec 2015]

2. Mineral and Coal licensing:
Geomatics Yukon, Government of Yukon (<http://mapservices.gov.yk.ca/GeoYukon>) [accessed 15 Dec 2015]
Aboriginal Affairs and Northern Development Canada (http://nwt-tno.inac-ainc.gc.ca/ism-sid/minfp_e.asp) [accessed 15 Dec 2015]

3. Future Mineral Potential:
Yukon Government, Energy, Mines and Resources (http://www.emr.gov.yk.ca/mining/pdf/yukon_exploration_projects_december_2012_13x17.pdf) [accessed 15 Dec 2015]
Northwest Territories Geological Survey, NORMIN database (<http://ntgodata.nwtgeoscience.ca>) [accessed 15 Dec 2015]
NunavutGeoscience.ca, Mineral Exploration Overview Magazine 2012.pdf (http://www.nunavutgeoscience.ca/eo/index_e.html) [accessed 15 Dec 2015]

4. Oil & Gas, Exploratory Wells:
Natural Resources Canada, BASIN Database (http://basin.gdr.nrcan.gc.ca/index_e.php) [accessed 15 Dec 2015]

5. Oil & Gas rights:
Aboriginal Affairs and Northern Development Canada, Oil and Gas Rights Digital Files (<https://www.aadnc-aandc.gc.ca/eng/1100100036298/1100100036301>) [accessed 15 Dec 2015]

6. Shipping routes:
Generalized from Canadian Arctic Shipping Routes for 2010, Transport Canada Special Projects and Arctic Shipping 2011, Transport Canada

Figure 6. Resource development potential (including roads and shipping lanes) in the Canadian Arctic. Map made by Andrew Murray (Environment and Climate Change Canada, Landscape Science Division).

Beneficiaries of the Nunavut Land Claim Agreement (NLCA), i.e. Inuit, are not restricted through legislation from hunting caribou, unless a conservation issue arises that results in establishing a total allowable harvest (TAH); absent a TAH, there is no reporting requirement. Specifically, Section 5 of the NLCA states: “Where a total allowable harvest for a stock or population of wildlife has not been established by the NWMB...an Inuk shall have the right to harvest that stock or population in the Nunavut Settlement Area up to the full level of his or her economic, social, and cultural needs, subject to the terms of this Article.” The parallel situation also pertains to the Inuvialuit Final Agreement.

An absence of hunting limits and mandatory reporting means that hunting records are not kept consistently, which prevents quantitative analysis or enumeration of trends. In addition, even when hunting levels are monitored, effort is unrecorded, adding to the difficulty of determining when hunting reaches unsustainable levels. Other evidence does suggest, however, that current offtake rates are low where hunting occurs within Peary Caribou range. A compilation of voluntary reporting of Peary Caribou hunt in Nunavut during the last decade showed about 10-36 animals per year hunted by residents from Resolute Bay (mostly on Bathurst Island), and another 10-60 hunted by residents of Grise Fiord on Ellesmere and Devon islands (Government of Nunavut 2011). Annual harvests during the last decade for the Northwest Territories were reported as 12 or fewer on Banks Island, and 0 from both WQEI and Minto Inlet (Gissing and Fleck 2011).

There is a history of voluntarily curtailing of hunting of Peary Caribou by Inuit and Inuvialuit hunters, through their local associations, when caribou populations were known to be at low levels (Ferguson 1987; Ferguson *et al.* 2001; Larter and Nagy 1995, 2000a; Miller and Gunn 1978; Taylor 2005). For example, from 1974 to 1989, the Resolute Bay Hunters and Trappers Association (HTA) prohibited Peary Caribou hunting on Bathurst Island. In 1982, upon noticing Bathurst Island caribou moving to Cornwallis Island, the ban was extended to include that island as well. From 1989 to 1996, as the population increased, the HTA allowed limited hunt in consultation with government biologists. After the 1995-1997 die-off, however, the hunt was halted again. Similarly, Inuit hunters from Grise Fiord instituted a 10-year moratorium on caribou hunting on most of southern Ellesmere Island from 1986 to 1996 while caribou numbers were low. There are currently no harvest limits imposed on NLCA beneficiaries hunting Peary Caribou in Nunavut.

Hunting may have been a factor in the declining trend of Peary Caribou on northwestern Victoria Island (Gunn *et al.* 1998). In response to the decline, the Olokhtomiut Hunters and Trappers Committee initiated a zero-harvest by-law that is now enforced by GNWT legislation (Gunn 2005). Approximately 300-450 caribou (mostly females) were hunted annually on Banks Island in the 1970s and 1980s, skewing the subpopulation towards males and younger animals (Larter and Nagy 2000a). Despite action by Sachs Harbor to institute a voluntary quota in 1990 for Banks Island, the caribou subpopulation continued to decline. The voluntary quota is still in

place (GNWT 2011 cited by SARC 2012); surveys since 1998 have shown an increasing trend (see **Fluctuations and Trends**). SARC (2012) reports a harvest rate on Banks Island of 1-3% since the mid-2000s. Miller *et al.* (2007 a and c) rationalized from estimated harvest rates and abundance how hunting on the Boothia Peninsula may have contributed to the 98% decline (1980-1995) of the Prince of Wales-Somerset subpopulation (see **Fluctuations and Trends**).

In summary, there is a history of cooperation between local community associations and biologists to implement community-based management in recognition of potential population-level impacts of hunting of Peary Caribou under certain conditions. Accordingly, current hunting rates of Inuit and Inuvialuit communities situated within Peary Caribou range appear to be low relative to before the 1990s. However, inconsistently collected hunting statistics, insufficiently-frequent population surveys and limited demographic sampling to quantify recruitment, age-specific mortality and fecundity collectively provide substantial uncertainty in population trends, hunting levels, and their interaction. The continued success of community harvest management as a dynamic component of Peary Caribou conservation will rely on both adequate monitoring and the ability to account for shifting trends, which include the steep declines of Baffin Island caribou and several mainland Barren-ground herds as well as Banks and Victoria Island Muskoxen (Kutz *et al.*, 2015), the increasing demand for caribou from rapidly growing human populations, and a rising interest in country food and potential commercial harvest implications.

Competition and Predation (IUCN Threat #8.2: Problematic native species)

Possible multi-prey (especially Muskoxen) and Wolf interactions were noted earlier (see **Interspecific Interactions**). Although the impact of Wolf predation on Peary Caribou population dynamics is unknown, many authors consider it likely to be a major threat to recovery when population sizes are low (Nagy *et al.* 1996; Gunn *et al.* 2000b; SARC 2012). How such interactions might change with a warming and greening environment adds a new dimension to the question, which is why they are considered a threat (albeit) low in this status report, rather than a limiting factor.

Energy Production and Mining (IUCN Threat #3)

Industrial activities are currently restricted, with market prices being an important determinant of the extent and intensity of activity at any given time. Mineral exploration, particularly for coal on Ellesmere Island, is currently occurring within Peary Caribou range (CWS 2013; 2014; 2015), but there is little current seismic activity or oil and gas development occurring in the range at large (Figure 6).

