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A CITES risk assessment for polar bear (*Ursus maritimus*)

Scientific Opinion of the Panel on alien organisms and trade in endangered species (CITES) of the Norwegian Scientific Committee for Food and Environment

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A CITES Risk assessment for polar bear (*Ursus maritimus*)

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Preparation of the opinion

The Norwegian Scientific Committee for Food and Environment (Vitenskapskomiteen for mat og miljø, VKM) appointed a project group to draft the opinion. The project group consisted of four VKM members and a project leader from the VKM secretariat. Two external referees commented on and reviewed the draft opinion. The VKM Panel on Alien Organisms and Trade in Endangered Species (CITES) evaluated and approved the final opinion.

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Competence of VKM experts

Persons working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third-party interests. The Civil Services Act instructions on legal competence apply for all work prepared by VKM.

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Summary

Key words: *Ursus maritimus*, CITES, polar bear, Non-Detriment Finding, Norwegian Scientific Committee for Food and Environment, Norwegian Environment Agency, VKM

Background: Canada is the only nation in the world that allows commercial export of polar bear products harvested from its own wild populations. Norway is among the destinations for exported material. Polar bears are listed on CITES appendix II and on list B of the Norwegian CITES Regulation. Import of harvested polar bears to Norway requires both export permits from the Canadian CITES authorities and import permits from the Norwegian Environment Agency. Consequently, a Non-Detriment Finding (NDF) is mandated and was commissioned by the Norwegian Environment Agency (Norwegian Management Authority for CITES) to the Norwegian Scientific Committee for Food and Environment (VKM) (Norway's CITES Scientific Authority). The NDF is a scientific risk assessment evaluating whether or not international trade can be detrimental to the survival of polar bears. The risk assessment may also be used by the Norwegian Environment Agency to assess whether the polar bears should be placed on Norwegian CITES list A.

Currently, the IUCN/SSC Polar Bear Specialist Group (PBSG) recognizes 19 subpopulations of polar bears in the circumpolar Arctic, of which 13 reside wholly (9) or partly (4) in Canada. Together, these 13 populations account for about two thirds of the world's total polar bear population. This risk assessment considers the populations that are within the hunting areas.

Methods: VKM has reviewed current knowledge about polar bear biological characteristics, population status and trends in subpopulations. Scenarios for the future development of the Arctic environment, to which the species is inextricably adapted, are presented. Habitat loss due to declining sea ice is widely recognized as the main threat to polar bears, and this, as well as other obstacles to the species survival, has been evaluated. The various legislations, regulations and monitoring regimes of the range countries are briefly summarised. Moreover, international trade in polar bear products has been analysed. VKM has further undertaken an assessment of data quality and uncertainties. In order to gain access to the most recent information on polar bear biology and management, four scientists from the PBSG were interviewed and the transcripts of the interviews (with consent from the hearing experts) are attached to this report.

Results: The best scientific knowledge available for polar bears in Canada suggests that four subpopulations are in decline, two are stable, and one is increasing, while the population trends for the remaining subpopulations are unknown. Noteworthy, all the estimates of population size are highly uncertain. Survey methods also changed between the 2008 and 2018 population estimates used for quota setting. Moreover, data are in most areas collected too infrequently to detect rapid changes in population size. Particularly, under

changing environmental conditions. The prognosis for the Arctic marine environment points towards continuing habitat loss and inevitably further decline for the polar bear population.

Analyses of data from the CITES trade database reveal a dynamic international market for polar bear products with significant changes in destination countries and the purpose for transactions. The United States was the main importer of polar bear products, mainly hunting trophies, until listing the polar bear as a threatened species in 2008. In more recent years, China has become the major importer, with hides being the preferred product. Simultaneously with these changes, there has been a significant increase in the price of polar bear hides.

Conclusion: Several polar bear subpopulations are in decline. Predictions of continuing habitat loss points to further decline. While not the main threat to polar bear survival, international trade in polar bear products is significant. It is not certain that polar bears traded internationally are harvested in accordance with the principle of sustainable use of biodiversity.

In summary, VKM is unable to find that international trade with Canadian polar bears is non-detrimental to the survival of the species.

Sammendrag på norsk

Nøkkelord: *Ursus maritimus*, isbjørn, CITES, Miljødirektoratet, VKM, Non-Detriment Finding.

Bakgrunn: Canada er det eneste landet i verden som tillater kommersiell eksport av isbjørnprodukter høstet fra egne ville bestander. Norge er et av importlandene. Isbjørn er oppført på CITES Appendix II og på liste B i den norske CITES-forskriften. For å importere isbjørn til Norge kreves det både en utførselstillatelse fra canadiske myndigheter og en innførselstillatelse fra Miljødirektoratet (som er administrerende CITES-myndighet for Norge). Det er derfor påkrevd med en 'Non-detriment finding' (NDF) for arten. Vitenskapskomiteen for mat og miljø (VKM) er som vitenskapelig myndighet for CITES i Norge ansvarlig for å utarbeide denne. En NDF er en risikovurdering som benyttes til å vurdere hvorvidt internasjonal handel kan utgjøre en trussel mot isbjørnens overlevelsessevne. Risikovurderingen skal også potensielt kunne brukes av Miljødirektoratet til å avgjøre om isbjørn skal flyttes til liste A av den norske CITES-forskriften.

Den internasjonale naturvernunionen (IUCN) sin ekspertgruppe for isbjørn (Polar Bear Specialist Group; PBSG) anerkjenner 19 delbestander av isbjørn hvorav 13 finnes helt og fire delvis i Canada. Disse utgjør til sammen 2/3 av den totale isbjørnbestanden i verden. Denne risikovurderingen gjelder for delbestander som ligger innen områder der jakt pågår.

Metode: VKM har gjennomgått eksisterende kunnskap om biologien og bestandsutviklingen til de canadiske isbjørnbestandene. Isbjørnen er helt avhengig av økosystemet på havisen i Arktis, og ulike scenarier for utviklingen av dette sårbare miljøet er derfor presentert. Tap av leveområder som følge av reduksjon i havis er isbjørnens største trussel og dette, samt andre utfordringer mot artens overlevelse er beskrevet. Det gis også en kort oppsummering av lover og regler som benyttes i forbindelse med forvaltning av isbjørn i de ulike utbredelseslandene. VKM har også analysert internasjonal handel med isbjørnprodukter. Det er videre foretatt en evaluering av kvaliteten på dataene som danner kunnskapsgrunnlaget for bestandsestimer og usikkerheten forbundet med disse. VKM har utført intervjuer med fire av verdens fremste isbjørneksperter fra PBSG for å få oversikt over den mest oppdaterte informasjonen tilgjengelig angående forskning på og forvaltning av isbjørn. Transskripter av disse samtalen (godkjent av ekspertene) er vedlagt rapporten.

Resultater: Den fremste vitenskapelige kunnskapen om isbjørn i Canada tyder på at fire delbestander er i nedgang, to er stabile, én øker mens de resterende har ukjent

status. Det er verdt å merke seg at alle beregningene av bestandsstørrelser er forbundet med stor usikkerhet. I tillegg er bestandsestimatene for kvotesetting fra 2008 basert på data fra en annen type bestandsmålinger enn det som ble brukt i 2018. I noen av områdene blir også bestandsmålinger utført for sjelden til at en rask nedgang vil kunne fanges opp. Dette gjelder særlig når miljøet er i endring. Ifølge prognosen for det marine økosystemet i Arktis vil isbjørnen miste mye av sitt leveområde i årene som kommer og ytterligere nedgang i bestanden vil dermed være uunngåelig.

Analysen av CITES handelsdata belyser et dynamisk internasjonalt marked for handel med isbjørnprodukter, med signifikante endringer i importland og bruksområde for produktene. Inntil USA oppførte isbjørn som en truet art i 2008, var dette landet den største importøren av isbjørnprodukter, hovedsakelig jakttrofeer. I senere år har Kina overtatt som hovedimportør av isbjørnprodukter, hovedsakelig skinn. Samtidig med disse endringene har prisen på isbjørnskinns økt betydelig.

Konklusjon: Flere av isbjørnens delbestander er i nedgang. Kontinuerlig tap av leveområder vil føre til ytterligere nedgang i bestandene. Handel er ikke hovedtrusselen mot isbjørnens videre overlevelse, men det internasjonale markedet for handel med isbjørnprodukter er betydelig. Det er usikkert om fangst av isbjørn som inngår i internasjonal handel foregår på en bærekraftig måte.

VKM kan ikke utelukke at internasjonal handel med isbjørn fra Canada kan utgjøre en trussel mot artens overlevelsessevne.

Abbreviations and/or glossary

Abbreviations

CITES - The Convention on International Trade in Endangered Species of Fauna and Flora

CMS - Convention on the Conservation of Migratory Species of Wild Animals

COSEWIC - Committee on the Status of Endangered Wildlife in Canada

ERQ - Exporter Reported Quantity

ESA -Endangered Species Act

IRQ - Importer Reporter Quantity

IUCN - International Union for Conservation of Nature

MMPA - Marine Mammal Protection Act

NDF - Non-detriment finding

NEA - The Norwegian Environment Agency

NPI - Norwegian Polar Institute

PBSG - Polar Bear Specialist Group

PBTC - Polar Bear Technical Committee

POPs - Persistent organic pollutants

SSC – Species Survival Commission

TAH - Total Allowable Harvest

TEK - Traditional Ecological Knowledge

USFWS - United States Fish and Wildlife Service

VKM - Norwegian Scientific Committee for Food and Environment

Background as provided by the Norwegian Environment Agency

CITES regulates international trade in endangered species. At present, Canada is the only nation in the world that allows commercial export of polar bear products harvested from its own wild populations. Polar bears are listed on CITES appendix II (Norwegian list B), and imports to Norway therefore require both export permits from the Canadian CITES authorities and import permits from the Norwegian Environment Agency. In Norway, possession of polar bear products also requires a CITES owner certificate.

There has been a tendency for an increase in the number of polar bear products being imported from Canada to Norway, at the same time as there are signs of a negative population trend for several sub-populations of polar bears in Canada. Consequently, an updated scientific risk assessment (Non-Detriment Finding - NDF) is needed.

The risk assessment shall be used by the Norwegian Environment Agency in the evaluation of applications for imports in accordance with the Norwegian Regulation on importation, exportation, possession, etc. of endangered species of wild fauna and flora (CITES-regulation). The risk assessment may also potentially be used by the Norwegian Environment Agency to assess whether the species should be placed on Norwegian Cites list A.

Terms of reference as provided by the Norwegian Environment Agency

The Norwegian Environment Agency asks VKM for a scientific risk assessment of trade in polar bears (*Ursus maritimus*) and specimens thereof, based on the criteria given under the Convention on International Trade in Endangered Species (CITES). The risk assessment shall focus primarily on populations in Canada, as Canada is currently the only country that, under national law, allows commercial exports of polar bears and polar bear products.

The assessment shall be based on the Norwegian Cites Regulation and Article IV of the Convention and resolution 16.7 (Rev. CoP17)

- a. Name, distribution, life history, habitat, role in ecosystem
- b. Populations and trends
- c. Summary of existing information on threats and conservation status
- d. Population monitoring programs in the range area
- e. National regulations / legislation and in the range countries
- f. Current management in the range countries, including harvest quotas
- g. Assessment of legal / illegal harvesting and trade
- h. Overall assessment of data quality

Limitation: The risk assessment primarily concerns the populations that are within the hunting areas, i.e. where there is legal - or known illegal - hunting, to the extent that limitation is possible.

1 Methodology and data

1.1 CITES and Non-detriment findings

The convention on International Trade in Endangered Species of Fauna and Flora (CITES) was established in 1975 to ensure that trade in wildlife species is managed sustainably (Rosser and Haywood, 2002). CITES aims to regulate international trade in wildlife products through international cooperation between its currently 183 member states (parties). Under CITES, species are listed in two main Appendices, I and II, depending on the level of protection they require. Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but for which trade must be controlled in order to avoid utilization incompatible with their survival (<https://www.cites.org/eng/disc/how.php>).

A non-detriment finding (NDF) (as outlined in Res. Conf. 16.7 (Rev. CoP17)) by a Scientific Authority is required before an export permit or a certificate for an introduction from the sea may be granted for a specimen of a CITES Appendix II species. Parties may also enforce stricter domestic CITES legislation. For example, in addition to export permits, the Norwegian CITES Regulation also require import permits for Appendix II species. NDFs are scientific assessments of whether trade is going to be detrimental to species survival in the wild or threaten their role in their ecosystem.

The Norwegian Scientific Committee for Food and Environment (VKM) is the national Scientific Authority for CITES in Norway, and is thus responsible for carrying out scientific assessments related to export and import of CITES-listed species. As recommended by the CITES Animals and Plants Committees (Annex II to the revised Resolution Conf. 13.2 (Rev. CoP14)), VKM applied the guidance provided by the International Union for Conservation of Nature, IUCN, the making of NDFs for Appendix II species (<https://portals.iucn.org/library/sites/library/files/documents/SSC-OP-027.pdf>).

For a more detailed description of CITES and NDFs, see Rosser and Haywood (2002).

1.2 Literature selection

NDFs are prepared using the most updated scientific information about the species in question. This may include peer-reviewed literature, CITES-meeting documents, national/international status reviews and reports and personal communication with species experts (Rosser and Haywood, 2002).

The Polar Bear Specialist Group (PBSG) website was used as a starting point for gathering the necessary information for the NDF. The PBSG is a group of 35 chair-appointed scientists involved in polar bear research and conservation globally. The PBSG falls under the umbrella

of the IUCN Species Survival Commission, as such it provides advice on the status of polar bears to the IUCN. The PBSG also serves as the independent advisory group to the Polar Bear Range States at their invitation. The PBSG website contains extensive information about polar bear research, status and trends, conservation and management, meeting minutes, proceedings and reports, legislation and news. Their main database is continuously updated, and updates are published regularly (2-3 times a year).

For additional literature on genetic structure, searches were conducted through the Web of Science core collection (<https://clarivate.com/products/web-of-science/>) and Google Scholar. Search terms used in Title/Abstract fields included "polar bear", "genetics", "populations", "structuring" and "diversity". Search strings were built using Boolean operators AND and OR. Full texts for articles of potential relevance were assessed to determine their importance to this report. The reference lists in the selected articles formed the basis for identifying additional articles or reports.

We used the database Species+ to access CITES and EU documents regarding polar bears, and the CITES trade database for the trade analysis (chapter 2.8).

1.3 Hearing experts

Four polar bear scientists (all members of the PBSG, including one of the co-chairs of the group) were interviewed in order to gain a clearer picture of the current situation for polar bears. These experts are all active researchers and thus ahead of the published literature. Questionnaires were sent out ahead of semi-structured interviews with the hearing experts. A summary of the main points made by all hearing experts is given in section 2.9 and full transcripts of the conversations can be found in the Appendix I to this report. In addition to the four PBSG-experts, the project group also had conversations with the author of the newly published book "Polar bears and humans" who gave a presentation of his book to the project group.

1.4 Climate modelling

Climate change is widely considered the main threat to future polar bear survival. This report therefore includes models of sea ice thickness and extent for Canada for the years 2006-2056, given different climate change scenarios.

A Representative Concentration Pathway (RCP) is a greenhouse gas concentration (not emissions) trajectory adopted by the Intergovernmental Panel on Climate Change (IPCC) for its fifth Assessment Report (AR5) in 2014. The pathways describe different climate futures, all of which are considered possible depending on the volume of greenhouse gases emitted in the years to come. The four RCPs, namely RCP2.6, RCP4.5, RCP6, and RCP8.5, are labelled after a possible range of radiative forcing values in the year 2100 (2.6, 4.5, 6.0, and 8.5 W/m², respectively). The Norwegian Earth System Model (NorESM) has produced the climate scenarios presented here and is one out of ca. 20 climate models that has produced

output for the Coupled Model Intercomparison Project Phase 5 (CMIP5) (<https://portal.enes.org/models/earthsystem-models/ncc/noresm>). NorESM provided all climate scenarios presented and has previously given accurate predictions of the Arctic sea ice cover (Dai et al., 2020).