The most active period for oil and gas exploration in Peary Caribou range was in the 1960s and 1970s, when it was widespread on Banks, Melville and Prince Patrick islands (Usher 1971; Miller *et al.* 1977a). Polaris mine – located on Little Cornwallis Island from 1980-2002 – was the one mine (Zn-Pb) that has been operational in Peary Caribou range. A surge in oil-related exploration and other factors in the 1960s led to the initial discovery and exploration of the deposit; logistic support through the mine's operation offered opportunities for continued exploration until the closure of the mine in September 2002 (Dewing *et al.* 2006). Mineral exploration took place in the Shaler Mountains of northwest Victoria Island in the 1990s, but this has not led to any development (SARC 2012). The known potential for oil and gas as well as minerals exists throughout Peary Caribou range, and exploratory wells have been drilled all over the WQEI and Banks Island (Figure 6). High-grade thermal coal deposits, with the potential for metallurgical coal, at or near the surface on Axel Heiberg and central Ellesmere islands have previously been proposed for development by West Star Resources, and more recently by Canada Coal, the company which owns the licences on the Fosheim Peninsula, although they withdrew their application from the Nunavut Impact Review Board pending more consultation in 2013. Boundaries for the recently gazetted Qausuittuq National Park on northern Bathurst Island reflect the recommendations of the Senior Mineral Energy & Resource Assessment Committee, which rated high potential for lead zinc mineralization on the northeast coast of Bathurst Island, and petroleum potential on southwest Cameron Island, and therefore excluded this island from within the park boundaries in spite of its known importance for caribou (Resolute Bay HTO 2013; Poole *et al.* 2015).

ATK concerns about strong negative influence of industrial activities on Peary Caribou include 1) direct, negative effects on animal health from smoke and dust from seismic explosions and fuel or rust leaking from oil drums (Taylor 2005; Ivig HTA 2013; Resolute Bay HTO 2013; Sachs Harbour HTC 2013); 2) avoidance behaviour due to sensory disturbance (Taylor 2005; CWS 2013; Ivig HTA 2013; Resolute Bay HTO 2013) or barriers to movement (Urquhart 1973; Slaney and Co., Ltd. 1975), seismic drill rigs and camps (Riewe 1973; Urquhart 1973; Slaney and Co., Ltd. 1975; Sachs Harbour HTC 2013); and 3) habitat loss, especially in critical areas for calving and higher-density areas (SARC 2012; Resolute Bay HTO 2013; Sachs Harbour HTC 2013).

Inuit in Resolute Bay and Grise Fiord suggested that disturbance by oil and gas exploration activities and prospecting for coal and base metals inhibited Peary Caribou from moving into areas necessary for their survival during years of high snow accumulation (Jenkins *et al.* 2010a, b; Taylor 2005).

Habitat loss from cumulative impacts of individual projects and associated infrastructure is the chief cause of concern for Peary Caribou; impacts have been well documented for caribou in general (Vistnes *et al.* 2008; Festa-Bianchet *et al.* 2011). The scale of development currently being contemplated by industry and the Government of Canada – new ports, mines, roads and expanding human populations (Government of Canada 2013) – may be a threat to Peary Caribou if not managed as to location and timing (e.g., migration routes, calving and rutting areas) of construction. Peary Caribou avoid industrial activities including roads and off-road vehicle traffic, although some individuals may approach a single vehicle out of curiosity (Slaney and Co., Ltd. 1974, 1975; Nellemann and Cameron 1998), they also avoid helicopters (Gunn 1984; Gunn and Miller 1980). Although these effects are localized, they may involve increased energy expenditure during nutritionally challenging periods and displacement from preferred habitats. The cumulative stressors may also lead to increased susceptibility to infectious diseases.

Other Threats

Work and Other Activities (IUCN Threat #6.2 [Military exercises]; 6.3)

There are signs that human intrusions from work (non-tourist) activities and year-round military exercises are increasing in some parts of Peary Caribou range, with increases in traffic from snowmobiles, helicopters, and airplanes (including unscheduled flights). If such human activities interrupt caribou foraging or lead to avoidance behaviour affecting movements, this may increase caribou energetic costs (Weladji and Forbes 2002). Grise Fiord and Resolute Bay Inuit have also documented concerns about potential negative impacts of netting, collaring, and other research activities on Peary Caribou (Iviq HTA 2013, Resolute Bay HTO 2013). No Peary Caribou captures have been undertaken in Nunavut since 2003 due to community concerns.

Air-borne Pollutants (IUCN Threat #9.5)

Global climate systems bring certain volatile organic compounds from southern to northern regions, where they condense, precipitate, and accumulate (e.g., Prowse *et al.* 2009). Mainland and Baffin Island Barren-ground Caribou have trace amounts of organic contaminants such as HCB (hexachlorobenzene) and PCB (polychlorinated biphenyl) that are probably transported atmospherically from other continents such as Asia (Elkin and Bethke 1995). In the 1990s, contaminant levels were measured in Peary Caribou on Banks Island, and it was found that these caribou had the lowest levels reported in the study of 15 Canadian caribou subpopulations and are similar to background levels found in humans (MacDonald *et al.* 1996; Larter and Nagy 2000b). Inuit and Inuvialuit communities have voiced concerns about contaminant levels, e.g., on Bathurst Island (Resolute Bay HTO 2013).

Peary Caribou on Banks had lower levels of kidney heavy metals than mainland Barren-ground Caribou, which Larter and Nagy (2000b) attributed to low levels of lichen in their diet. Those metals are naturally occurring elements with no known local anthropogenic sources.

Number of Locations

The highest threat to Peary Caribou is from climate change-induced habitat changes (e.g., severe weather events and sea ice loss), but the timing and geographic location of threatening events that might take place as a result makes it impossible to estimate the number of discrete locations, as defined by IUCN (2014).

PROTECTION, STATUS AND RANKS

Peary Caribou are co-managed in Nunavut according to the Nunavut Land Claims Agreement and in NWT according to the Inuvialuit Final Agreement. These agreements confer primary wildlife management authority on the respective management boards: the Nunavut Wildlife Management Board and the Wildlife Management Advisory Council (NWT).

Legal Protection and Status

COSEWIC most recently assessed this species as Threatened in 2015. Peary Caribou are currently listed under Schedule 1 as Endangered under the federal *Species at Risk Act* (2011); Canada Gazette Part II, Vol. 145, No. 4, 2011-02-16). Under the *Species at Risk Act* (NWT), Peary Caribou are listed as threatened in NWT. Provisions for Species at Risk designation under the *Nunavut Wildlife Act* have not yet been enacted.

Non-Legal Status and Ranks

The NatureServe global status rank of Peary Caribou is G5T1 (2012), signifying this as a critically imperiled subspecies of an otherwise widespread and common species. Its national status is N1; it is S1 in NWT and SNR (unranked) in Nunavut (NatureServe 2014).

Habitat Protection and Ownership

All land except owned privately, by Inuit Organizations or by municipalities, is Crown Land in right of the respective territories. Figure 7 shows the national parks and other federally protected areas. National parks in the range of Peary Caribou are Quttinirpaaq National Park (Ellesmere Island), Qausuittuq National Park (Bathurst Island), and Aulavik National Park (Banks Island).

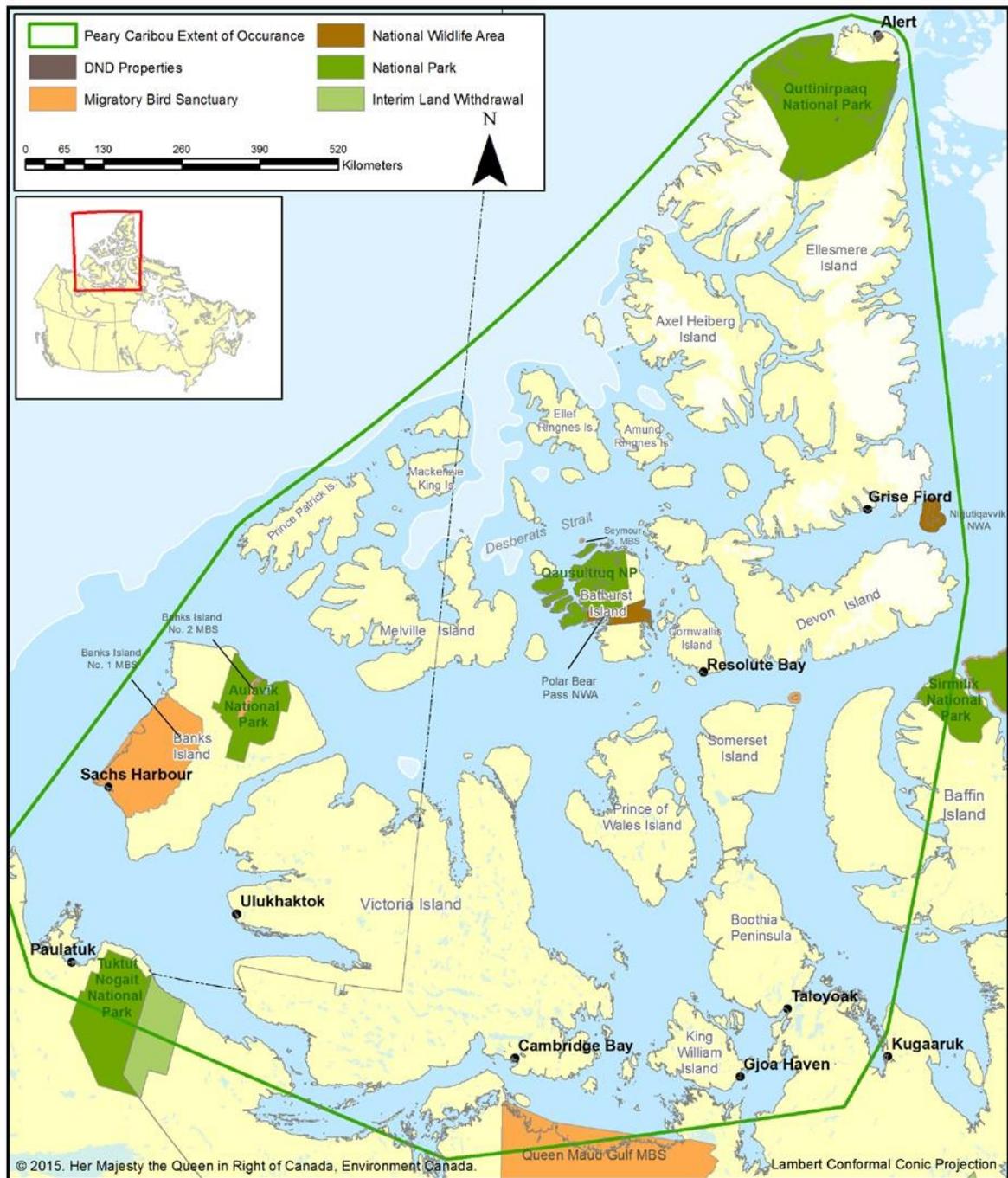


Figure 7. National parks and other protected areas (e.g., Wildlife Management Areas and Migratory Bird Sanctuaries). Map created by Dawn Andrews (Environment Canada).

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Dr. Lee E. Harding has a BSc in wildlife management and a PhD in wildlife toxicology. He is the principal of SciWrite Environmental Sciences Ltd. and was formerly a senior biologist and science program manager with Environment Canada from 1976 until he took early retirement in 1997. From 1977 to 1980 he managed the Impact Assessment division of the Environmental Protection Service district office in Yellowknife, NWT. During 1972-1976, as an environmental consultant assessing the impact of industrial developments in the Arctic, he studied Barren-ground Caribou and reindeer in the Mackenzie Delta, mountain caribou in British Columbia and Yukon and Peary Caribou on Bathurst, Melville and Little Cornwallis Islands. He first called attention to the possible endangered status of British Columbia's mountain caribou in a magazine article in 1975. He was the author of the 2004 COSEWIC re-assessment of Peary Caribou.

COLLECTIONS EXAMINED

Collections were not examined for this reassessment.

Appendix 1A. Survey estimates and area-corrected population estimates for surveys of Banks-Victoria Island subpopulation (adapted from Johnson *et al.* in prep.).

Island	Year	Month	Survey Estimate	Error type	Age Class	Area sampled (km ²)	Scaling factor	Area-corrected population est.	References
Banks	1970	June	5300		inc. calves	38804	1.8301	9699	Kevan 1974
Banks	1971	June	10327		inc. calves	74333	0.9554	9866	Urquhart 1973
Banks	1972	Sept.	12098		inc. calves	74333	0.9554	11558	Urquhart 1973
Banks	1982	July	9036 ± 2927	95% CI	Non-Calf	70582	1.0061	9091	Nagy <i>et al.</i> 2009d
Banks	1985	July	4931 ± 914	SE	Non-Calf	70266	1.0064	4983	Nagy <i>et al.</i> 1996
Banks	1987	June	4251 ± 663	SE	Non-Calf	70266	1.0064	4296	Nagy <i>et al.</i> 1996
Banks	1989	June	2641 ± 344	SE	Non-Calf	70266	1.0164	2669	Nagy <i>et al.</i> 1996
Banks	1991	June - July	897 ± 151	SE	Non-Calf	70266	1.0164	907	Nagy <i>et al.</i> 1996
Banks	1992	August	1018 ± 270	95% CI	Non-Calf	70583	1.0061	1024	Nagy <i>et al.</i> 2009f
Banks	1994	July	742 ± 132	95% CI	Non-Calf	70583	1.0061	747	Nagy <i>et al.</i> 2013b
Banks	1998	July	451 ± 123	95% CI	Non-Calf	70583	1.0061	454	Nagy <i>et al.</i> 2013a
Banks	2001	July	1142 ± 324	95% CI	Non-Calf	70583	1.0061	1149	Nagy <i>et al.</i> 2006
Banks	2005	July - Aug.	929 ± 289	95% CI	Non-Calf	70585	1.0061	935	Nagy <i>et al.</i> 2009e
Banks	2010	July	1097 ± 343	95% CI	Non-Calf	70579	1.0061	1104	Davison <i>et al.</i> 2013
Banks	2014	July	2234 ± 830	95% CI	Non-Calf	70580	1.0061	2248	Davison <i>et al.</i> 2014
Victoria (NW)	1980	August	4512 ± 988	SE	inc. calves	33520	1.0668	4,814	Jakimchuk and Carruthers 1980
Victoria (NW)	1987	June	2600		non-calf	32710	1.0932	2800	Gunn 2005; Gunn and Fournier, 2000
Victoria (NW)	1993	June	159		inc calves	22363	1.5990	250	Gunn 2005
Victoria (NW)	1994	June	39 ± 28	SE	inc calves	26992	1.3248	52	Nishi and Buckland 2000
Victoria (NW)	1998	July	95 ± 60	95% CI	non-calf	24880	1.4373	137	Nagy <i>et al.</i> 2009c
Victoria (NW)	2001	July	204 ± 103	95% CI	non-calf	20364	1.7560	358	Nagy <i>et al.</i> 2009a
Victoria (NW)	2005	July	66 ± 61	95% CI	non-calf	20364	1.7560	116	Nagy <i>et al.</i> 2009b

Island	Year	Month	Survey Estimate	Error type	Age Class	Area sampled (km ²)	Scaling factor	Area-corrected population est.	References
Victoria (NW)	2010	Jul-Aug.	150 ± 104	95% CI	non-calf	20364	1.7560	263	Davison and Williams 2013
Victoria (NW)	2015	Apr.-May	2		Min. num. (non-calf)	20364	1.7560	4	Davison and Williams 2015

Appendix 1B. Survey estimates and area-corrected population estimates for surveys of Prince of Wales-Somerset-Boothia subpopulation (adapted from Johnson *et al.* in prep.).