1.5 Analysis of international data on import and export from the CITES Trade Database

International wildlife trade can represent a major threat to biodiversity conservation. CITES monitors trade in ca. 35,000 species, and all 183 parties provide annual reports detailing their international trade in CITES-listed species, culminating in more than 18 million trade records. This wealth of data, reported from 1975 to-date, is maintained in the 'CITES Trade Database' (trade.cites.org), managed by the UN Environment World Conservation Monitoring Centre (UNEP-WCMC) on behalf of the CITES Secretariat. This data is used to assess and understand wildlife trade, and has resulted in numerous scientific publications. The 'Guide to Using the CITES Trade Database' (UNEP-WCMC, 2013) provides technical instruction on utilizing the database, to avoid incorrect interpretation of this highly complex data.

Polar bears are listed on CITES Appendix II. CITES Appendix II listed species require an export permit issued by the Management Authority of the State of export, and this should only be issued if the specimen was legally obtained and if the export will not be detrimental to the survival of the species. For re-export, a re-export certificate issued by the Management Authority of the State of re-export is required, and this should only be issued if the specimen was imported in accordance with the Convention. No import permit is required, but specimens should be declared on import accompanied by the export or re-export permit issued by the Management Authority of the State of export or re-export (<https://www.cites.org/eng/disc/how.php>).

The CITES Trade Database was used in this NDF report to assess international trade in polar bear skins and other parts to assess the scale and distribution among destination countries of this trade through time. The trade database includes information on export and import, as well as information on the type of material, the quantity of the material, and the purpose of the trade. Codes for the purpose-of-transaction (purpose codes) were used as specified in Resolution Conf. 12.3 (Rev. CoP16) as listed in the guide to using the CITES trade database (UNEP-WCMC, 2013).

The analysis is based on all reported legal export (Exporter Reported Quantity, ERQ) and import (Importer Reported Quantity, IRQ). The limit of 1996 was chosen based on the recommendation that data from 1995 and before are less reliable. The limit of 2017 was chosen as not all data for 2018 was fully reported by all CITES parties.

As an example, a Canadian polar bear skin in a Chinese home bought on Svalbard, would have been logged in the CITES Trade Database when it was exported from Canada, when it was imported to Norway, when it was re-exported from Svalbard to China, and again when it

was imported to China. In our analysis we distinguish between Whole Bear Equivalents and bear parts. Whole Bear Equivalents are those parts that represent a single bear, e.g., a skin or a skull, whereas parts are all other derivatives such as blood samples and tissue samples.

2 Assessment

2.1 Description

Names: *Ursus maritimus* (Phipps 1774)

Synonyms: *Thalarctos maritimus*

Common name: Polar bear

Norwegian name: Isbjørn

2.1.1 Characteristics

Polar bears are ecologically marine mammals adapted to the extreme climatic conditions in the Arctic and a life in close association with the sea and sea ice (as reflected in the scientific name, which means 'sea bear', and the Norwegian name, isbjørn, which means 'ice bear')(PBSG, 2019a).

The polar bear is the largest bear species with head-body length of 240-260 cm and shoulder height up to 170 cm. Full grown adult males usually weigh 400-600 kg, whereas adult females weigh 150-250 kg in summer, but can weigh up to up to 400-500 kg before entering their maternity dens (Derocher, 2012; PBSG, 2019a; Stirling, 2011). The body mass of adult polar bears changes by 50% or more throughout the year (increase in weight is largely as fat) and there is also some variation in body size of adult bears from different areas (Derocher, 2012; Stirling, 2011).

Polar bears have a thick fur, which appears white or yellowish, providing both insulation from the cold and camouflage while hunting (Derocher, 2012; PBSG, 2019a; Stirling, 2011). The fur consists of a dense undercoat and an outer coat of guard hairs. Both guard hairs and underfur layers are translucent. Guard hairs are also hollow, enhancing their insulation properties. Summer coats are shorter than winter coats, but unlike other bear species, polar bears do not have thinner fur on their bellies. Other adaptations to reduce heat loss include small ears and a short tail (Derocher, 2012). The thick layer of fat (blubber) of up to 11 cm under their skin (Stirling, 2011) also provides thermal insulation.

The blubber along with the hollow hairs also provides buoyancy when the polar bears are swimming. Polar bears are good swimmers, and adult bears can swim for hours and even days if needed (Pilfold et al., 2017). Polar bears have large paws for shovelling snow and travelling on thin ice, and partly webbed toes that function as 'paddles' when swimming. The paws are well-furred beneath the sole, and have a surface that acts as suction cups, providing both insulation and traction.

2.1.2 Life history and behaviour

Once polar bears reach maturity, the normal life span is about 25 years for males and 30 years for females, although a small number of individuals may live longer (PBSG 2019a). Age of first birthing is usually 5-6 years and average generation time is 11.5 years (range 9.8-13.6) (Wiig et al., 2015). However, in the most comprehensively studied subpopulation (Western Hudson Bay) the survival of juvenile, subadult, and older adult polar bears has declined, and this decline is significantly related to progressively earlier dates of sea ice breakup (Regehr et al., 2007).

Polar bears mate on sea ice from March to May/June, but implantation and development of the fertilized egg is delayed until September-October, when females enter maternity dens (Stirling 2011, Derocher 2012) where they give birth in November to January. Cubs stay in the den with their mother until March/early April; after which the family returns to the sea ice so the mother can resume hunting seals. The number of cubs per litter is usually two (average across subpopulations: 1.7, range 1.5-2.1) (Derocher 2012, PBSG 2019a). In Western Hudson Bay litter size has declined with the increasing length of the ice-free period (Derocher, 2012) and the number of cubs observed, as a proportion of total observations, are lower than those recorded for the neighbouring subpopulations (Peacock et al., 2010; Regehr et al. 2007; Stapleton et al., 2014; Obbard et al., 2015; 2018). Females typically care for the offspring for 2.5 years and breed every third year, but offspring may remain with their mother for 3.5 and even 4.5 years in less productive areas (PBSG 2019a). Cub mortality rates during the first year are often high and can exceed 70% (Derocher, 2012; PBSG, 2019a). Increased cub mortality has been associated with decline in body condition and low maternal weight of adult female polar bears and has been documented in Western Hudson Bay (Derocher and Stirling, 1995; PBSG 2019b; Stirling et al., 1999; Sciuillo et al., 2016), the neighbouring Southern Hudson Bay subpopulation (Obbard et al., 2016), and in the Southern Beaufort Sea subpopulation (Rode et al., 2010).

Females show high fidelity to denning sites, and female maternity dens are highly congregated in some areas (Derocher 2012). Dens are usually on land, but close to the coast in most subpopulations (Kolenosky and Prevett, 1983; Durner et al., 2006; Derocher, 2012; Rode et al., 2018). With the exception of pregnant females, polar bears are active year-round and do not hibernate (Derocher, 2012; Stirling, 2011). Adult polar bears are generally solitary.

2.1.3 Habitat and movements

Polar bears are habitat specialists that rely heavily on the sea ice environment (Wiig et al. 2015) for hunting, traveling, mating, resting, and in some areas, maternity dens (Derocher, 2012; Stirling, 2011; Wiig et al., 2008). Polar bears prefer sea ice concentrations (relative

area of sea ice versus marine surface water) exceeding 50% in the shallow productive waters of the continental shelves (Durner et al., 2009; Stirling and Derocher, 2012). Sea ice dynamics influence the timing of seasonal movements; when the sea ice retreats north in the summer, polar bears either follow the ice, or move to terrestrial habitats until the sea ice returns (Wiig et al., 2015).

Polar bears cannot hunt for seals when the sea is ice-free, and those that stay on land for longer periods live on stored body fat (Derocher 2012; Stirling, 2011, Wiig et al., 2015). Declines in sea ice duration and distribution have been found to correlate with negative trends in body condition, survival and reproductive success in the Hudson Bay (Castro de la Guardia et al., 2017, Regehr et al., 2007; 2010; Rode et al., 2010; 2012; Obbard et al., 2016). Pagano et al. (2018) observed that fragmentation of the spring sea ice in the Beaufort Sea increased activity and metabolic rates of polar bears, and suggested that increased energy demands may explain the observed declines in body condition and survival in polar bear subpopulations.

Polar bears are generally non-territorial highly mobile animals (Derocher, 2012; Wiig et al., 2008) making seasonal movements to maximize their foraging time on sea ice (Amstrup, 2003). Their home ranges can be very large, but bears usually show high fidelity to their home areas (Derocher, 2012). Most bears seem to remain within a discrete subpopulation, but according to Amstrup et al. (2004; 2005) there can be considerable overlap in areas occupied by members of different subpopulations. Home range sizes and movements depend on habitat, season and reproductive condition, and are generally larger than those of terrestrial carnivores of similar size (Derocher, 2012; Ferguson et al., 1999; Stirling, 2011). In the Canadian Arctic, bears living in highly variable and unpredictable ice conditions (including ice-free periods), have larger ranges than bears living on more stable ice (Derocher, 2012).

Most movement (radiotracking) data have been collected from adult female bears (Durner et al., 2019), because adult male polar bears and subadults cannot be radio-collared (males have wider necks than heads and subadults grow; Derocher, 2012). Ferguson et al. (1999) found that on average, the home range of female polar bears is 125,100 km². Individual ranges recorded span from less than 1000 km² to 960,000 km² (Amstrup et al., 2000, Derocher, 2012).

2.1.4 Role in the ecosystem

Polar bears are apex predators in the Arctic marine ecosystem and have no natural predators, apart from humans (Derocher, 2012; Stirling, 2011). They are almost strictly carnivorous, and their diet consists primarily of ringed seals (*Pusa hispida*) and to a lesser extent bearded seals (*Erignathus barbatus*) (Derocher et al., 2002; Iversen et al., 2013; Galicia et al., 2015; Thiemann et al., 2008a; 2011). They feed intensively on seals for a brief period in spring when the seals use the ice for pupping and moulting, replenishing fat

reserves used up during the winter (Wiig et al., 2008). Polar bears also prey or scavenge opportunistically on harp seals (*Pagophilus groenlandicus*), hooded seals (*Cystophora cristata*), beluga whales (*Delphinapterus leucas*), narwhals (*Monodon monoceros*), harbor seals (*Phoca vitulina*), walrus (*Odobenus rosmarus*), bowhead whales (*Balaena mysticetus*) (Johnson et al., 2019; Peacock et al., 2013; Thiemann et al., 2008a), as well as birds, bird eggs, fish, animal carcasses, kelp, food waste from human settlements (Russell, 1975; Wiig et al., 2008) and even other polar bears (Amstrup et al., 2006). A recent study from the Western Hudson Bay subpopulation (Figure 2.1.5-1) suggests that the proportion of alternative prey species (alternative to ringed seal) in the polar bears' diet has been variable over the last 25 years, and that these changes correspond to changes in climate (Johnson et al., 2019).

Polar bears hunt primarily by stalking seals that are hauled out on sea ice or by still-hunting at breathing holes (Stirling, 1974; 2011). The intimate ecological interaction between polar bears and ringed seals is evident from studies showing a close relationship between their population sizes in the Canadian Arctic (see e.g. Fig. 5 in Stirling and Øritsland, 1995), and the fact that ringed seals have evolved a unique anti-predator behaviour; they give birth beneath the snow on the sea ice (Smith and Stirling, 1975; Smith and Hammill, 1981). The great majority of the seals killed by polar bears are ringed seal pups (Smith, 1980).

2.1.5 Geographic distribution and subpopulations

Polar bears are unevenly distributed in the ice-covered waters of the Arctic. Native populations occur in Canada (Labrador, Manitoba, Newfoundland, Northwest Territories, Nunavut, Ontario, Québec, Yukon), where their range is limited by the southern extent of sea ice (Hudson Bay); Greenland; Norway (Svalbard and Jan Mayen); the Russian Federation (Krasnoyarsk, North European Russia, West Siberia, Yakutiya); and the United States (Alaska) (Figure 2.1.5-1, Wiig et al., 2015).

Currently, the IUCN/SSC Polar Bear Specialist Group (PBSG) recognizes 19 subpopulations of polar bears (Figure 2.1.5-1). Canada hosts 13 of the 19 polar bear management units, with nine units found solely in Canada. These units are the Norwegian Bay, Lancaster Sound, Gulf of Boothia, Foxe Basin, Southern Hudson Bay, Western Hudson Bay, M'Clintock Channel, Viscount Melville Sound, and Northern Beaufort Sea. Davis Strait, Baffin Bay and Kane Basin are shared with Greenland (Denmark) and Southern Beaufort Bay is shared with the US (see Table 2.1.5-1). In addition, the Arctic Basin management unit is shared among all range states.

Table 2.1.5-1 Subpopulation structure of Canadian polar bears (*Ursus maritimus*) and the provincial or territorial jurisdictions associated with each (table adapted from Peacock et al. 2011).

Subpopulation	Jurisdictions
Southern Beaufort Sea	Northwest Territories, Yukon, USA
Northern Beaufort Sea	Northwest Territories, Nunavut
Viscount Melville Sound	Northwest Territories, Nunavut
M'Clintock Channel	Nunavut
Lancaster Sound	Nunavut
Norwegian Bay	Nunavut
Gulf of Boothia	Nunavut
Foxe Basin	Nunavut, Quebec
Western Hudson Bay	Manitoba, Nunavut
Southern Hudson Bay	Ontario, Nunavut, Quebec
Kane Basin	Nunavut, Greenland
Baffin Bay	Nunavut, Greenland
Davis Strait	Newfoundland and Labrador, Nunavut, Quebec, Greenland

Note: The Canadian federal government responsibility for polar bears is noted for areas below the tide line.