Island	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Boothia	1974	August	561		includes calves	33000	0.9723	545	Fischer and Duncan 1976
Boothia	1975	June	1739		includes calves	32811	0.9779	1701	Fischer and Duncan 1976
Boothia	1976	March	1120		includes calves	32941	0.9740	1091	Thompson and Fischer 1980
Boothia	1985	June	4831±543	SE	adults and 1year olds	32715	0.9808	4738	Gunn and Ashevak 1990, Gunn and Dragon 1998
Boothia	1995	July and August	3329		adults and 1year olds	32715	0.9808	3265	Gunn and Dragon 1998
Boothia	2006	June	1		minimum count	32715	0.9808	1	Dumond 2006
Prince of Wales	1974	July	5437		includes calves	33770	1.0000	5437	Fischer and Duncan 1976
Prince of Wales	1975	June	3768		includes calves	33643	1.0038	3768	Fischer and Duncan 1976
Prince of Wales	1980	July	3952±932	95% CI	adults and 1year olds	31686	1.0658	3952	Gunn and Decker 1984
Prince of Wales	1995	July	5		minimum count	32946	1.0251	5	Gunn and Dragon 1998
Prince of Wales	1996	April and May	0			33340	1.0129	0	Miller 1997a
Prince of Wales	2004	April	0			33274	1.0150	0	Jenkins <i>et al.</i> 2011
Somerset	1974	June	245		includes calves	24786	0.9892	242	Fischer and Duncan 1976

Island	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Somerset	1975	June	903		includes calves	24786	0.9892	893	Fischer and Duncan 1976
Somerset	1980	July	561±300	95% CI	adults and 1year olds	23818	1.0294	577	Gunn and Decker 1984
Somerset	1995	July and August	2		minimum count	8544	2.8695	115	Gunn and Dragon 1998
Somerset	1996	April and May	2		minimum count	23818	1.0294	49	Miller 1997a
Somerset	2004	April	0			25549	0.9596	0	Jenkins <i>et al.</i> 2011
Russell	1975	June	159		includes calves	940	1.0251	163	Fischer and Duncan 1976
Russell	1980	July	584±90	95% CI	adults and 1year olds	930	1.0362	605	Gunn and Decker 1984
Russell	1995	July	0			975	0.9883	0	Gunn and Dragon 1998
Russell	1996	April and May	0			940	1.0251	2	Miller 1997a
Russell	2004	April	0			937	1.0284	0	Jenkins <i>et al.</i> 2011

Appendix 1C. Survey estimates and area-corrected population estimates for surveys of Eastern Queen Elizabeth Islands subpopulation (adapted from Johnson *et al.* in prep.).

Island	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Axel Heiberg	1961	August	300		includes calves	30232	1.0053	302	Tener 1963
Axel Heiberg	1973	July	35		includes calves	1010	30.0867	1053	Riewe 1973
Axel Heiberg	1995	June	25		minimum count (includes calves)	8101	3.7515	94	Gauthier 1996
Axel Heiberg	2007	Apr.-May	2291 (1636-3208)	95% CI	10 month olds and adults	30877	0.9842	2255	Jenkins <i>et al.</i> 2011

Island	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Ellesmere Island	1961	Jun-Aug	200		includes calves	116407	0.9585	192	Tener 1963
Southern Ellesmere	1973	July	450		includes calves	19788	5.6389	2538	Riewe 1973
Southern Ellesmere	1989	July	89±31	SE	includes calves	25050	4.4543	396	Case and Ellesworth 1991
Central Ellesmere	1995	June	38		minimum count (includes calves)	28383	3.9313	149	Gauthier 1996
Southern Ellesmere	2005	May	219 (109-442)	95% CI	adults and 1 year olds	22243	5.0164	1099	Jenkins <i>et al.</i> 2011
Northern Ellesmere	2006	Apr,-May	802 (531-1207)	95% CI	adults and 1 year olds	96567	1.1555	927	Jenkins <i>et al.</i> 2011
Southern Ellesmere	2015	March	183 ± 128	SE	adults and 10-month	22243	5.0164	918	Anderson and Kingsley 2015

Appendix 1D. Survey estimates and area-corrected population estimates for surveys of Western Queen Elizabeth Islands subpopulation (adapted from Johnson *et al.* in prep.).

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Melville	1961	August	12,799		Includes Calves	41334	1.0349	13246	Tener 1963
Melville	1972	August	2,551 ± 724	SE	Includes Calves	42220	1.0132	2585	Miller <i>et al.</i> 1977b; SARC 2012; Jenkins <i>et al.</i> 2011
Melville	1973	July and August	3,425 ± 618	SE	Includes Calves	42220	1.0132	3470	Miller <i>et al.</i> 1977b; SARC 2012; Jenkins <i>et al.</i> 2011
Melville	1974	July and August	1679		Includes Calves	42220	1.0132	1701	Miller <i>et al.</i> 1977b; SARC 2012; Jenkins <i>et al.</i> 2011
Melville	1987	July	943 ± 126	SE	Includes Calves	42220	1.0132	955	Miller 1988
Melville	1997	July	787 ± 97	SE	No calves seen	42220	1.0132	797	Gunn and Dragon 2002
Melville	2012	July-August	2,728 ± 647	95% CI	1+ yr old	42583	1.0045	2740	Davison and Williams 2012

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Prince Patrick	1961	July	2,254		Includes Calves	15750	1.0360	2335	Tener 1963
Prince Patrick	1973	July-August	807 ± 259	SF	Includes Calves	15830	1.0307	832	Miller <i>et al.</i> 1977b; SARC 2012; Jenkins <i>et al.</i> 2011
Prince Patrick	1974	July-August	621 ± 177	SE	Includes Calves	15830	1.0307	640	Miller <i>et al.</i> 1977b; SARC 2012; Jenkins <i>et al.</i> 2011
Prince Patrick	1986	July	151		Includes Calves	15830	1.0307	156	Miller 1987
Prince Patrick	1997	June	84 ± 34	SE	1+ yr old	15830	1.0307	87	Gunn and Dragon 2002
Prince Patrick	2012	July-August	2,708 ± 855	95% CI	1+ yr old	16090	1.0141	2746	Davison and Williams 2012
Eglinton	1961	July	204		Includes Calves	1427	1.0917	223	Tener 1963
Eglinton	1972	August	83 ± 59	SE	Includes Calves	1550	1.0051	83	Miller <i>et al.</i> 1977b
Eglinton	1973	August	12 ± 9	SE	Includes Calves	1550	1.0051	12	Miller <i>et al.</i> 1977b
Eglinton	1974	July	18 ± 10	SE	Includes Calves	1550	1.0051	18	Miller <i>et al.</i> 1977b
Eglinton	1986	July	79		Includes Calves	1550	1.0051	79	Miller 1987
Eglinton	1997	July	0	SE		1550	1.0051	0	Gunn and Dragon 2002
Eglinton	2012	July-August	181 ± 134	95% CI	1+ yr old	1573	0.9902	181	Davison and Williams 2012
Emerald	1961	July	161		Includes Calves	650	0.8556	138	Tener 1963
Emerald	1973	July	39		Includes Calves	550	1.0113	39	Miller <i>et al.</i> 1977b
Emerald	1974	July	20		Includes Calves	550	1.0113	20	Miller <i>et al.</i> 1977b
Emerald	1986	July	14 (0-49)	95% CI	Includes Calves	550	1.0113	14	Miller 1987
Emerald	1997	July	0			550	1.0113	0	Gunn and Dragon 2002
Emerald	2012	July-August	46±78	95% CI	1+ yr old	570	0.9756	45	Davison and Williams 2012
Byam Martin	1972	August	86 ± 65	SE	Includes Calves	1160	1.0189	88	Miller <i>et al.</i> 1977b; Jenkins <i>et al.</i> 2011
Byam Martin	1973	July	43 ± 36	SE	Includes Calves	1160	1.0189	44	Miller <i>et al.</i> 1977b; Jenkins <i>et al.</i> 2011

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Byam Martin	1974	August	6±4	SE	Includes Calves	1160	1.0189	6	Miller <i>et al.</i> 1977b; Jenkins <i>et al.</i> 2011
Byam Martin	1987	July	98 ± 37	SE	Includes Calves	1160	1.0189	100	Miller 1988; Jenkins <i>et al.</i> 2011
Byam Martin	1997	July	0			1160	1.0189	0	Gunn and Dragon 2002; Jenkins <i>et al.</i> 2011
Byam Martin	2012	July-August	119 ± 73	95% CI	non-calves	1158	1.0207	121	Davison and Williams 2012
Mackenzie King	1961	August	2,192		All			2192	Tener 1963
Mackenzie King	1973	April	3		Minimum count			3	Miller <i>et al.</i> 1977b
Mackenzie King	1974	April	60		All			60	Miller <i>et al.</i> 1977b
Mackenzie King	1997	July	36 ± 22	SE	1+ yr old			36	Gunn and Dragon 2002
Borden	1961	August	1,630		All			1630	Tener 1963
Borden	1973	April	16		All			16	Miller <i>et al.</i> 1977b
Brock	1961	August	190		All			190	Tener 1963
Brock	1973	April	24		All			24	Miller <i>et al.</i> 1977b
Brock	1997	July	0					0	Gunn and Dragon 2002
Devon	1961	June	150		includes calves	37550	1.0323	155	Tener 1963
Devon	2002	May	35		min. count (includes calves)	12316	3.1475	110	Jenkins <i>et al.</i> 2011
Devon	2008	April-May	17		min. count (includes calves)	39731	0.9757	17	Jenkins <i>et al.</i> 2011
Lougheed	1961	August	1325		includes calves	808	1.6458	2181	Tener 1963
Lougheed	1973	April	66		includes calves	1300	1.0230	68	Miller <i>et al.</i> 1977b
Lougheed	1974	April	0			1300	1.0230	0	Miller <i>et al.</i> 1977b

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Lougheed	1985	July	0			1300	1.0230	0	Miller 1987b
Lougheed	1997	July	101±73	SE	1+year	1300	1.0230	103	Gunn and Dragon 2002
Lougheed	2007	April	372 (205-672)	95% CI	1+year	1319	1.0083	375	Jenkins <i>et al.</i> 2011
Bathurst Is. Complex	1961	June and July	3509		Includes calves			3509	Tener 1963; adjusted by Miller <i>et al.</i> 2005
Bathurst Is. Complex	1973	March-April	990		Includes calves	19266	1.0350	1025	Miller <i>et al.</i> 1977b
Bathurst Is. Complex	1974	August	269		Includes calves	19266	1.0350	278	Miller <i>et al.</i> 1977b
Bathurst Is. Complex	1985	July	724 (460-987)	95% CI	Includes calves	19266	1.0350	749	Miller 1987b
Bathurst Is. Complex	1988	July	1034±146	SE	Includes calves min. count	19266	1.0350	1070	Miller 1989
Bathurst Is. Complex	1990	July	871		(includes calves) min. count	19266	1.0350	901	Miller 1992
Bathurst Is. Complex	1991	June and July	949		(includes calves) min. count	19266	1.0350	982	Miller 1993
Bathurst Is. Complex	1992	July	1644		(includes calves) min. count	19266	1.0350	1701	Miller 1994
Bathurst Is. Complex	1993	August	2387		(includes calves)	19266	1.0350	2470	Miller 1995b
Bathurst Is. Complex	1994	July	3100		Includes calves min. count	27550	0.7238	2244	Miller 1997b; Miller 1998
Bathurst Is. Complex	1995	July	2200		(includes calves)	27550	0.7238	1592	Miller 1997b; Miller 1998
Bathurst Is. Complex	1996	July	552±108	SE	Includes calves	27550	0.7238	400	Miller 1998
Bathurst Is. Complex	1997	June and July	78		1+ year old	19266	1.0350	81	Gunn and Dragon 2002
Bathurst Is. Complex	2001	May	187 (104-330)	95% CI	1+ year old	19644	1.0150	190	Jenkins <i>et al.</i> 2011
Bathurst Is. Complex	2013	May	1482±387	95% CI	Includes calves	20200	0.9871	1463	Anderson 2014
Cornwallis	1961	June	43		Includes calves	6915	1.0338	44	Tener 1963

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Cornwallis	1988	July	51 (0-107)	95% CI	Includes calves	7000	1.0213	52	Miller 1989
Cornwallis	2002	May	1		Minimum count	3411	2.0958	2	Jenkins <i>et al.</i> 2011
Cornwallis	2013	May	2		min. count (includes calves)	3411	2.0958	4	Anderson 2014
Little Cornwallis	1961	June	0			412	1.0249	0	Tener 1963
Little Cornwallis	1973	Mach and August	9		Includes calves	410	1.0294	9	Miller <i>et al.</i> 1977b
Little Cornwallis	1974	March	12		Includes calves	410	1.0294	12	Miller <i>et al.</i> 1977b
Little Cornwallis	1988	July	0			410	1.0294	0	Miller 1989
Little Cornwallis	2002	May	0			381	1.1077	0	Jenkins <i>et al.</i> 2011
Little Cornwallis	2013	May	1		minimum total count	381	1.1077	1	Anderson 2014
Helena	1973	April	0		Includes calves	220	1.5043	0	Miller <i>et al.</i> 1977b
Helena	1974	March	3		Includes calves	220	1.5043	5	Miller <i>et al.</i> 1977b
Helena	1985	July	0			220	1.5043	0	Miller 1987
Helena	1988	July	17 (0-42)	95% CI	Includes calves	220	1.5043	26	Miller 1989
Helena	1990	July	34		min. count (includes calves)	220	1.5043	51	Miller 1992
Helena	1991	June	22		min. count (includes calves)	220	1.5043	33	Miller 1993
Helena	1992	June	46		min. count (includes calves)	220	1.5043	69	Miller 1994
Helena	1995	June	49		min. count (includes calves)	220	1.5043	74	Miller 1997b
Helena	1997	July	0			220	1.5043	0	Gunn and Dragon 2002
Helena	2001	May	2		min. count (includes calves)				Jenkins <i>et al.</i> 2011

Island Group	Year	Month	Survey Estimate	Error type	Age Class	Area Sampled (km ²)	Scaling factor	Area-corrected population est.	References
Helena	2013	May	2		min. count (includes calves)				Anderson 2014

Appendix 2. IUCN Threats calculator for Peary Caribou (DU1).