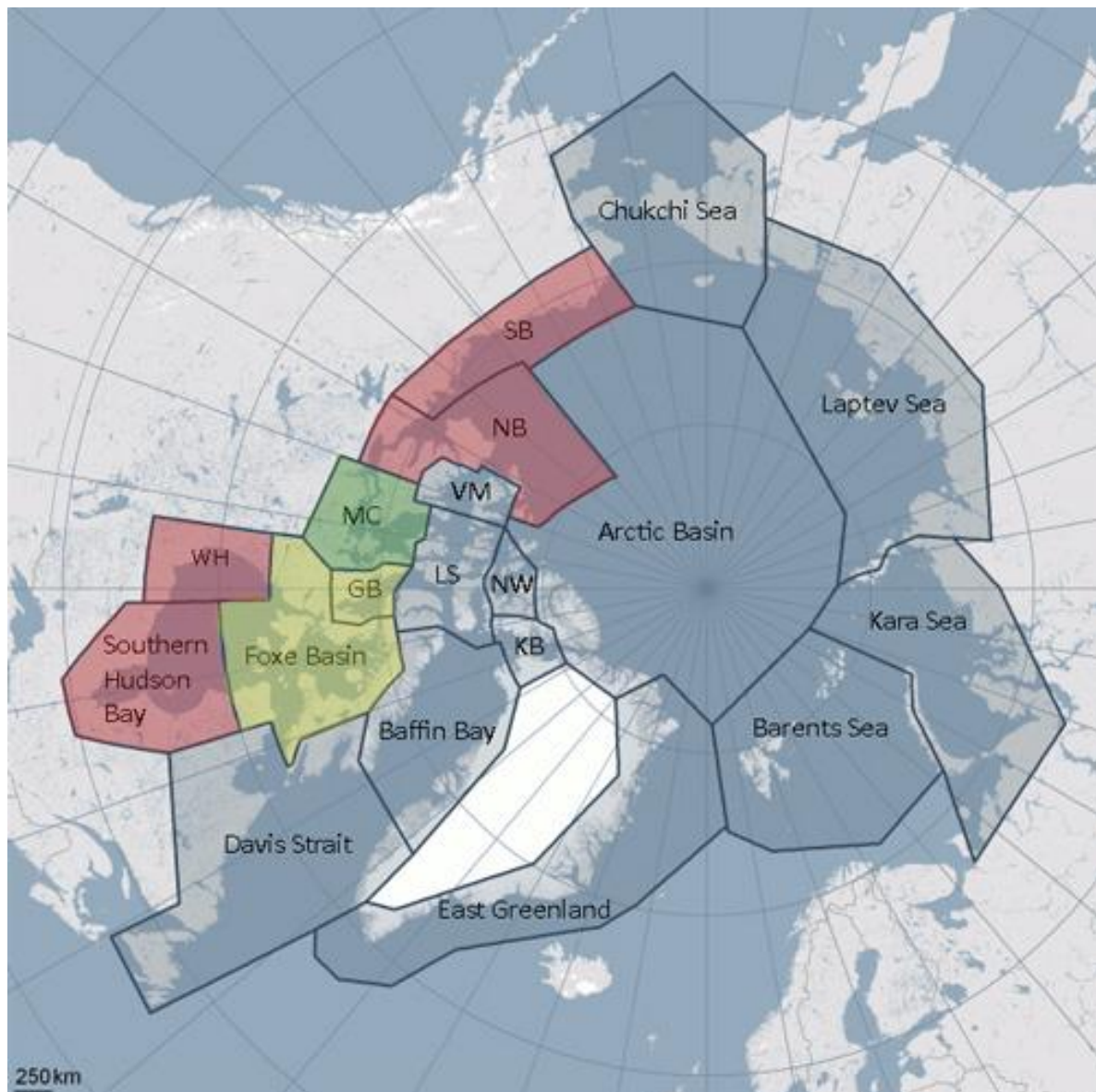


Figure 2.1.5-1 Map showing the geographic delineations of the 19 subpopulations of polar bears recognized by the IUCN/SSC Polar Bear Specialist Group (GB = Gulf of Boothia, KB = Kane Basin, LS = Lancaster Sound, MC = M'Clintock Channel, NB = Northern Beaufort Sea, NW = Norwegian Bay, SB = Southern Beaufort Sea, VM = Viscount Melville Sound, WH = Western Hudson Bay). Information on subpopulation trends (approximate 3 generations) are available for subpopulations with yellow (stable), green (increasing) and red (decreasing) fill colours, whereas for subpopulations with grey fill colour, the population trend is unknown due to data deficiency. See Figure 2 for estimates of subpopulation size and number of human-caused removals. Reference: <http://pbsg.npolar.no/export/sites/pbsg/en/docs/2019-PBSG-StatusTable.pdf>

In Canada, subpopulation boundaries were initially proposed based on barriers to movements, military surveys, anecdotal sampling of traditional knowledge of Inuit hunters, and management considerations such as political boundaries (Taylor and Lee, 1995; Lunn et al., 2010). Subsequently, some boundaries have been validated using information from radio-collared bears (e.g., Obbard and Middel, 2012). There can be considerable overlap in areas occupied by members of different subpopulations such as the Beaufort Sea (Amstrup

et al., 2004; 2005) and Hudson Bay (Viengkone et al., 2018). In 2014, the boundary between Northern Beaufort Sea and Southern Beaufort Sea subpopulations was moved for management purposes on the basis of Traditional Ecological Knowledge (TEK) and older telemetry data, whereas more recent scientific evidence was not included in the decision (PBSG, 2019c). Ecological similarities allow clustering of the 19 subpopulations into larger geographic regions within which their habitats are more similar than different (Amstrup et al., 2008). Vongraven et al. (2012) adopted the ecoregion approach when suggesting a framework for monitoring of polar bears to understand impacts of climate change and other stressors.

2.1.6 Genetic structure

2.1.6.1 Genetic structuring and conservation units

The most comprehensive study of genetic structuring by Paetkau et al. (1999) includes 473 polar bears representing 17 of the 19 subpopulations. By analysing mitochondrial (*mtDNA*) and nuclear DNA (16 microsatellites) markers, the authors found significant differentiation among most of the subpopulations (except between Kane Basin/Baffin Bay). The results have later been corroborated in a general way by several studies on both smaller geographical scales (e.g. Campagna et al., 2013; Crompton et al., 2008; Viengkone et al., 2016; 2018) and on a global scale (Peacock et al., 2015).

Paetkau et al. (1999) described four large-scale clusters based on genetic data and movement data from satellite tracking of 135 female bears. These were interpreted to reflect configuration of land masses in conjunction with the seasonal distribution of sea ice, and thus access to seals. The genetically most distinct cluster consisted of the Norwegian Bay subpopulation alone. This is also the smallest population (estimated to around 200 individuals in 1997). In the second cluster, the remaining populations in the Canadian Arctic Archipelago (Viscount Melville Sound, M'Clintock Channel, Lancaster Sound, Gulf of Boothia) were grouped with Kane Basin and Baffin Bay, while the three southernmost subpopulations (W. Hudson Bay, Foxe Basin, Davis Strait and presumably S. Hudson Bay) formed a third cluster. The last cluster, covering a vast area around the perimeter of the Arctic Basin, included the Northern and Southern Beaufort Sea populations (see map, figure 2.1.5-1). Most noteworthy, a relatively high degree of genetic discontinuity was found among populations in the archipelagic environment of the Canadian Central and High Arctic as compared to populations in geophysically simpler environments. Thiemann et al. (2008a) studied patterns of genetic and ecological diversity and suggested that, polar bears in Canada comprise five distinct conservation units (so called designatable units, DUs), namely: Beaufort Sea, High Arctic, Central Arctic, Hudson Bay and Davis Strait). Each unit is indicative of local adaptation. Subpopulations within these units are expected to experience similar impacts of climate change (Thiemann et al., 2008b).

2.1.6.2 Genetics and demography

Overall, the level of genetic diversity in polar bears has been measured to be lower than in other bear species. For instance, the nucleotide diversity is 20–25% of that found in brown bears, assumed to reflect severe population bottlenecks and the smaller distribution range and population size of polar bears (Hailer et al., 2012). In polar bears, the largest proportion of genetic variance is found among individuals and not among subpopulations. This pattern can probably be explained by the species' large dispersal capacity (Kutschera et al., 2016). Furthermore, little difference in patterns between *mtDNA* and Y-chromosomes implies less strongly sex-biased dispersal in polar bears than in brown bears (Bidon et al., 2014). It has been suggested that long distant migrants play an important role in maintaining connectivity, buffering against subpopulation size fluctuations and declines of genetic diversity (Kutschera et al., 2016). Particularly, for the Hudson Bay it has been suggested that a continued trend towards earlier ice break-up could lead to decreased gene flow and potential isolation of southern polar bears (Crompton et al., 2008).

2.2 Population and habitat trends

2.2.1 Population size

The size of the global population of polar bears is uncertain, but is estimated to comprise between 22,000 and 31,000 polar bears, with a mid-point estimate of 26,000 bears (PBSG, 2019d). For the 14 subpopulations for which scientific estimates exist (Figure 2.2.1-1), the sum of the mid-point population estimates is 18,349 bears (PBSG, 2019e). The subpopulation size estimates suffer from wide confidence intervals (Hamilton and Derocher, 2019). PBSG expects that the number of individuals ranges from several hundreds to a few thousands in each of the subpopulations in Chukchi, Kara, Laptev and East Greenland, bringing the midpoint estimate to approximately 25,000 (PBSG 2019a). Approximately two-thirds of the world's polar bears occur in Canada, including those in subpopulations shared with the United States or Greenland (Peacock et al., 2011). About half of these again reside within the Canadian territory of Nunavut (Table 2.1.5-1, PBSG 2019d).

According to Vongraven et al. (2012), population size is the most difficult parameter to estimate for polar bears. The density estimates range from 0.57 to 9.30 bears per 1000 km² with a mean of 2.36 bears per 1000 km² (Hamilton and Derocher, 2019). Due to low sample size (number of subpopulation estimates) and high variance in environmental input variables, direct evidence of a relationship between population density and availability of sea ice is difficult to establish (Hamilton and Derocher, 2019). However, ice conditions have been found to affect foraging success, mating and movements (Derocher et al., 2004; Cherry et al., 2013; Wiig et al., 2008) and thus most likely the abundance of polar bears (Amstrup et al., 2008; 2010; Stirling and Derocher, 2012).

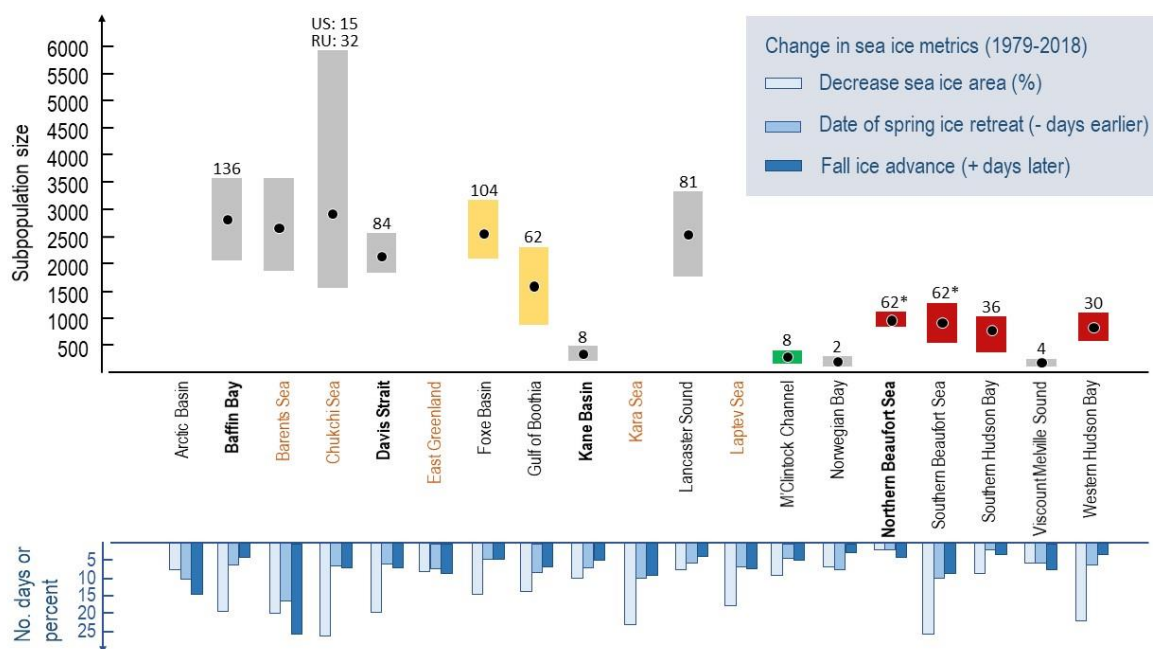


Figure 2.2.1-1 Estimated subpopulation size (number of individuals) for the 19 subpopulations of polar bears. Black bullets indicate point estimates and bars the 95% confidence limits for subpopulation size. Bar fill colour indicates change in subpopulation size over ca 3 polar bear generations. Red = (likely) declining, Green = increasing, Yellow = (likely) stable, Grey = unknown trend. The number above each bar is the number of human-caused removals (5-year mean during 2013/2014-2017/2018). Subpopulations shared between Canada and other countries are indicated in bold. Entirely non-Canadian subpopulations are indicated in brown colour. * removals merged for NB and SB due to unresolved boundary. Lower graph: Per decade change in sea ice metrics for the period 1979-2018 in the 19 subpopulations. The y-axis is percent change in sea ice area, or number of days, depending on sea ice metric (see legend). See <http://pbsg.npolar.no/export/sites/pbsg/en/docs/2019-PBSG-StatusTable.pdf> for more information.

2.2.2 Polar bear population trends

Long-term trends for most of the world's polar bear subpopulations are unknown due to lack of empirical data (Vongraven et al., 2012), with the exception of Hudson Bay the Beaufort Sea and Svalbard. There are large natural fluctuations in the reproduction of polar bears due to environmental fluctuations in Arctic marine ecosystems and long-time monitoring is therefore essential to detect changing trends in population size estimates.

Decline in the total population size of polar bear is expected due to habitat loss (Amstrup et al., 2010; Stirling and Derocher, 2012; Wiig et al., 2015). The timing of the negative impacts

will, however, differ among regions (Amstrup et al., 2008; Stirling and Derocher, 2012). Figure 2.2.1-1 summarizes the trends for each subpopulation. As of 2019, the PBSG considers that over three generations the population trends for four populations are likely or very likely to have decreased (Southern Hudson Bay, Western Hudson Bay, Southern Beaufort Sea, and Northern Beaufort Sea), two are stable or very likely to be stable (Foxye Basin, Gulf of Boothia), one has very likely increased (M'Clintock Channel), and 12 are data deficient (Figure 2.2.1-1, Table 2). Notably, the M'Clintock Channel subpopulation is believed to still recover from overharvest, as it previously was reduced from around 900 to a little over 300 bears (Derocher, 2012; PBSG 2019f). PBSG also reports population trends for one generation only (PBSG, 2019d), however, the necessity of data from a minimum of three generations, particularly for species with a history of harvest, is emphasized in the IUCN NDF guidance (Rosser and Haywood, 2002).

Table 2.2.2-1 Comments, vulnerabilities and concerns listed by IUCN/SSC Polar Bear Specialist Group (see footnotes) concerning declining subpopulations (Figure 2.1.5-1). Subpopulation size estimates and associated uncertainty, and population trends (approximately 3 and 1 generation(s)).

Subpop.	Estimate (uncert.)	Trend (3 gener.)	'Trend' (1 gene.)	PBSG comments	
WH	842 (562-1121)	Very likely decreased (1995-2016)	Likely decreased (2011-2016)	Concerns include harvest, increased time onshore due to changing dates of breakup and freeze-up, declines in body condition, and lower productivity. Earlier declines in size of subpopulation linked to reduced survival due to timing of sea ice breakup. 2016 abundance estimate was 18.3% lower than 2011 estimate; similar rate of change in abundance over same time period in adjacent Southern Hudson Bay subpopulation.	
SH	780 590-1029	Very likely decreased (1986-2016)	Likely decreased (2012 to 2016)	Increased time ashore due to changes in breakup and freeze-up; declining body condition; declining survival rates, especially of cubs-of-the-year. 2016 abundance estimate was 17% lower than 2011/2012 estimate. Similar rate of change in abundance in neighbouring Western Hudson Bay subpopulation.	
NB	980 (825-1135)	Likely decreased (2006-2018)	Likely decreased (2013-2018)	Potential and actual removals merged for NB and SB due to unresolved boundary make population trends difficult to assess.	Breakup becoming earlier and freeze-up later, resulting in longer period of open water and unavailability of prime fast ice feeding habitat in spring. Fact that recorded harvest level is less than half the total allowed quota is likely at least partly the result of population decline.
				Concerns include declining body condition, periods of low survival, and growing reliance of part of population on land during summer.	Increased potential for human-polar bear conflict arising from increased industrial development of Alaska's coastal plain.
SB	907 (548-1270)	Likely decreased (1998-2010)	Likely decreased (2001-2010)		

<http://pbsg.npolar.no/en/status/populations/western-hudson-bay.html> downloaded 2020-3-20

<http://pbsg.npolar.no/en/status/populations/southern-hudson-bay.html> downloaded 2020-3-20

<http://pbsg.npolar.no/en/status/populations/northern-beaufort-sea.html> downloaded 2020-3-20

<http://pbsg.npolar.no/en/status/populations/southern-beaufort-sea.html> downloaded 2020-3-20

2.2.3 Habitat trends - predictions for sea ice thickness and extent from climatic modelling

There has been substantial warming in the Arctic in recent decades (Post et al., 2019) and the area covered by sea ice in September (month of minimum extent each year) declined by 14% per decade from 1979 through 2011, which is faster than predicted (Stroeve et al., 2012). Arctic sea ice extent is linearly related to global mean temperature, which in turn, is directly related to atmospheric greenhouse gas concentrations (Amstrup et al., 2010).