Species:	Peary Caribou (DU1)																										
Date:	12/09/2014																										
Assessor(s):	<p><u>Members:</u> Justina Ray (TM SSC Co-chair, moderator), Dave Fraser (BC, moderator), Dan Benoit (ATK SC Co-chair), Suzanne Carrière (NT), Nic Larter (NT)</p> <p><u>External Experts:</u> Tracy Davison (NT), Marsha Branigan (NT), Joanna Wilson (NT), Morgan Anderson (NU), Lisa-Marie LeClerc (NU), Andrew Maher (PCA), Renee Wissink (PCA), Peter Sinkins (PCA), David Lee (NTI), Cheryl Johnson (EC), Agnes Richards (EC), Donna Bigelow (CWS), Dawn Andrews (CWS), Lisa Pirie (CWS), Anne Gunn (Status Report writer for Barren-ground Caribou (DU3)), Karla Letto (NWMB), John Lucas (WMAC), Phillip Manik, Sr. (Resolute Bay HTO), Peter Qayutinuak Sr. (Spence Bay HTA - Taloyoak), Issiac Elanik (Sachs Harbour HTC), Bradley Carpenter (Olohaktomiut HTC - Uluhaktok)</p>																										
Overall Threat Impact Calculation Help:	<table border="1"> <thead> <tr> <th colspan="2"></th> <th colspan="2">Level 1 Threat Impact Counts</th> </tr> <tr> <th colspan="2">Threat Impact</th> <th>high range</th> <th>low range</th> </tr> </thead> <tbody> <tr> <td>A</td> <td>Very High</td> <td>0</td> <td>0</td> </tr> <tr> <td>B</td> <td>High</td> <td>1</td> <td>0</td> </tr> <tr> <td>C</td> <td>Medium</td> <td>2</td> <td>1</td> </tr> <tr> <td>D</td> <td>Low</td> <td>3</td> <td>5</td> </tr> </tbody> </table>					Level 1 Threat Impact Counts		Threat Impact		high range	low range	A	Very High	0	0	B	High	1	0	C	Medium	2	1	D	Low	3	5
		Level 1 Threat Impact Counts																									
Threat Impact		high range	low range																								
A	Very High	0	0																								
B	High	1	0																								
C	Medium	2	1																								
D	Low	3	5																								
Calculated Overall Threat Impact:	Very High		High																								
Assigned Overall Threat Impact:	AC = Very High - Medium																										
Impact Adjustment Reasons:	There is considerable uncertainty and potential overlap and interaction of threats that is difficult to predict and assess and that might be best captured with a wide range rank of threat impacts.																										

Threat	Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	
1.1	Negligible	Negligible (<1%)	Extreme (71-100%)	High (Continuing)	Scope includes portion of species range that is alienated by human settlements plus a buffer zone for animals displaced by disturbance.
3	D Low	Restricted - Small (1-30%)	Slight (1-10%)	High (Continuing)	
3.1	D Low	Restricted - Small (1-30%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	No seismic activity or O&G development at present but an expectation was expressed by participants that this is very likely to increase within the next 10 years. There is some experience of impacts to caribou populations from seismic drilling activities (particularly blasting) in the 1970s, although difficult to tease apart from other sources of decline. Impacts will be higher if high intensity activities occur where most of the population is at that time.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.2	Mining & quarrying	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	There is mineral exploration underway, e.g., coal on Foshein Peninsula on Ellesmere Island and on Axel Heiberg Island, staking for coal on Banks Island but these activities ceased when markets fell. A number of old sites on Prince Patrick Island and Victoria Island require clean-up.
4	Transportation & service corridors	C D	Medium - Low	Restricted - Small (1-30%)	Serious - Moderate (11-70%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Small (1-10%)	Slight (1-10%)	Moderate (Possibly in the short term, < 10 yrs)	
4.2	Utility & service lines		Negligible	Negligible (<1%)	Negligible (<1%)	Unknown	
4.3	Shipping lanes	C D	Medium - Low	Restricted - Small (1-30%)	Serious - Moderate (11-70%)	High (Continuing)	There is a large range of uncertainty associated with this threat, particularly looking out to the next 10 years. The severity to the overall population will depend on which island crossings are affected and how big are the populations. Shipping channels could open in Prince of Wales complex (PoW-Somerset and Queen Elizabeth-PoW crossings), Bathurst – Cornwallis; less likely Banks-Victoria, Ellesmere complex. For Peary Caribou, island crossings between islands are exceptionally important. In next 10 years develop projects that require shipping could have high impact on available crossings for caribou, as well as cruise ships. Ships & ice breakers come earlier and earlier every year and stay and keep breaking the ice to make it safer for the cruise ships continue to break ice until season is over. Kitikmeot region opening of NW Passage increase transport minerals south.
4.4	Flight paths		Negligible	Negligible (<1%)	Slight (1-10%)	Moderate - Low	Regularly scheduled commercial flights
5	Biological resource use	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.1	Hunting & collecting terrestrial animals	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	There are many other threats and circumstances that can interact with this one when it comes to determining severity: climate, management response, and quality of survey information. In terms of scope, a large portion of range not accessible. Severity: there are quotas in place where they are hunted, and not all caribou that encounter a hunter will be killed. If management is doing its job, there should be no decline. Increasing the severity to slight takes into account other factors that may lead to a decline, including unreported mortality and inaccurate knowledge of population status.
6	Human intrusions & disturbance	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	
6.1	Recreational activities		Negligible	Negligible (<1%)	Negligible (<1%)	High (Continuing)	
6.2	War, civil unrest & military exercises	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	Year-round military exercises are increasing in Peary Caribou range; mostly ships and land exercises. Military personnel are travelling long distances, from island to island. We can expect this to increase in the future.
6.3	Work & other activities	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	This relates to activities on land for work: i.e., snowmobiles, helicopters, airplanes. Includes unscheduled flights. More research (e.g., climate change) is taking place and traffic is increasing as a result.
8	Invasive & other problematic species & genes	C D	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	
8.1	Invasive non-native/alien species	C D	Medium - Low	Large - Restricted (11-70%)	Moderate - Slight (1-30%)	High (Continuing)	Pathogens include native & non-native species in this category. In terms of the scope, there is much uncertainty as to how much of the population will be affected by pathogens within the next 10 years; probably not over 50% given current evidence and accounting for uncertainty. Need to consider the interaction of a changing climate on pathogen-host relationships that is already being documented. Could have more cycles of parasites with increased temperatures.
8.2	Problematic native species	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Muskoxen, wolves, wolverines, and grizzly bears considered in this category, not disease. Scope must be pervasive because all Peary Caribou encounter one or more of these species. The direct impact is uncertain but likely to be low. There is, however, evidence for an inverse relationship between caribou and muskox in some areas, although this is variable throughout the distribution of Peary Caribou. The mechanism for this is unknown, but could be aversion. In some areas, elders say that muskox need to be controlled to keep Peary Caribou populations healthy.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.3	Introduced genetic material		Unknown	Small (1-10%)	Unknown	High (Continuing)	The future depends on climate change and the extent to which Barren-ground and Peary or D&U and Peary meet and hybridize. The only place where there is a real possibility of mixing is on NW Victoria, affecting 10% of the overall population. Results from genetic analyses are showing a lot of Peary Caribou gene flow southward and not a corresponding northward flow of Barren-ground genes; As such, the impact would expect to be felt by D&U and Barren-ground. However, the impact (severity) on Peary Caribou is fundamentally unknown.
9	Pollution		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
9.5	Air-borne pollutants		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	There are few sources of contaminants in NU or NWT, but they can be sink holes for southern air-borne pollution. Because of wind currents scope is everywhere. Although lichen does tend to collect air-borne pollution, it is a small part of Peary Caribou diet. It would be more of a concern if arctic willow sucked up pollutants. Studies have shown that Banks Island caribou have lower pollution load than mainland. There is a growing concern around pollinated bromiles (used in fire retardants), which may act like DDT and are showing up in wildlife in NWT; Unknown effects. Air currents bring pollutants from India/China to arctic; volatile contents condense; precipitate out in arctic where they land on snow or ice and go into aquatic systems; lighter fractions that are more volatile are showing up in arctic ecosystems.
11	Climate change & severe weather	B C	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	
11	Habitat shifting & alteration	B C	High - Medium	Pervasive (71-100%)	Serious - Moderate (11-70%)	High (Continuing)	This category includes sea ice loss; sea level rise; habitat changes as result of climate change and severe weather. Negative effects may be countered in some places by positive aspects like vegetation growth and biomass. But because much of this is shrubs, unclear how much Peary Caribou will actually benefit from this enhanced vegetation growth. If changes occur gradually, then there may be more opportunities for adaptation. This category does not include icing events (see 11.4)

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
11	Storms & flooding	C D	Medium - Low	Restricted - Small (1-30%)	Serious - Moderate (11-70%)	Moderate (Possibly in the short term, < 10 yrs)	Peary Caribou can move to avoid smaller icing events, but frequent small events or one larger event (which may happen once every 1-2 generations) can have a high impact, as has been the case on at least two major occasions since monitoring of Peary Caribou began in the 60s. Although there is an expectation that the frequency of these events will increase in the next 3 generations due to climate change, there is considerable uncertainty regarding the impact to the overall Peary Caribou that can be expected.



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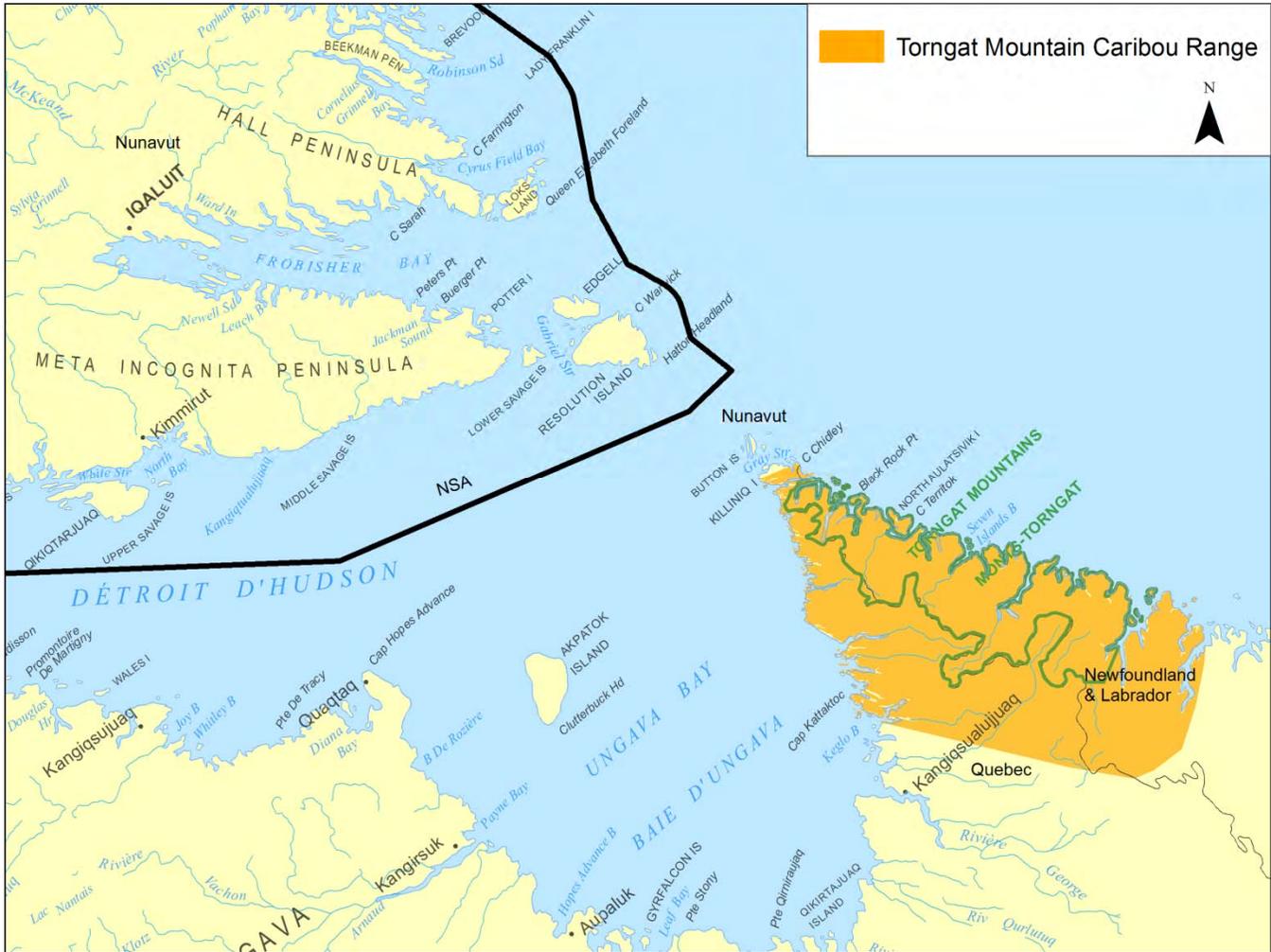
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http://sararegistry.gc.ca/document/default_e.cfm?documentID=2972



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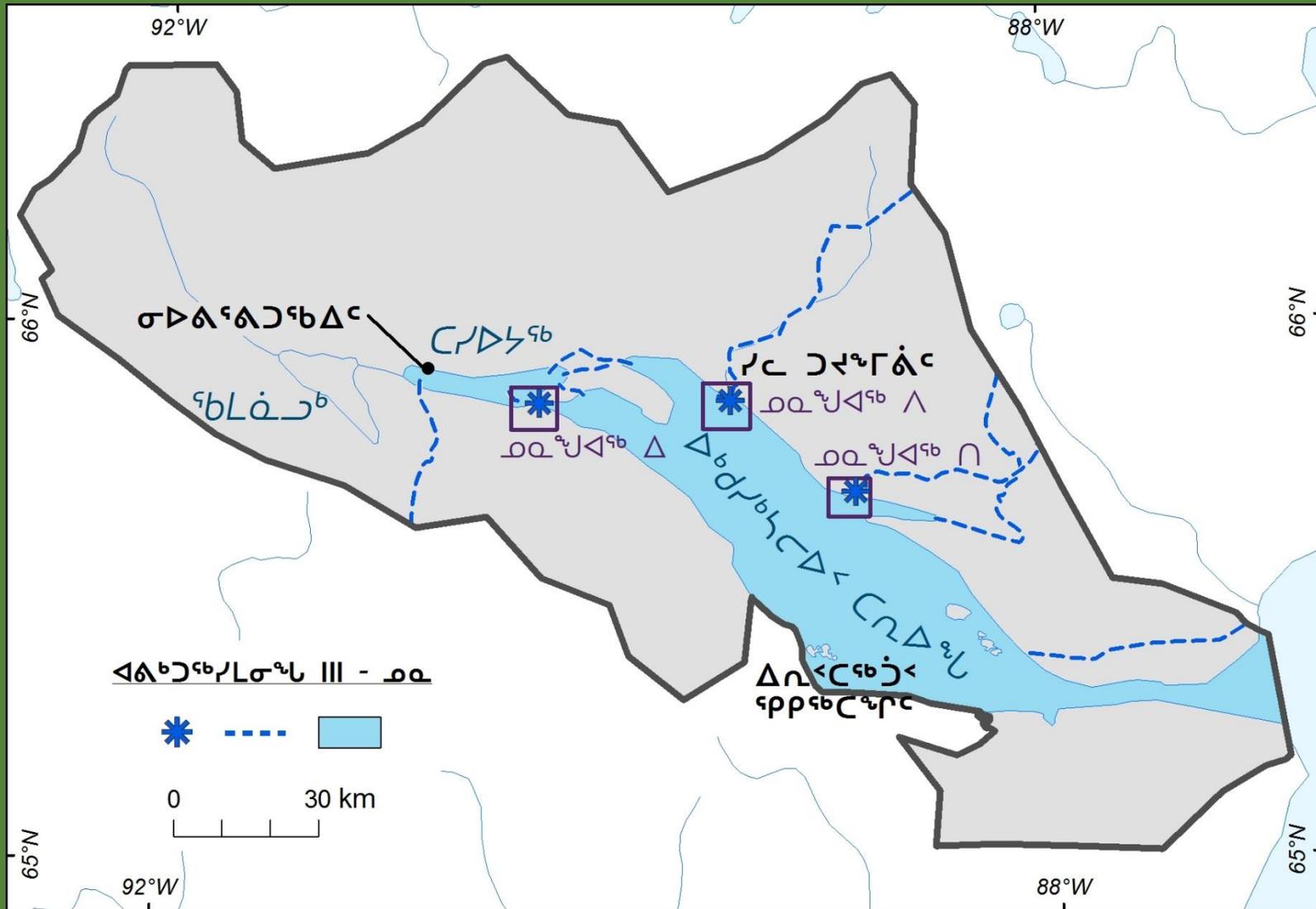