Here, we present projected sea ice thickness and extent, as well as snow mass for the RCP4.5 (medium emissions) and RCP8.5 (high emissions) scenarios. All data presented are for the geographical ranges from 40-85°N and 30-140°W.

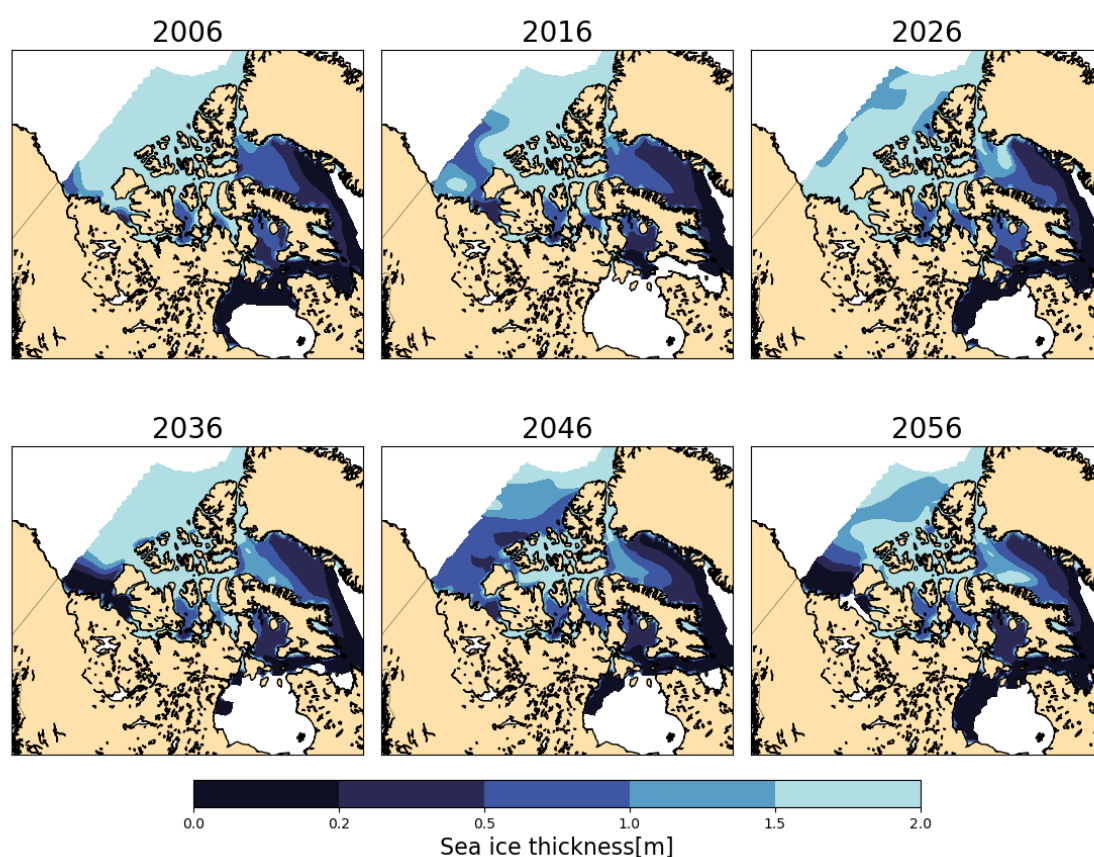


Figure 2.2.3-1 Development of sea ice thickness for Canada in November 2006-2056 as projected by the NorESM climate model, RCP4.5 scenario.

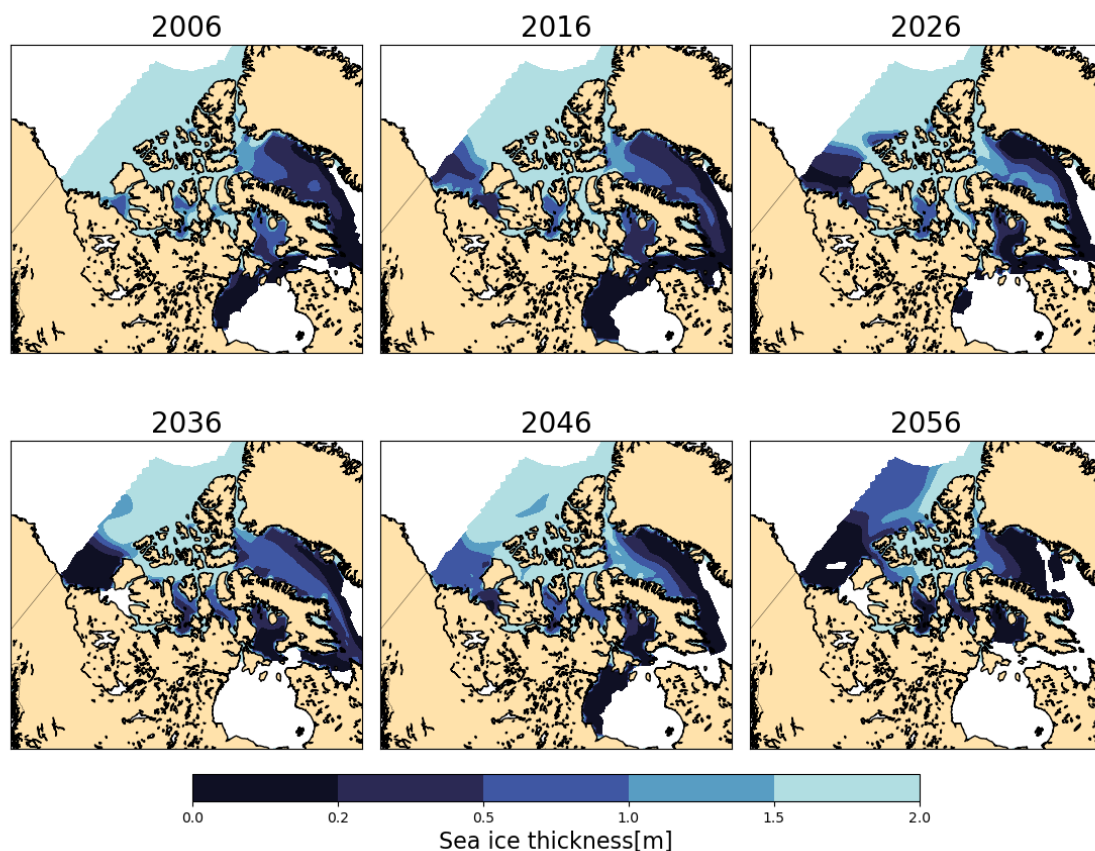


Figure 2.2.3-2 Development of sea ice thickness for Canada in November 2006-2056 as projected by the NorESM climate model, RCP8.5 scenario (worst case).

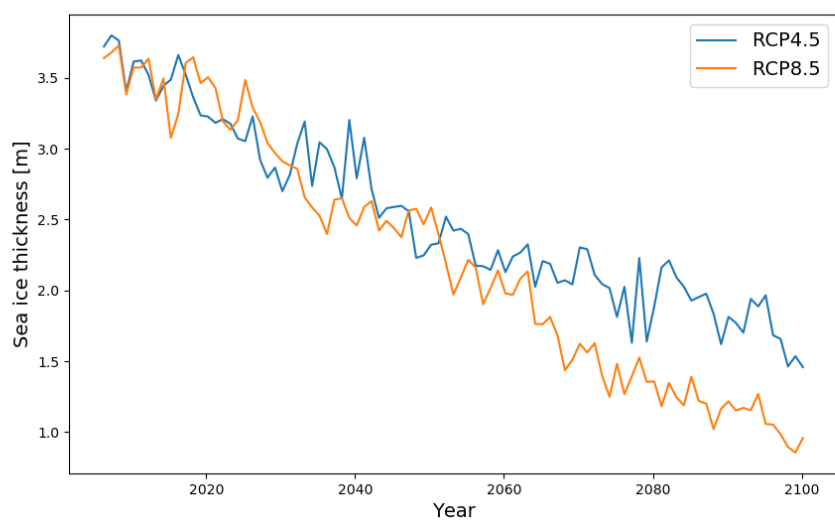


Figure 2.2.3-3 Projected trends of average sea ice thickness in Canada for the month of March in the 21st century for RCP4.5 and RCP8.5 climate scenarios. Please note that the area of sea ice will also

decrease in the period.

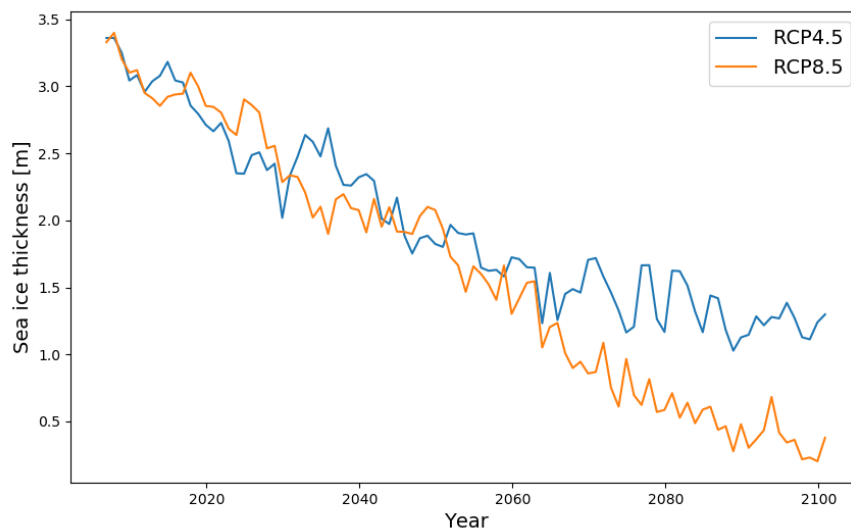


Figure 2.2.3-4 Projected trends of average sea ice thickness in Canada for the month of November in the 21st century for RCP4.5 and RCP8.5 climate scenarios. Please note that the area of sea ice will also decrease in the period.

All simulations (Figure 2.2.3-1 to 2.2.3-4) predict extensive continued habitat loss for polar bears for the period 2006-2056. This is in line with the on-going trend described by Stern and Laird (2016). The IUCN NDF guidance suggests that in absence of population data from the field, data on habitat loss can be used to infer population decline.

2.2.4 Prey population trends

Seals are heavily dependent on sea ice as habitat, e.g., for giving birth and for protection from predators (Smith, 1980; Smith and Hamill, 1981; Stirling and Derocher, 1993; Kovacs et al., 2011). Baseline population estimates are lacking, but population sizes are likely to decline rapidly due to habitat loss (e.g. Gilg et al., 2012; Kovacs et al., 2020; Laidre et al., 2015; Reimer et al., 2019).

The ringed seal is the smallest (adult weight 40-70 kg; Stirling, 2011) and most common Arctic seal species and the most common prey for polar bears (Stirling and Smith, 2004). The global population trend for ringed seals is reported as unknown in the IUCN Red List of Threatened Species (Lowry, 2016), but the species has been suggested as one of the first Arctic mammals to experience negative effects of global warming (Ferguson et al., 2005; Kelly et al., 2010; Laidre et al., 2008; Reimer et al., 2019).

The bearded seal is less abundant, but has a much larger body size than ringed seals (adults weigh up to 425 kg) and is hunted primarily by adult male polar bears (Thiemann et al.,

2011). The global population trend for bearded seals is reported as unknown in the IUCN Red List (Kovacs, 2016), but recent studies have shown that the species will likely be negatively impacted by climate change (e.g. Kovacs et al., 2020).

The negative effects of climate warming on sea ice may increase the importance of alternative prey species, such as harp seals and hooded seals, for polar bears in the northern pack ice areas (Aars et al., 2017; Peacock et al., 2013). Indeed, it has been hypothesized that the recovery of the Davis Strait polar bear population may be due in part to recovery of the Northwest Atlantic harp seal population, which increased from 1-2 million in 1971 to >7 million in 2008 due to reduced human-caused mortality (Hammill et al., 2015). Keeping track of (changing) species interactions under changing climate and ice conditions requires high quality data, which are often lacking (Hamilton et al., 2017; Laidre et al., 2015; Reimer et al., 2019).

2.3 Scientific population monitoring in the range area (Canada)

Monitoring of polar bear abundance occurs at the subpopulation level (Hamilton and Derocher, 2019), and the two main methods for obtaining scientific data (PBSG, 2019e) are capture-(mark)-recapture (Regehr et al., 2007; Bromaghin et al., 2015; Lunn et al., 2016) and aerial survey methods (mainly line transects) (Aars et al., 2009; Stapleton et al., 2014, 2016; Obbard et al., 2015; 2018). Estimating population size is challenging, because the density of polar bears is highly variable in space and time (Derocher, 2012). Long-term studies of polar bears in Hudson Bay, Canada, the Beaufort Sea region (shared by USA and Canada), and Svalbard have provided valuable information on status and trends of polar bears (Vongraven et al., 2012, Hamilton and Derocher, 2019). The other subpopulations have not been studied to the same extent. There is a broad consensus among polar bear scientists that in order to understand the cumulative impacts of climate change and other stressors, including harvest, circumpolar monitoring of subpopulation abundance and trends are needed. Vongraven et al. (2012) suggested a monitoring framework for polar bears, with no longer than five years between estimates of subpopulation size and trend in at least some subpopulations within each of the four major sea ice ecoregions (Amstrup et al. 2008), and low-intensity monitoring primarily for those subpopulations where research access is difficult. They recommended that collection of data on harvest should occur with the same intensity for all subpopulations. The framework suggested by Vongraven et al. (2012) has not been implemented, but the call to implement a 5-year inventory cycle was recently echoed by Hamilton and Derocher (2019).

Hamilton and Derocher (2019) reviewed population size information for all the 19 subpopulations, and found that three subpopulations (i.e. Northern Beaufort Sea, Southern Beaufort Sea and Western Hudson Bay) were regularly monitored with 3–6 subpopulation estimates since the 1970s (although the most recent estimate is from 2011 or older). The remaining subpopulations had a mean re-estimation interval of 10.9 years (range: 1–36

years), with six subpopulations having mean intervals of more than 15 years and with only six subpopulations having estimates newer than 10 years old (Hamilton and Derocher, 2019). For the population in Viscount Melville Sound, the last estimate is from 1992. Hamilton and Derocher (2019) found that after data were collected, it took a mean of 5.5 years (range: 0–12 years) before a subpopulation estimate was published.

The Scientific Working Group to the Canada-Greenland Joint Commission on Polar Bear undertook during the years 2011–2014 an extensive study of the Kane Basin and Baffin Bay subpopulations to obtain updated information on subpopulation size and status (SWG 2016). It was later concluded that for the Baffin Bay subpopulation, the methodology for the surveys in the 1990s and 2010s were too different to directly compare the results and to assess trends in the size of the subpopulation (Regehr et al., 2017a).

The most recent national status assessment for polar bear in Canada was published by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 2018. In this report it is stated that: "*Population levels and trends are currently uncertain, as population estimates undertaken since the last COSEWIC assessment in 2008 exist for less than half of the range and survey methodology has changed.*" (COSEWIC, 2018).