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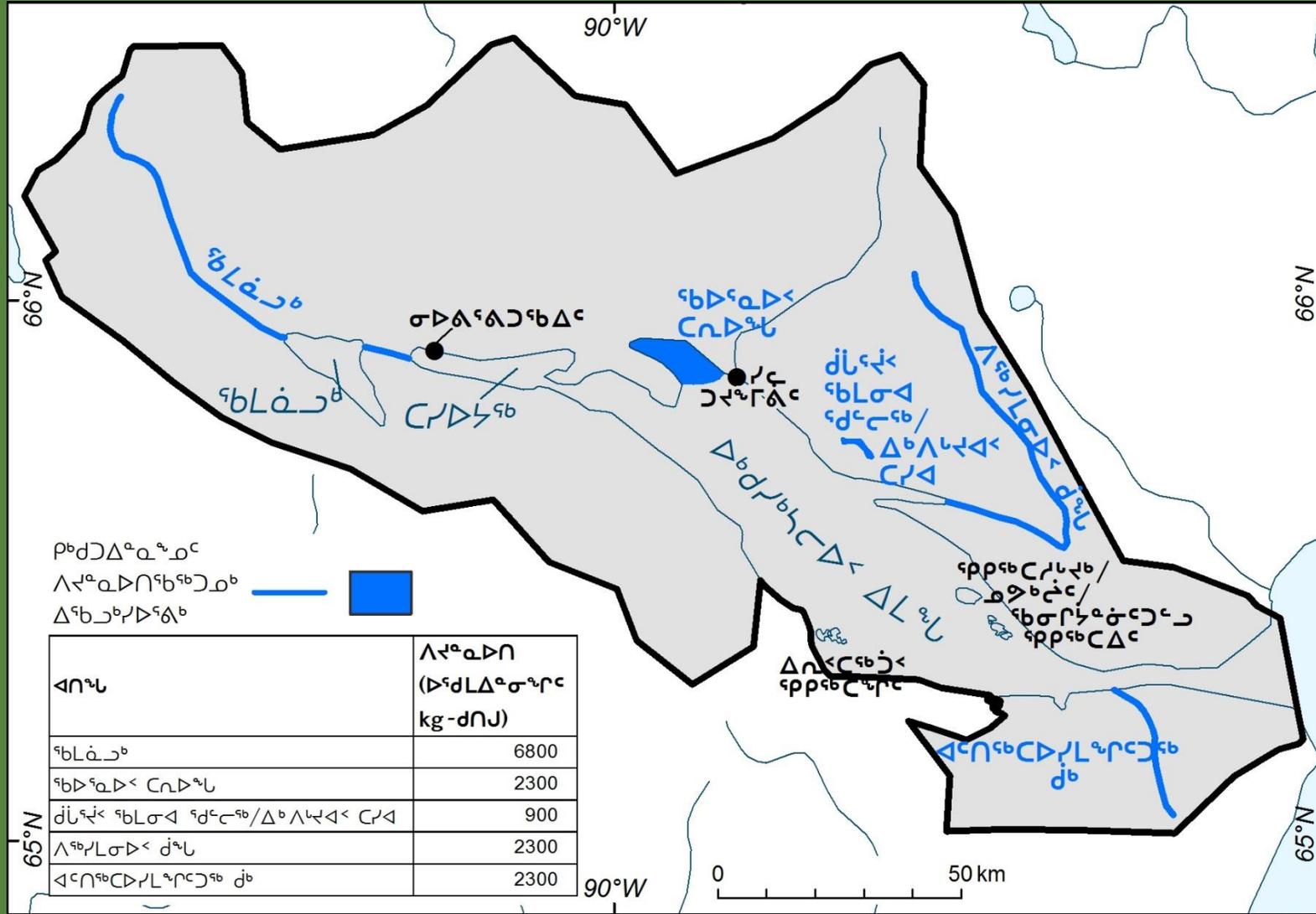


ᓄᓇᐅᐸ ᐱᐸᐸᐸᐸᐸ III





ᐃᑦᑲᐳᑲᑦᑲᑦᑲᑦ: ᐃᑦᑲᐳᑲᑦᑲᑦᑲᑦ



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ገረገረው	ካህናት ስርዓት	1
የሰራተኛ ስራ ለሰራተኛ ስራ ስራ	ካህናት ስርዓት	1
ሰራተኛ ለረጅም ጊዜ ስራ *	ካህናት ስርዓት	3
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ገረገረው ለረጅም ጊዜ ስራ	ጠቅላይ	?
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ሰራተኛ ስራ ስራ ስራ	ካህናት ስርዓት	1
ሰራተኛ ስራ ስራ ስራ ስራ	ካህናት ስርዓት	1
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ገረገረው ስራ *	ካህናት ስርዓት ስራ ስራ ስራ ስራ	4
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Δημόσια Διαβούλευση
για την υιοθέτηση του Προγράμματος
Εκπαίδευσης και Κατάρτισης
για τον τομέα της Αλιείας

Πρόσκληση στην
Διαβούλευση:

Πρόγραμμα Εκπαίδευσης και Κατάρτισης για τον τομέα της Αλιείας - RM 004-2017

Δημόσια Διαβούλευση Για το Σχέδιο Διαχείρισης Λαβών Σηλιών

- Διευκρινίζονται οι διαδικασίες που θα ακολουθηθούν για την υλοποίηση του Σχεδίου Διαχείρισης Λαβών Σηλιών
- Για περισσότερες πληροφορίες σχετικά με το Σχέδιο Διαχείρισης Λαβών Σηλιών (RM 003-2017)
- Για περισσότερες πληροφορίες σχετικά με το Σχέδιο Διαχείρισης Λαβών Σηλιών (RM 003-2017)



Δημόσια Υποστήριξη Επιχειρηματικής Ανάπτυξης

- Δημόσια Υποστήριξη για την ανάπτυξη των επιχειρήσεων που δραστηριοποιούνται στον τομέα της αλιείας και της αλιεικής βιομηχανίας
- Προώθηση της ανάπτυξης των επιχειρήσεων που δραστηριοποιούνται στον τομέα της αλιείας και της αλιεικής βιομηχανίας
- Προώθηση της ανάπτυξης των επιχειρήσεων που δραστηριοποιούνται στον τομέα της αλιείας και της αλιεικής βιομηχανίας





რძე და

და რძე?