2.4 Current non-detriment findings for Canada and Greenland

The Canadian Scientific Authority for CITES advises that harvest of polar bears in Canada is sustainable, and accordingly their export is non-detrimental to the survival of the species in the wild.

The NDF was last updated in 2018 (<https://www.canada.ca/en/environment-climate-change/services/convention-international-trade-endangered-species/non-detriment-findings/polar-bear.html>). It is based on the annual assessments of the Polar Bear Technical Committee (PBTC), a national-level scientific and Indigenous Traditional Knowledge committee. Indigenous Traditional Knowledge, ITK, is also referred to as Traditional Ecological Knowledge, TEK, and Aboriginal traditional knowledge, ATK. PBTC concluded that the majority (an estimated 65%) of polar bears in Canada are in subpopulations that are increasing, stable or likely stable.

The Greenland Institute of Natural Resources' NDF from 2007 is based on data from PBSG and PBTC (for subpopulations shared with Canada). The conclusion of this NDF regarding the three polar bear subpopulations shared between Canada and West Greenland (Kane Basin, Baffin Bay and Davis Strait), is as follows: "*As it cannot be asserted that current catches in all populations, including the combined catch of Greenland and Canada is sustainable, and there is no trade-system in place that will help to distinguish the origin of polar bear products, it cannot be concluded that the current export of polar bear products from Greenland is non-detrimental.*"

The PBSG advised that in order to avoid certain decline in the Kane Basin and Baffin Bay populations, a maximum of 7.7 individuals (Kane Basin) and 72 individuals (Baffin Bay) should be taken out each year. The average annual harvest over 5 years from these two subpopulations was 5.6 and 130.4 (COSEWIC, 2018), which is considerably above the recommended sustainable harvest level for the Baffin Bay subpopulation.

2.5 Threats and conservation status

IUCN Global Red List status for the polar bear is VU – vulnerable (Wiig et al., 2015). Since loss of Arctic sea ice is the most serious threat to polar bears throughout their circumpolar range (Stirling and Derocher, 2012; USFWS, 2015) the Red List assessment was solely based on this factor (Regehr et al., 2016) (see supplementary material for *Ursus maritimus* Red List Assessment). Global warming contributes to magnify other potential threats, as described below. Local conservation status in Canada: COSEWIC (2018) classifies the polar bear as a species of special concern. A species of special concern is defined as wildlife species that exhibit characteristics that makes it particularly sensitive to human activities or natural events.

2.5.1 Direct effects of sea ice change

Sea ice cover is reducing year-on-year in the ranges of all the polar bear subpopulations (Stern and Laidre, 2016). As the sea ice melts earlier and forms later (see above), the foraging period for polar bears is gradually reduced. Polar bears rely on stored energy during summer, and extended periods spent with reduced feeding cause lowered health, reduced reproduction and higher mortality of cubs. Particularly at the southern extent of their range, the accessibility of maternity denning sites has been reduced (Sterling and Derocher, 2012). With less sea ice the bears are also forced to spend more time walking and swimming during and between hunts costing them additional energy. Moreover, the polar bear's main prey species, ringed and bearded seals are listed as threatened under the U.S Endangered Species Act as a consequence of climate change (<https://www.fisheries.noaa.gov/species/ringed-seal>, <https://www.fisheries.noaa.gov/species/bearded-seal>). It is not assumed that a switch to a more land-based diet will prevent polar bear decline (e.g. Rode et al., 2015). Habitat destruction due to ice melting moreover affects migration patterns and reduces connectivity among polar bear subpopulations and among geographical areas.

2.5.2 Indirect effects of changing seasonal ranges and warmer climate

One indirect effect of a warming Arctic is that polar bears may have more interaction with terrestrial species either on land resulting in increased exposure to infectious agents or on

the sea ice leading to hybridization with brown bears (Pongracz et al., 2017). Warming climate has been associated with an increase in pathogens and parasites in other Arctic marine and terrestrial organisms (Hueffer et al., 2011). Alternative food may also increase the potential of exposure to pathogens and reduced health since nutritional stress could increase susceptibility to disease and enhance the negative effects of pollutants (Patyk et al., 2015).

2.5.3 Pollution

As top predators, polar bears are exposed to high levels of pollutants through their food and thereby particularly vulnerable to pollution. Persistent organic pollutants, or POPs, are of special concern. These chemicals are soluble in fat, hardly degrade and may therefore accumulate to toxic levels. Pollutants have been linked with reproductive and immune problems, as well as cancer in polar bears (e.g. Dietz et al., 2015). For example, PCB may affect levels of progesterone in polar bear females (Haave et al., 2003). Because the cubs are nursed on fat rich milk, they are exposed to very high pollution loads from their mothers (Bytingsvik et al., 2012). The potential for contaminants to impact Arctic systems is predicted to increase as climate warming alters global circulation and precipitation patterns (Jenssen et al., 2015).

2.5.4 Over-harvesting

Polar bears are particularly vulnerable to over-harvesting due to their low reproductive rate and long generation time. Small populations are generally more susceptible to suffer from negative effects of over-harvesting (i.e. have higher extinction risk). Population surveys occur relatively infrequently in some areas, which means that if the harvest rate is above the sustainable level, population decline may occur before the next inventory is made. Moreover, the carrying capacities (i.e., the size at which a population would stabilize if there were no anthropogenic removals) of the subpopulations are unknown, continuously changing and likely declining due to environmental change in many cases (USFWS, 2015). Annually 500 and 600 bears are harvested in Canada (Canadian NDF, 2018), which implies that currently harvest is the largest direct cause of mortality to adult polar bears.

2.5.5 Other human impact

Reduced sea ice cover and longer ice-free seasons make previously isolated areas accessible for industrial development, shipping, new settlements and tourism. All of these activities pose a variety of both direct and indirect risks to polar bears. For instance, oil development in the Arctic will adversely affect polar bears through pollution, disturbance and increased human-bear interactions and conflict (Wilder et al., 2017). Oil spills in the Arctic could have

lethal effects on polar bears due to oil fouling reducing the insulation value of fur and due to direct ingestion of oil while grooming (Hurst and Øritsland, 1982; Hurst et al., 1991).

2.6 Regulations, legislation and agreements

2.6.1 Introduction

All polar bear range countries have regulatory mechanisms directed towards conservation and threats to polar bears. Some populations are shared between countries, and several bilateral agreements are therefore in place in order to manage these populations. The PBSG publish status reviews for all populations, as well as the status of management and research from all range states (<http://pbsg.npolar.no/en/>).

The 1973 circumpolar “Agreement on the Conservation of Polar Bears” (Isbjørnavtalen) is a non-binding agreement that was established in order to reduce the hunting pressure on polar bears and to protect polar bear habitat. Today’s purpose is still protection of habitat, but with a particular focus on the climate issues facing the Arctic. Between 2011 and 2013, a circumpolar action plan was developed for the period 2015-2025. Range countries meet every other year to share information about national management actions, status for research projects and common goals under the circumpolar action plan. The agreement requires that all parties take appropriate action to protect polar bear ecosystems and to manage polar bear populations based on the best available scientific data.

2.6.2 International regulations, legislation and agreements

CITES Convention: The polar bear is listed on CITES Appendix II as a part of the family listing of Ursidae spp. All range states are parties to CITES, with no reservations taken to the listing of polar bears. The United States proposed to transfer polar bears to Appendix I at CoP15 (2010) and CoP16 (2013), but the proposals were rejected. The species was also subject to significant trade review following CoP16, but was removed from the process at the 29th meeting of the Animals Committee (2017, cf. AC29 Doc.13.1).

EU Wildlife Trade Regulations: The polar bear is listed in Annex B under the family listing of Ursidae spp. At the 84th meeting of the Scientific Review Group of the Committee on Trade in Wild Fauna and Flora (in 2018) it was concluded positively for import of Canadian polar bears except from the Kane Basin subpopulation (https://circabc.europa.eu/sd/a/c7c37ae4-139b-47dd-a4eb-8a2a5d4fe6fa/84_Summary_SRG.pdf).

Convention on the Conservation of Migratory Species of Wild Animals (CMS) (effective since 2015) includes the polar bear in its Appendix II. The appendix covers migratory species with

an unfavourable conservation status that require international agreements for their conservation and management.

The Inupiat-Inuvialuit Agreement for the Management of Polar Bears of the Southern Beaufort Sea was signed in 1988. Both the Inuvialuit of Canada and the Inupiat of Alaska harvest polar bears for subsistence purposes from the same population in Southern Beaufort Bay. Provisions of the agreement include annual quotas, hunting seasons and protections of dens (CITES, 2013).

The agreement between United States and the Russian Federation on the conservation and management of the Alaska-Chukotka polar bear population was signed in 2000. The bilateral agreement provides that there should be no take of polar bears for commercial purposes and it commits the two parties to the conservation of important polar bear habitats (CITES, 2013).

Canada-Greenland Memorandum of Understanding: Memorandum of Understanding between the Government of Canada, the Government of Nunavut, and the Government of Greenland for the Conservation and Management of Polar Bear Populations was signed in October 2009 (CITES, 2013). The purpose of the memorandum is to manage the shared polar bear populations within the Kane Basin and the Baffin Bay management units to ensure conservation and sustainable management.

2.6.3 National regulations, legislation and agreements

2.6.3.1 Canada

Federal level:

The polar bear has been listed as a Species of Special Concern in the federal Species at Risk Act (SARA) since 2011. SARA is concerned with the protection of endangered wildlife and their habitat. Furthermore, the polar bear is listed as being at risk under provincial/territorial legislation in Manitoba, Ontario, Quebec, Newfoundland and Labrador (<https://polarbearagreement.org/polar-bear-management/national-management/canada>).

Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act (WAPPIITA) is to protect species of animals and plants in trade and to protect Canadian ecosystems from the introduction of harmful species. The Act applies to CITES-listed species, and thus the polar bear (<https://www.polarbearsCanada.ca/en/legislation/federal/wild-animal-and-plant-protection-and-regulation-international-and>).

Provincial and Territorial level

The information below is retrieved from: <https://www.polarbearsCanada.ca/en>

It is important to note that more than 90% of polar bears in Canada occurs in the northernmost territories: Nunavut and Northwest Territories.

Nunavut

- The Nunavut Land Claims Agreement gives the Inuit of Nunavut the right to harvest wildlife on lands and waters throughout the Nunavut settlement area.
- The Nunavut Wildlife Act takes into account Traditional Ecological Knowledge and protects the Inuit rights to harvest and access to land for harvest.

Northwest Territories and Yukon (Inuvialuit Settlement Region)

- The Inuvialuit Final Agreement gives the Inuvialuit the exclusive right to harvest polar bears in their settlement region. The Agreement goal is further to preserve Inuvialuit cultural identity and enable Inuvialuit to be equal and meaningful participants of society and the economy, as well as to protect biodiversity in the region.
- The Northwest Territories Wildlife Act ensures that wildlife management will integrate indigenous rights and interest while at the same time contributing to the sustainability of northern wildlife.
- The Canada National Parks Act preserves polar bears and habitats within protected areas.
- The federal and NWT Species at Risk Acts.

Newfoundland and Labrador

- Labrador Inuit Land Claims Agreement gives the Labrador Inuit the exclusive rights to harvest throughout the Labrador Inuit Settlement Area.
- Newfoundland and Labrador Wild Life Act provides authority to the minister of Fisheries and land resources for the management of polar bears, including the setting of quotas.
- The Canada National Parks Act contributes to protect Polar Bears and their habitat in the Torngat Mountains National Park in Labrador.

Quebec

- James Bay and Northern Quebec Agreement. Under this Land Claim Agreement, polar bear is a species that can be hunted exclusively by the Cree and the Inuit.
- Eeyou Marine Region and Land Claims Agreement. Under this Agreement, the polar bear harvest is reserved exclusively to the Eeyou Istchee Cree in the Eeyou Marine Region.
- The Nunavik Inuit Land Claims Agreement. Under this Agreement, the polar bear harvest is reserved exclusively to the Inuit of Nunavik in the Nunavik Marine Region.

Ontario

- The Ontario Endangered Species Act serves to protect and recover species at risk and their habitat.
- Cree peoples living in coastal communities of Ontario along James Bay and Hudson Bay have treaty rights to harvest polar bears under Treaty Nine signed in 1905 (Archives of Ontario, 2005).

2.6.3.2 United States

The polar bear is included in the Marine Mammal Protection Act of 1972 (MMPA). This act established a general moratorium on the taking and importing of marine mammals. There are some exemptions, including taking for scientific purposes, public displays and for subsistence use by Alaska natives (CITES, 2013).

On May 15, 2008 the polar bear was listed as a threatened species under the U.S. Endangered Species Act of 1973 (ESA). This listing means that the species is at risk of becoming an endangered species throughout all or a significant portion of its range (ESA, 1973). Provisions of this law include prohibition of actions that are likely to jeopardize the species or its habitat (CITES, 2013)

In addition, there are other domestic legislations concerned with aspects of polar bear management, see for example CITES (2013) for further description of these.

2.6.3.3 Denmark (Greenland)

The government of Greenland is responsible for management of all renewable resources, including polar bears (CITES, 2013; Jessen 2018). Wildlife management in Greenland is regulated based on the Greenland Home Rule Act No. 12 of October 29, 1999, on Hunting and Game. There is an Executive Order on the Protection and Hunting of Polar Bears which regulated the harvest of polar bears <https://polarbearagreement.org/polar-bear-management/national-management/greenland>). In 2008, the Greenland government introduced an export ban on all polar bears originating from Greenland until a positive NDF could be made (Jessen, 2018) (at the time of finalising this report, the negative NDF is still standing for Greenland).

2.6.3.4 Norway

The Polar Bear Act was ratified in 1957, and according to this Act, polar bears are protected.

The Norwegian CITES-Regulation is rooted in the Norwegian Biodiversity Act. The polar bear is currently listed in Appendix B of the national CITES-regulation, which means that both an export permit (from the country of origin) and an import permit (from the Norwegian CITES management authority) is required for importing polar bears to Norway (including Svalbard). A prerequisite for the Norwegian Management Authority to grant an import permit is that the

import is considered non-detrimental to the survival of the species (CITES Non-Detriment Finding) and that the individual was legally acquired (CITES Legal Acquisition Finding). An owner certificate is required for holders of hides, skulls and trophies. Commercial display of dead polar bears is prohibited.

In Norway, polar bears are only found on the archipelago of Svalbard, and on the ice-covered areas of the Barents Sea. The Barents Sea management unit, which partly resides in Svalbard and on the surrounding pack ice, is shared with Russia. Svalbard is considered as a special jurisdictional matter under the Spitsbergen Treaty, which means that not all Norwegian Law is applicable to Svalbard and authorities with management responsibilities do not automatically have the same authority in Svalbard. Polar bears in Svalbard are therefore managed in accordance with the Svalbard Environmental Protection Act (Svalbardmiljøloven). This legislation regulates all human activity on Svalbard (including pollution, waste handling, development and planning etc.), which may affect polar bears on land and at sea in the Svalbard territory. The law came into force in 2002.

2.6.3.5 Russian federation

Polar bears are listed in the Red Data Book of the Russian Federation, a book that establishes official policy for protection and restoration of rare and endangered species in Russia (Belikov et al., 2019). The Ministry of Natural Resources is responsible for management of species listed in the Red Data Book (CITES, 2013 and references herein). The Russian Regional Committees of Natural Resources are responsible for managing polar bear populations consistent with Federal legislation (Belikov et al., 2019).

Natural Protected Areas (NPAs) have been established to protect marine and associated terrestrial ecosystems, including polar bear habitat (Belikov et al., 2019). A federal law concerned with the traditional use of nature by indigenous people of the Russian federation, particularly in the Northwestern-, Ural-, Siberian- and Far Eastern Federal Districts, was signed in 2001 (CITES, 2013). It establishes areas for traditional use of nature within NPAs and other protected areas (CITES, 2013).

2.7 Species management in the range countries

2.7.1 General

The Circumpolar Action Plan (CAP) was adopted in 2015 and is a 10-year cooperation plan between the Range States to strengthen their efforts in polar bear conservation. The CAP was adopted at the biennial meeting of the Polar Bear Agreement in Greenland in 2015, with the aim of strengthening international cooperation to conserve polar bears across their range (<https://polarbearagreement.org/circumpolar-action-plan>).

2.7.2 Canada

As mentioned in chapter 2.1.5, Canada fully or partly hosts 13 of the 19 polar bear management units.

Polar bear management in Canada is a collaborative effort among provincial and territorial governments and the Wildlife Management Boards. Harvest management systems are based on best available science and TEK, and decisions on harvest quotas are made by the relevant Wildlife Management Boards (<https://polarbearagreement.org/polar-bear-management/national-management/canada>).

In Canada, some indigenous groups (Inuit and Cree) have an exclusive right to hunt polar bears for subsistence purposes. Harvest quotas are established through consultations between the federal government, local government, provincial and territorial governments, local communities and wildlife management boards created through land claim agreements (Shadbolt et al., 2012). For Newfoundland and Labrador, Northwest Territories, Nunavut, and Yukon Territory, which together comprise the vast majority of the polar bear population in Canada, harvest of polar bear is controlled through a Total Allowable Harvest (TAH) and community specific quota allocation system (Shadbolt et al., 2012). In the provinces of Manitoba and Ontario, harvest is very limited and export is generally not permitted. In the province of Québec, harvest is managed without a quota (NDF Canada, 2018).

Community-based Hunters and Trappers organizations (HTOs) and Hunters and Trappers Committees (HTCs) allocate polar bear harvest tags to the local communities. The tags must be attached to the skin of the bear and function as proof that the polar bear was legally hunted (Shadbolt et al., 2012).

Trophy hunting occurs in Nunavut and the Northwest Territories, where Inuit hunters are allowed to transfer their exclusive rights (and hunting tag) to another hunter. An Inuit guide must take part in the trophy hunt and traditional methods (sled and dog team) must be used (<https://polarbearagreement.org/polar-bear-management/national-management/canada>).

The majority of polar bear harvest occurs in Nunavut which accounts for about 75% of all harvest, with Northwest Territories accounting for about 11% and Québec accounting for about 8% of total Canadian harvest) (NDF Canada, 2018).

Between 500 and 600 bears have been killed annually in Canada over the last three decades (NDF Canada, 2018). A harvest rate of 4.5% of population size and a sex ratio of 2:1 male:female adult bears, has been the standard procedure since the 1973 Polar Bear Agreement (Derocher, 2012). This procedure has been considered sustainable (Regehr et al., 2017b), with adult female survival being critical to a healthy population development (Derocher, 2012). Harvest is also carried out in the four subpopulations where scientific data indicates population decline (Western Hudson Bay, Southern Hudson Bay, Southern Beaufort Sea and Northern Beaufort Sea) (PBSG, 2019b).

Hamilton and Derocher (2019) points out that the Baffin Bay, Davis Strait and Southern Beaufort Sea subpopulations experience harvest rates >4.5 . In addition, citing human-bear conflict, the government of Nunavut has recently passed legislation that shift the female:male ratio to 1:1, while maintaining the harvest rate (Nunavut Polar Bear Co-Management Plan, 2019). According to Sonne et al. (2019), this change in practice may increase the annual number of killed females by at least 82 individuals, which equals an increase of 17%, and represent 0.7 % of the total circumpolar female population. Hamilton and Derocher (2019) also indicate that population inventories are too infrequent to capture any negative trends in subpopulation size and to adapt harvest levels accordingly.

2.7.3 Norway

The Ministry of Climate and Environment, the Environment Agency and the Governor of Svalbard are responsible for the legal management system of polar bears in Norway. The Norwegian Polar Institute is responsible for scientific research and monitoring of polar bears in Norway. There is only one polar bear management unit in Norway, the Barents Sea unit, which is shared with Russia. The Barents Sea unit stretches from Svalbard via Franz Josef to the western half of Novaya Zemlya and down to the Russian and Norwegian coast.

Polar bears are not harvested in Norway, and may only be killed in self-defence, protection of property and mercy kills. Approximately one polar bear is killed every year because of one of the aforementioned reasons. The Governor of Svalbard is then responsible for microchipping the hide, which is usually subsequently donated to an annual charity-event and sold to the highest bidder (Pers. Comm. Paul Lutnæs, Governor of Svalbard's office, 14.01.20).

It is important to note that in June 2019, the Norwegian Environment Agency requested the Norwegian Polar Institute to prepare a statement on whether there should be a temporary ban on import of polar bears to Norway. The Norwegian Environment Agency questioned whether it is possible to document that polar bear skins from Canada are from sustainable and legal harvest and if import/export to Norway is in accordance with CITES. The Norwegian Polar Institute points out that several subpopulations are in decline, thus preventing sustainable harvest. They conclude that the lack of tags on polar bear skins imported to Norway (tags are removed somewhere on the way from Canada to Norway) prevents control of origin of the animal and timing of harvest. The Norwegian Polar Institute therefore concluded that import should be stopped temporarily until a thorough investigation had been conducted by preparing a NDF (the current report).

2.7.4 Russia

In Russia, the Ministry of Natural Resources and Ecology of the Russian Federation is responsible for the management of polar bears, including the issuance of permits for killing conflict bears. The Department of State Police and Management of Hunting and Wildlife are responsible for management (Shadbolt et al., 2012). Regional Authorities that have a responsibility for management and control over the use of natural resources also have a responsibility in managing polar bears. Polar bear research is carried out by the All-Russian Research Institute for Nature Protection under the Ministry of Natural Resources and Ecology (Shadbolt et al., 2012). Four of the 19 polar bear management units are found in Russia, with two being located solely in Russia (Laptev Sea and Kara Sea), one is shared with the United States (Chukchi Sea) and one is shared with Norway (Svalbard, the Barents Sea management unit) (Shadbolt et al., 2012). Polar bears have been fully protected in Russia since 1956. Polar bears may only be killed to protect people, or if they are considered conflict bears, or for scientific purposes. It is permitted to capture cubs from the wild for use in education and public entertainment, such as zoos and circuses (Shadbolt et al., 2012). Between 1 and 3 polar bears were killed legally per year in the time period between 2010 and 2015 (Belikov et al., 2018).

2.7.5 Greenland (Denmark)

The Greenland Ministry of Fisheries, Hunting and Agriculture is responsible for management of polar bears in Greenland, whereas the Greenland Institute of Natural Resources (GINR) carries out the majority of research on polar bears in Greenland (Shadbolt et al., 2012; Jessen 2019). Of the four Polar Bear Management Units in Greenland, one is situated in eastern Greenland (the East Greenland management unit) and three are shared with Canada (Kane Basin, Baffin Bay, and Davis Strait management units).

Polar bears in Greenland are hunted for subsistence purposes, and only residents who are full-time hunters are allowed to participate in the hunt (Shadbolt et al., 2012). In 2005, a hunting quota system was introduced, brought on by concerns for the harvest levels for the shared management units Kane Basin and Baffin Bay. The new quota system was implemented on January 1, 2006 (Shadbolt et al., 2012). The hunting quotas are set based on the best available information about population status, harvest levels and local knowledge, and in consultation with the Greenland Hunting Council (Shadbolt et al., 2012). The Government of Greenland determine the final quota based on recommendations from the Ministry of Fisheries, Hunting and Agriculture. Quotas are set for one year at the time, and are distributed to local authorities, who subsequently issue the permits to hunters (Shadbolt et al., 2012). In the time period between 2010 and 2016, between 100 and 143 polar bears were taken out annually in Greenland (Jessen, 2018)

Each polar bear hunting permit is valid for one bear only. After each hunt, the permit must be stamped by either a settlement office or a local authority. Details relating to the catch are

reported to the settlement office/local authority using a standardised form (Shadbolt et al., 2012). In addition, hunters also have to report their annual catches to the Ministry of Fisheries, Hunting and Agriculture (Shadbolt et al., 2012).

In order for a hunter to sell polar bear parts, a settlement office or a local authority must stamp hunting permits. When a sale takes place, the hunter signs a copy of the stamped permit and this document must accompany the sold item. The purchase of any polar bear parts must be accompanied of a stamped hunting permit with the permit holder's signature (Shadbolt et al., 2012).

It is important to note that the Greenland Authorities issued a negative NDF for CITES exports in 2007 (Jessen, 2018). This was a consequence of the Greenland Authorities being unable to determine that the harvests, both the Greenland/Canada harvests and all Greenland harvests, were sustainable (Shadbolt et al., 2012; NDF Greenland, 2007). No commercial export of polar bear products from Greenland is therefore allowed.

2.7.6 USA

The United States Fish and Wildlife Service (USFWS) is responsible for the management and conservation of polar bears in the United States. There are two subpopulations of polar bears in the US, the Southern Beaufort Sea management unit (which is shared with Canada) and the Chukchi Sea management unit (which is shared with Russia). Management and conservation of polar bears in the US are governed by the Marine Mammal Protection Act (MMPA) and the ESA. In addition, co-management between Alaska Natives living in polar bear habitat and harvesting polar bears for subsistence purposes plays an important role in polar bear conservation. The 2016 UNFWS Polar Bear Conservation and Management Plan is the national action plan (<https://polarbearagreement.org/polar-bear-management/national-management/united-states>).

Only coastal-dwelling Alaskan Natives are permitted to participate to harvest polar bears for subsistence purposes as authorized by the MMPA. The USFWS monitors the harvest through a marking, tagging and reporting program. Hunters are responsible for tagging the skull and hide of harvested bears within 30 days of harvest (<https://polarbearagreement.org/polar-bear-management/national-management/united-states>).

For the Chukchi Sea population, harvest management is regulated by the Agreement between the Government of the United States and Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population, a.k.a. the U.S.-Russia Polar Bear Agreement (since 2007). Based on this Agreement, both the US and the Russian Federation can formally address harvest issues, including the establishment of hunting quotas. Quotas are voluntarily. Since 1988, the Southern Beaufort Sea population has been managed under the Inupiat-Inuvialuit Agreement, which allows setting harvest

quotas (on a voluntary basis) (<https://polarbearagreement.org/polar-bear-management/national-management/united-states>).

2.8 Assessment of legal and illegal harvesting and trade

2.8.1 Legal

Between 500 and 600 polar bears have been harvested annually in Canada in the last three decades (Canadian NDF, 2018). In many cases, harvesting is the major cause of mortality for bears (Durner et al., 2018).

The annual proportion of the harvested bears that was traded internationally was 58% on average in the period 2005-2014 (Cooper, 2015). However, hides and skulls exported in a given year are not necessarily from animals harvested the same year (Cooper, 2015).

CITES CoP18 Resolution Conf. 12.8 (Rev. CoP18) assigns the CITES Animals Committee to carry out a Review of Significant Trade. This work was carried out by the UN Environment Programme World Conservation Monitoring Centre through an extended analysis of data from the CITES Trade Database 2014-2018 (UNEP-WCMC, 2020). Polar bear was among the selected species as it met the criterion for High volume (Globally Threatened) as a taxon traded at levels considered to be high compared to other taxa in their order. As Vulnerable on the IUCN Red List the actual trade volume was multiplied by 10 to account for the global threat status. Figure 2.8.1-1 illustrates how registered trade whole bear equivalents have developed between 2014 and 2018.

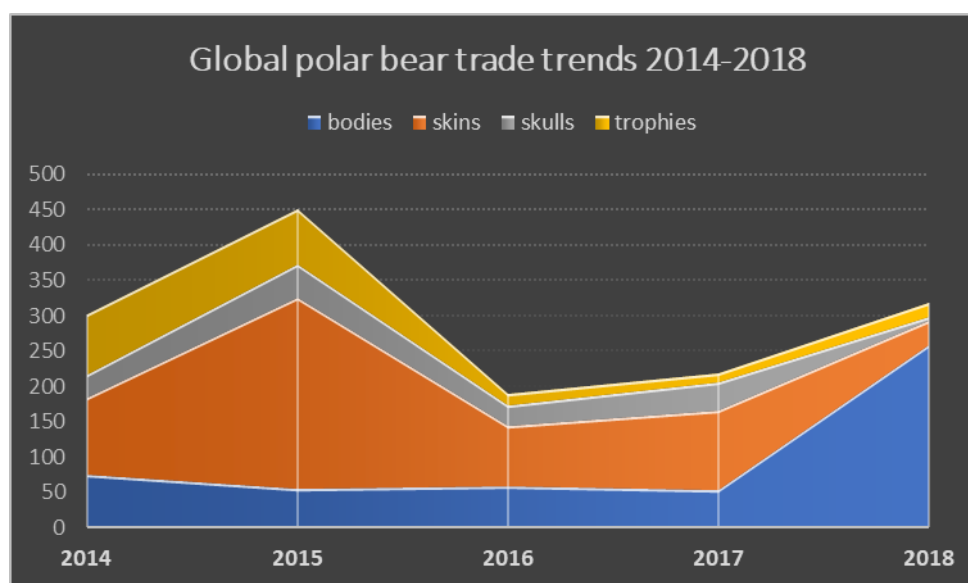


Figure 2.8.1-1 Trade trends in whole bear equivalents (bodies, skins, skulls and trophies) between 2014 and 2018.

In addition, we present a detailed analysis of the CITES Trade Database data for polar bears from 1996-2017. We distinguish between whole bear equivalents (bodies, skins, skulls and trophies) and bear parts, such as bones, hairs, toes, that do not add up to a complete specimen and are therefore not useful to determine the number of polar bears represented by this trade. The analysis is based on all reported legal export (Exporter Reported Quantity, ERQ) and import (Importer Reported Quantity, IRQ). The data is presented in two cohorts or time series, 1996-2007 and 2008-2017.

As can be seen in figure 2.8.1-2 prior to 2008, the United States was the single biggest importer of polar bear hides and skulls, while between 2008 and 2017, the number of commercially exported polar bear hides to China increased significantly.

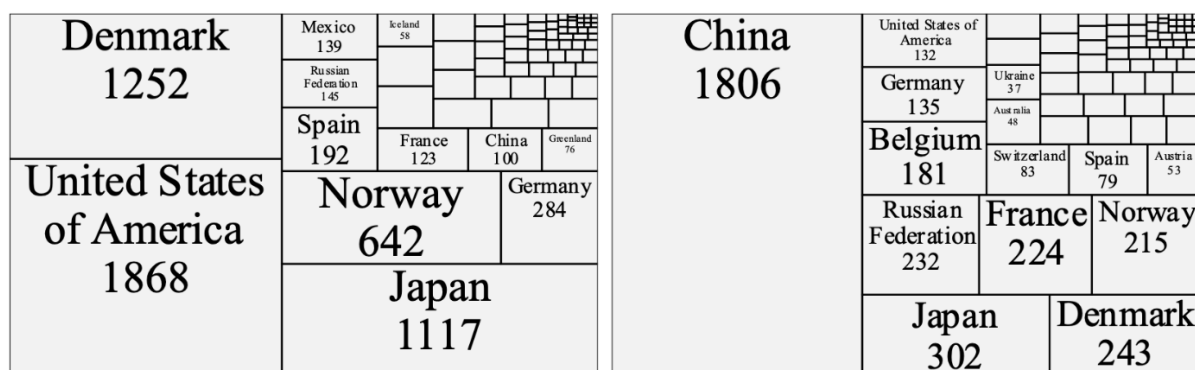


Figure 2.8.1- 2 Proportional representation of global import of whole bear equivalents by different countries. 1996-2007 on the left and 2008-2017 on the right. The area is proportional to the traded quantity. Areas between time periods are not comparable.

In 2008, the United States declared polar bears a "threatened species" under the Endangered Species Act (ESA), and prohibited the import of polar bear products. Hunting trophies were the most commonly imported products.

After 2008, China emerged as the single largest importer of polar bears, with a roughly 40% share of the total trade, while Denmark sees an 81% reduction in the import of bears (Figure 2.8.1-2). This is probably linked to the negative NDF by the Greenland Authorities for CITES exports in 2007 (see section 2.4 of this report), thus prohibiting commercial exports of polar bears from Greenland. At the same time the Russian Federation doubles its import.

Interestingly, the shift in the international market shifted from U.S to China as the main importer of polar bear products around 2008 was accompanied by a shift in the international market of re-exported polar bears, as visualized in Figure 2.8.1-3.

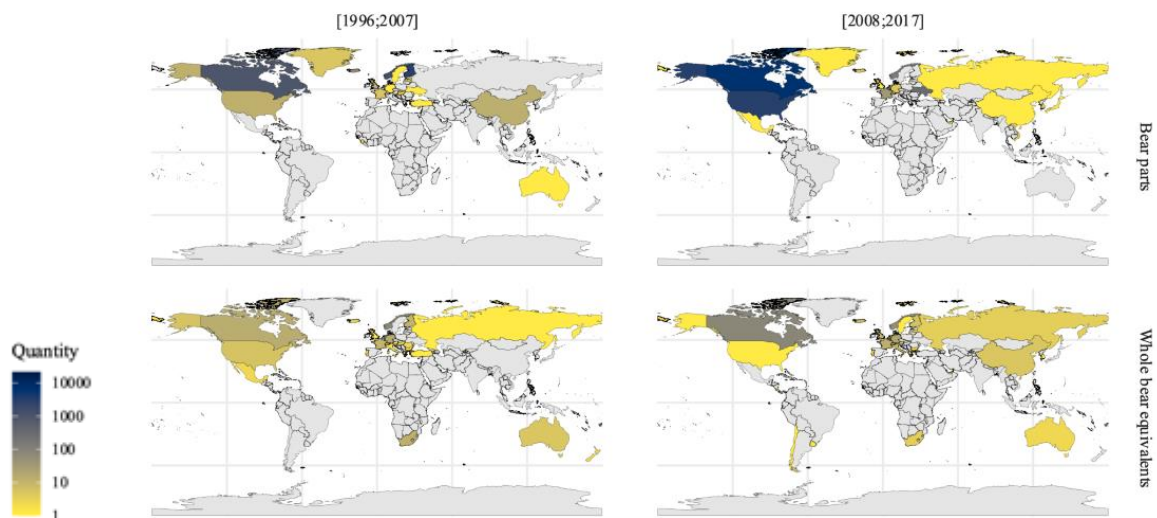
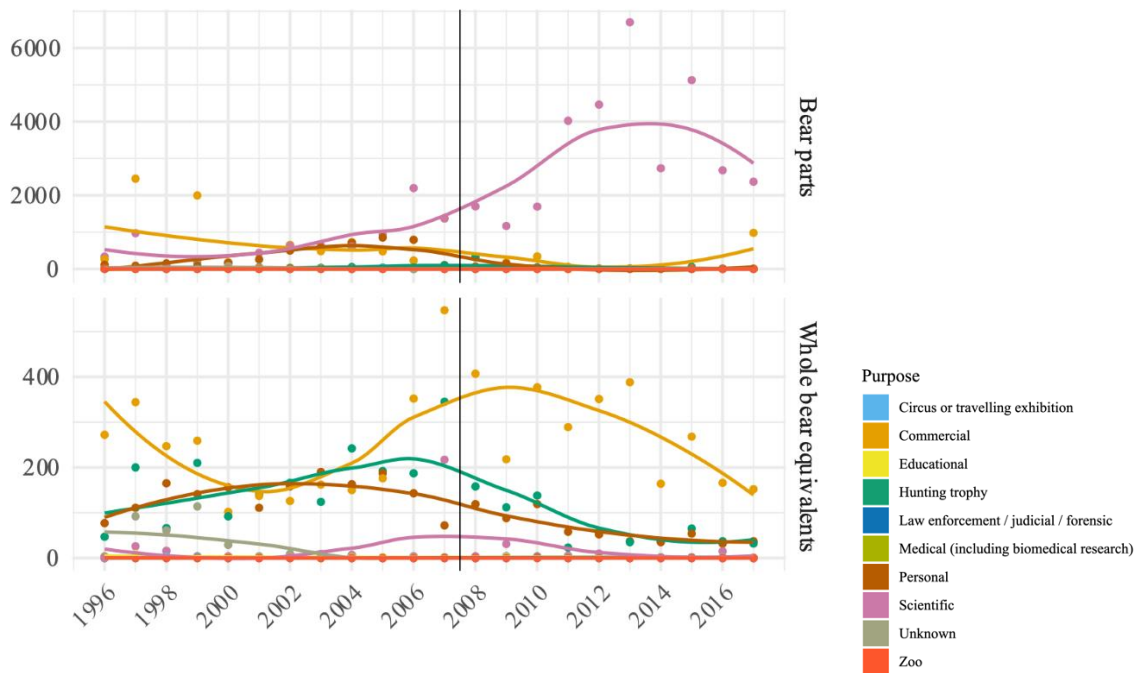


Figure 2.8.1-3 Map of re-exports for two periods: 1996-2007 and 2008-2017. Number of bears re-exported by each importing country during [1996-2007] and [2008-2017].

The increasing demand for skins in some importing countries such as Russia and China has been accompanied by rising prices, and in 2013 a polar bear hide was auctioned for CAD 21,115 (Cooper, 2015).

CITES permits includes the purpose of transaction, which is shown as a one-letter code in the trade database. Purpose codes can for example be T for trophy, Z for Zoo or T for Commercial. Figure 2.8.1-4 illustrates the trends of different purpose codes over time showing an increase in the commercial trade during the 2000s.



2.8.1-4 Trends in the trade purpose over time. Number of traded bears by purpose through time. Each colour corresponds to a purpose.

Cooper (2015) highlights various factors explaining how hide prices may impact on polar bear hunting levels. In 2011, the reduced income from sports hunting caused by the loss of the U.S. market for trophies, as well as the financial incentive of rising hide prices, contributed to increased hunting of polar bears (Cooper, 2015). Thus, the gap between the number of reported kills and the Canadian hunting quota was reduced. The increased hunting was primarily in the Northwest Territories and Quebec, as the numbers of bears hunted in Nunavut already filled the hunting quota (Cooper, 2015). Other factors include better ice-conditions for hunting in the Nunavik community Inukjuak in 2011 and possibly also improved reporting of kills (Cooper et al., 2015). Since 2014 the statuses for 6 of the 13 Canadian subpopulations have changed as one more is declining, three less is considered stable and two more are data deficient (PBSG, 2019).

2.8.2 Illegal

Poaching is not assumed to be a major issue for polar bears in general, but there have been some concerns related to high levels of illegal harvest in Northwest Russia, and particularly for the Chukotka population (Belikov et al., 2018). Between 2010 and 2015, illegal hunting was recorded at several locations. In Chukotka, 18-56 polar bears were being harvested annually within the above time period (Belikov et al., 2018). Information from interviews with local villagers conducted in 2010-2012 suggests that the current level of illegal shooting appears to be significantly lower than what it was in the 1990s (Belikov et al. 2018). VKM did not find any evidence of illegal trade with Canadian polar bears. In their 2012 review of

international trade and management of polar bears the Wildlife Trade Monitoring Network, TRAFFIC, recommends an mandatory international tracking system for traded polar bear skulls and skins. They further propose that consumer and exporting countries should coordinate efforts for elucidating and addressing illegal trade in polar bear products (Shadbolt et al., 2012).

2.9 Summary of opinions of hearing experts

Full transcripts of the conversations with the four hearing experts can be found in Appendix I. These are some main concerns that were raised by all of them:

Change in harvest gender ratio in Nunavut

The recent transition from a 2:1 to a 1:1 male:female harvest ratio in Nunavut, where the majority of the polar bear harvest occurs, is highly concerning as adult females are critical for a healthy population development.

Use of TEK for quota setting

The use of Traditional Ecological Knowledge (TEK) when calculating harvest quotas is concerning. TEK is in many cases given equal weight as empirical scientific evidence. While TEK may be good for gaining insight into a range of biological factors it is not a reliable method for estimating population size and trends. For example, hungry bears are more often than previously gathering in the areas surrounding human settlements in order to find food. This will give an impression of more bears, however, without monitoring of areas further away from the settlements, it is not possible to conclude on population trends.

Lack of scientific data

Reliable empirical population data is missing for the majority of the subpopulations. This is mainly due to the fact that surveying polar bear populations in a reliable manner is both difficult and expensive and there are not enough skilled people to carry out the surveys. It is also increasingly difficult to carry out surveys in many of the management areas because local people are often against invasive studies, such as capture-mark-recapture. In addition to providing information on population size and trends, which can also be done by aerial surveys, capture-mark-recapture studies provide important additional information such as survival rates, information on body condition, and samples for ancillary studies.

Harvesting of declining subpopulations

Harvesting polar bear populations in decline is not sustainable. Estimating harvest quotas based on carrying capacity could maybe work in theory, but for the polar bear

subpopulations the carrying capacity is unknown. In a changing habitat, caused by sea-ice melting, the carrying capacity will change continuously.

Uncertain future due to environmental change

Climate change is the most important threat to polar bears. Taken together with the uncertainty around carrying capacity and the habitat development (sea ice and snow), their future survival is highly uncertain. All the polar bear populations will ultimately decline as their habitat declines, but they will be affected differently and with different timing.

3 Overall assessment of data quality (uncertainties)

Polar bears are inherently difficult to monitor due to their low densities in remote and inaccessible habitats. The limited amount of data, even for subpopulations that are monitored with scientific methods, makes all population estimates highly uncertain and surrounded by large variance. 12 of 19 of the global subpopulations are data deficient for long-term population trends (over 3 generations).

The quality of information to support harvest management varies considerably among subpopulations (Vongraven et al., 2012; Hamilton and Derocher, 2019; COSEWIC, 2018). Many population size estimates are also based on 10-20 year old surveys (PBSG, 2019c). Given the rapid changes in polar bear habitat, population survey cycles of about 15 years is too long to detect any declines in subpopulation trends in time to implement adaptive management of harvest levels.

4 Conclusions (with answers to the terms of reference)

Article IV of the Convention and resolution 16.7 (Rev. CoP17)) states that the export of specimens of any Appendix II species should be limited in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I.

Following CITES' recommendations, NDFs for Appendix II species should be based on the best available scientific knowledge to ensure sustainable harvest (Resolution Conf. 16.3).

The best scientific knowledge available for polar bears in Canada suggests that four subpopulations are in decline, two are stable, one is increasing while the population trends for the remaining subpopulations are unknown (Figure 2.2.1-1). All estimates of population sizes have a high level of uncertainty. Moreover, surveys in most areas are undertaken too infrequently to detect decline and to adapt harvest levels accordingly, particularly under changing environmental conditions.

The Canadian NDF assesses the detriment to the entire Canadian polar bear population without distinguishing subpopulations, despite substantial disparities among subpopulations. For some subpopulations, harvest quotas are partly based on traditional ecological knowledge (TEK), and too little is known about the accuracy of these methods to know whether they provide data that secures sustainable management over time. Thus, it is not certain that polar bears traded internationally are harvested in accordance with the principle of sustainable use of biodiversity (Resolution Conf. 13.2).

The prognosis for the Arctic marine environment, on which the polar bear is highly dependent, points towards continuous habitat loss and inevitable population decline for the polar bear.

In summary, VKM is unable to find that international trade with Canadian polar bears is non-detrimental to the survival of the species.

5 Data gaps

VKM identified the following data gaps:

- Recent population size and trend data for both the total population and many subpopulations of polar bears in Canada.
- Knowledge on species interactions between polar bear and their main prey species in a changing environment.
- The relationship between the rates of habitat decline and polar bear population decline.
- The potential impact of commercial polar bear trade on harvest rates.
- The level of illegal hunting and trade of polar bear hides internationally.
- The impact of a change in gender ratio of harvested polar bears, from 2:1 to 1:1 males versus females, on population trends.

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Appendix I

Conversations with hearing experts

Conversation with Jon Aars 30.10.2019

Jon viser til rapporten fra Norsk Polarinstitutt (NP) som ble gjort på oppdrag fra Miljødirektoratet. Her svarer NP på hvorvidt det er grunnlag for å iverksette et midlertidig norsk forbud mot import av isbjørn fra Canada inntil saken er utredet i sin fulle bredde.

Spørsmål: Datagrunnlaget for bestandsestimat og trender til mange av delbestandene av isbjørn (<http://pbsg.npolar.no/en/status/status-table.html>) er basert på enten gamle eller manglende data. Prosjektgruppen ønsket å få informasjon om hvorfor det er sånn:

Svar: Det er flere grunner til dette, blant annet så er det veldig dyrt og tidkrevende å overvåke isbjørn og det er logistiske utfordringer, samt utfordringer relatert til lokal forvaltning av isbjørn i de canadiske bestandene. I Canada legges det like stor (og i noen forvaltningssoner større) vekt på tradisjonell lokalkunnskap som på vitenskapelige data for å beregne status og trender i isbjørnbestandene. I mange tilfeller ønsker ikke lokalbefolkningen at det skal utføres invaderende (invasive) studier som for eksempel radiomerking. Data fra disse områdene må dermed fremskaffes på mer indirekte måter, noe som ofte gir større usikkerhet i datagrunnlaget.

Spørsmål: Samsvarer forvaltningssonene med reelle (økologisk avgrensede) bestander av isbjørn?

Svar: Forvaltningssonene samsvarer stort sett bra med de faktiske delbestandene av isbjørn. Det er migrasjon mellom delbestander, men inndelingen i forvaltningssoner er basert på biologiske data. Et unntak er den omdiskuterte inndelingen av Northern/Southern Beaufort Sea.

Spørsmål: Hva tror du vil være betydningen av en videre økning i prisen på isbjørnskinns?

Svar: En økning i prisen på isbjørnskinns vil mest sannsynlig ha en større innvirkning på ulovlig jakt som særlig foregår i Russland. Så lenge kvotene overholdes burde det ikke ha noen betydning for den lovlige jakten.

Spørsmål: Hvordan settes kvotene?

Svar: Det er jakt i de fleste Canadiske bestander, også i de bestandene hvor det er en nedadgående trend i populasjonstørrelsen. Et uttak på 4.5 % (med kjønnsfordeling 2:1 hanner:hunner) er regnet som bærekraftig og blir benyttet til å beregne kvotestørrelse. Det har til nå vært et mål å ta ut dobbelt så mange hanner som hunner, da voksne hunners

overlevelse er kritisk for bestanden. Nyere forskning (Eric Regehr 2017) foreslår at det er mulig å høste fra en bestand i nedgang. Modellen tar utgangspunkt i (antar at) bærekraftig bestandsstørrelse for isbjørn reduseres med tap av habitat (havis) grunnet klimaendringer. For isbjørn er klimaendringer og ismelting hovedtrusselen for videre overlevelse, og det som primært bidrar til lavere bærekraft. Det stilles ikke lenger krav til oppdaterte vitenskapelige studier som grunnlag for fastsetting av kvoter, det er opp til lokale forvaltningsmyndigheter å bestemme hvordan de vil gjøre det.

Conversation with Dag Vongraven 13.01.20

Spørsmål: Etter din mening, har det vært noen signifikante endringer i isbjørnforvaltningen i Canada de siste 10-15 årene?

Svar: Den største endringen har vært dette med at Nunavut har innført en 1:1 hann:hunn høstingspraksis.

Spørsmål: Hvordan kontrolleres skinn som innføres til Tromsø?

Svar: Når det gjelder skinn som ankommer Norge fra Canada så kan vi ikke vite hvor eller når bjørnen er tatt, siden taggen er kontrollmekanismen fra Canada og den ikke sitter på skinnene når de ankommer. Det krav om at de skal sitte på skinnene ved utførsel fra Canada, men ikke krav i Norge om at de skal sitte på ved ankomst. Det er uforståelig for meg hvorfor taggene fjernes fra skinnene. Det ryktes at tagger sendes i retur. Alle skinn som kommer til Norge går til Svalbard, og i følge tollkontoret i Tromsø går skinnene kun i transit gjennom Gardermoen, evt Tromsø, til Svalbard, og det er heller ingen tollkontroll i Longyearbyen. Det er vanskelig/tilnærmet umulig for tollere i Tromsø å kontrollere importen av isbjørnskin.

Spørsmål: Tror du det ville blitt mindre uttak av isbjørn hvis handel ble forbudt?

Svar: Ja, uttaket ville trolig gått ned hvis det ikke var lov med handel. Den dagen det blir forbudt å eksportere skinn vil det meste av jakten gå over til ren «subsistence» jakt. Alaska eksporterer ikke skinn og der finnes det ingen lignende problemer. Det kan være betydelig "time lag" fra bjørnen blir skutt til skinnen blir eksportert; det kan gå 10-15-20 år.

Spørsmål: Hvordan fungerer Polar Bear Technical Committee (PBTC)?

Svar: Det pleide å sitte forskere i PBTC men nå er det kun representanter fra ulike regioner (stake holders) som sitter der. Traditional Ecological Knowledge (TEK) har blitt mer sentralt, og inntrykket er at forskning er marginalisert.

Spørsmål: Tar man høyde for klimaendringene og effekten av disse i Canadisk isbjørnforvaltning?

Svar: Nei. Man har ikke tatt med noe om habitatendringer (som jo er konsekvensen av klimaendringene) i rødlistevurderingene. Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lager status-rapporter for truede arter i Canada, og inntil 2018 var ikke habitatendringer (som en følge av klima) inkludert i vurderinger av bestandsstatus og rødlistestatus. Ny COSEWIC-vurdering av isbjørn ble ferdigstilt i 2018 og der er endelig habitat tatt med som en faktor som påvirker bestandsstatus.

Dette er problematisk fordi bjørnene påvirkes av at den isfrie perioden er lenger enn før. Studier av bestanden i Hudson Bay viser en sammenheng mellom tidspunkt for når havisen brytes opp og 'kondisjon' hos bjørnene. Denne dataserien viser entydig nedadgående trend i kondisjon korrelert med tidspunkt for ismelting om våren siden 1980-tallet.

Situasjonen for isbjørnen vil sannsynligvis gå fra OK til mye verre innen relativt kort tid. Overvåking av 'sea ice metrics' (sjøis); isfri periode har økt med 40 døgn per tiår fra 1979 til i dag innenfor arealet som er definert for Barentshavsbestanden. Isbjørnene har jo lenge klart seg med mindre og mindre is men på et eller annet tidspunkt vil det bli for lange isfrie perioder. Men vi vet ikke når. I noen områder, spesielt i «archipelago» områder, kan det på kort sikt bli bedre før det blir verre, som følge av endringer i isforholdene (forårsaket av klimaendringer). Kondisjonen til isbjørnene er negativt relatert til varigheten av de isfrie periodene. Isbjørner er godt tilpasset å klare seg lenge uten mat, men før eller siden blir fasteperioden for lang. Det er gjort modellstudier som viser at om lengden på den isfrie perioden passerer terskelverider så kan f.eks. dødeligheten hos hanner gjøre sprang til det verre - dette er ikke nødvendigvis lineære sammenhenger.

Det er vanskelig å forstå at forvaltningen i Nunavut ikke har tatt innover seg at det foregår betydelige endringer i klimaet, hvilket er et stort paradoks, da inuittene beviselig ser at isen forsvinner og snøen blir av dårligere kvalitet. TEK har ingen metode for å beregne antall bjørn over store områder, men baserer seg gjerne på observasjoner av isbjørner på de punktene man normalt besøker (og der kan antall observasjoner ha økt fordi bjørnene av ulike årsaker beveger seg nærmere folk).

Spørsmål: Hvordan er situasjonen for ringsel?

Svar: En studie fra 2015 viser at antallet ringsel i Hudson Bay går i sykluser, og at antallet de siste årene av studien var langt lavere enn forventet. Det kan være en sammenheng mellom dårlig rekruttering hos isbjørn og dårlig rekruttering hos ringsel; svikt i rekruttering hos isbjørn i området fra 100-150 binner m/unger ut fra hi i Wapusk National Park om våren til kun et fåtall, samtidig som ungeoverlevelsen synes å gå ned.

Spørsmål: Hva er din vurdering av det empiriske underlaget for kvote settingen?

Svar: Empirisk grunnlag blir dårligere og dårligere. Det er fangst-gjenfangst studier som gir best resultat for bestandsestimering av isbjørn, men i Nunavut gir man ikke lenger tillatelse til å utføre slike studier, og jeg mener det heller ikke gis slike tillatelser i NWT. Man bruker i noen grad flytelling, som kan gi gode estimater, dog med store konfidensintervall. Man bruker i stor grad tradisjonell økologisk kunnskap (TEK) i stedet, og TEK er ikke særlig egnet til å kvantitativt beregne bestandsstørrelser. Dermed er bestandsestimatene i stor grad basert på 10-15-20 år gamle 'surveys'. Man har de siste årene lagt til grunn en toktplan, som en del av den sirkumpolar handlingsplanen, som skal gi partslandene tillit til at nasjonene gjennomfører regelmessige bestandsestimat. Man ser imidlertid i dag at det er gjennomført bestandstelling i f.eks. Viscount Melville og Southern Hudson Bay, men at resultatene ikke offentliggjøres selv 7-8 år etter gjennomførte tellinger. Mange av mine kanadiske kolleger tror at dette kan skyldes at man har fått estimater som er lavere enn man liker.

Spørsmål: Er det, slik du ser det, adaptiv forvaltning av isbjørn i Canada?

Svar: Jeg ser ingen adaptiv forvaltning av isbjørn i Canada. Man kan ikke kalle det adaptiv forvaltning når status for isbjørn har blitt satt uten at man har tatt inn habitatendringer. Og, kvoter har stort sett bare økt de siste årene.

Spørsmål: Er det noen del-bestander som det er særlig bekymring for?

Svar: Henviser til PBSG sin tabell som ble publisert høsten 2019. Fire bestander i nedgang; SHB, WHB, SBS, NBS. Stor bekymring over at så mange bestander har datamangel, og at det fortsatt fangstes i disse bestandene. Vi vet også at det er gjort bestandstillinger i flere bestander hvor resultatene ikke er offentliggjort, bl.a. Viscount Melville og Southern Hudson Bay.

Spørsmål: Er forvaltningsområdene basert på reelle økologiske grenser?

Svar: Forvaltningsregioner er utviklet gjennom mange år, men de er ikke nødvendigvis økologisk relevante. Forvaltningsområdene er basert på data fra satellitthalsbånd, hovedsakelig fra 1970-, 80-, og 90-tallet. De siste 10-15 årene har det blitt gjort to studier som har forsøkt å se på grenser basert på forskjeller i økologi. En studie fra 2008 (Thiemann, Derocher og Stirling) konkluderer med 5 økologiske regioner i Canada, i motsetning til de 13 de har hel eller delvis jurisdiksjon for. Steve Amstrup og US Geological Survey gjorde en modelleringsstudie ifm den amerikanske rødlisteprosessen i 2007 som plasserte alle 19 delbestander i hver av 5 økoregioner, en studie som generelt er vurdert å være av høy kvalitet.

Spørsmål: Forekommer det ulovlig handel?

Svar: Nei, det har jeg ingen kunnskap om.

Spørsmål: Hvordan bestemmes det hvem som skal bli medlem av PBSG?

Svar: Gruppen ble stiftet for å følge opp Isbjørnavtalen og ble etablert som følge av bekymring for 'over-harvest'. Derfor hadde alle medlemslandene en utpekt representant med i gruppen (cap på 15 medlemmer). Men etter at avtalen hadde ligget på is i mange år ble den aktiv igjen etter et møte i 2009, særlig som følge av økt bekymring fra og med IPCC's 3. rapport i 2001 for konsekvensene av klimaendringer på havisen. Heretter ble PBSG mer som en vanlig IUCN spesialistgruppe, ved at det er gruppen selv som nominerer og godkjenner medlemmer. PBSG er et mer uavhengig organ i dag enn det var da det ble opprettet, og har siden 2009 fungert som partsnasjonenes uavhengige vitenskapelige rådgivere. Gruppen er konsensusbasert og transparent med detaljerte referater som er åpent tilgjengelige for alle, og har vanligvis møter hvert 4. år. Det neste møtet skulle vært i juni 2020 i København, men blir nå utsatt i opp til et år pga koronaviruset.

Spørsmål: Hva synes du om bruken av estimert bærekapasitet som basis for kvotesetting i bestander som er i nedgang.

Svar: Fangst på bestander i nedgang blir generelt oppfattet som dårlig forvaltningspraksis. Det kan muligens teoretisk sett gå an å ta ut dyr basert på redusert bæreevne, selv om beregning av bæreevne er svært komplisert. Et slikt fangstregime vil kreve massiv forsknings- og overvåkingsinnsats over mange år, og det er derfor vanskelig å tro at dette vil kunne fungere i praksis. Her blir bærekraft og føre-var i stor grad meningsløse begreper.

Spørsmål: Refleksjon rundt punktestimater for bestandsestimater og usikkerhet?

Svar: Det er stor usikkerhet i estimatene. For eksempel basert på telling med fly og fangst/gjenfangst er variansen $\pm 15-20\%$. Variansen er så stor at endring er vanskelig å oppdage. Dette er svært problematisk i en føre var sammenheng.

Spørsmål: Hvorfor synes det å være en del avvik mellom Canadas NDF og PBSG bestandsprognoser?

Svar: Det er et komplekst bilde. Isolert sett er den fangsten som har foregått de siste to årene kanskje ikke helt gal, men hvis man ser lenger tilbake i tid, har det vært store problemer med klar overfangst, særlig i Baffin Bay, Davis Strait, Kane Basin og Southern Hudson Bay (opptil 10-15% fangst pr. år) og også overfangst i Western Hudson Bay. Når det gjelder Nunavut, som har 2/3 av alle isbjørnene, har PBSG uttalt flere ganger at fangsten i WHB og FB ikke er OK, men dette har ikke blitt tatt til følge/blitt ignorert av forvaltningen. Kvotene blir basert på 'traditional knowledge'.

Om høstingen er bærekraftig? Nja... som sagt store problemer med til dels klar overfangst siden år 2000, selv om fangsten de siste to år ser ut til å ha vært bærekraftig. Men overgangen fra 2:1 til 1:1 hanner:hunner kommer til å bli et problem i framtiden; spesielt hvis man mener å beholde samme totalkvote. Da vil man fangst langt flere hunner enn tidligere. Dette kan i så fall kalles 'management for decline', og det er ikke bærekraftig. Nunavut sir selv at de ønsker færre isbjørn, da de frykter for sikkerheten til innbyggerne. 'Sustainability' blir i denne sammenhengen et meningsløst begrep.

Conversation with Ian Stirling 13.01.20

Question: In your opinion, is the current Canadian polar bear harvest sustainable?

Answer: The regions are too different to answer this question in a simple direct manner; The reason it is not possible to answer this question in a general way is that each of the subpopulations have different issues. Also, for some subpopulations, reliable long-term data are available, but for others no similar data exist. The population sizes in different regions fluctuate for a variety of reasons and thus long-term data from long-term monitoring are needed but in several cases, those data do not exist. Because of the presence of natural fluctuations, population estimates may depend on the period during which you did a survey. There could be problems 5-10 years from now in some populations, but it is not possible to say for sure with existing data. Thus, it is not possible to say whether the Canadian harvest, as a single number is sustainable or not. The harvest may be sustainable in some subpopulations, whereas in others the harvest is not.

Question: Do you have confidence in the Canadian polar bear management program as it is currently applied?

Answer: Overall, intentions are good. However, in some regions, such as Nunavut and the North Western Territories they sometimes seem reluctant to rely on science as a primary basis for management. They do not like to stick to "best scientific evidence". Local politics have a strong influence on management decisions, based on Local Ecological Knowledge (LEK). Regarding local ecological knowledge, it should be noted that the observations of bears made by hunters are usually very good, whereas the reliability of interpretations based on the observations can be more variable.

There are no longer capture-mark-recapture studies in most regions of Nunavut and Northwest Territories. Due to concern about methods, managers and user groups seem unwilling to allow handling and collaring of bears anymore, even though several studies conducted to date have not confirmed any detrimental effects on the bears from being handled. Surveying populations reliably is both difficult and expensive and the system is not working for populations in decline. This has, in some cases, facilitated overestimation of the size of some polar bear populations by some user groups and management agencies. In my opinion at least, management schemes worked quite well overall up to maybe 10 or 15 years ago. Now things sometimes seem a bit more piecemeal. In particular, the current system does seem to work as well in some of the declining populations.

One thing the PBTC in Canada badly needs is a web site on which reports, publications, and explanations of the basis of management decisions are clearly laid out for all to see.

Question: Has Canadian polar bear management taken on board the current and predicted future effects of climate change? Is there any application of the precautionary principle?

Answer: No, overall, I don't think climate change is taken into account, and there have been no specific applications of the precautionary principle in polar bear conservation that I am aware of.

Question: Among the various Committees, scientists and others involved in Canadian polar bear management, is there generally agreement on how the populations are managed or are there conflicts?

Answer: There used to be fairly good agreement on most things but more recently there is less general agreement on the topic of how we should manage populations. There are conflicts between members of Committees (e.g. PBTC) and independent scientists about population sizes and management approaches in Nunavut and the NWT.

Question: Climate change appears to increase bear-human conflict in certain areas (Canada, Greenland). Could this imply that smaller populations of bears would reduce conflict? Could this mean that some bear populations should be reduced?

Answer: I don't think a reduction in population size would solve the problem. Hungry bears around settlements will likely only increase in declining populations. Hungry bears will also still visit human settlements in search of food, especially ones with accessible garbage dumps. There have been some suggestions that population reduction is due to safety reasons but, personally, I don't know if it would help. In general, I doubt that would be effective and I would be very cautious about recommending reductions in population size.

Question: In your view, how will the polar bear population develop over the coming years? How do you think climate change will affect the population?

Answer: All the polar bear populations will ultimately decline as their habitat declines, but they will be affected differently and in different time frames. Climate change will be important to all subpopulations. The end result will be the same for all of them, but the timing and some of the pathways will be different.

Question: Have there been significant changes to management protocols over the last 10-15 years? Last 30+ years?

Answer: Yes, there have been significant changes over the last 10-15 years. Most important is the recent change in Nunavut to a 1:1 female:male ratio for harvest without, apparently, reducing the harvest quota of 4.5%, which was based on a harvest sex ratio of 2 males: 1 female.

Question: What are the most important threats to polar bears?

Answer: 1) Climate change and 2) Hunting and management regulations.

Question: Do current harvesting practices/export of skins/international trade pose a threat to polar bear populations?

Answer: Yes, harvesting practices can present a threat, especially to declining populations, such as those in Western Hudson Bay, Southern Hudson Bay, Southern Beaufort Sea and Northern Beaufort Sea. There is no way a declining population can have a sustainable harvest.

Question: Would a stop in international trade affect harvesting in Canada?

Answer: The extent to which the total harvest is driven by economic return alone is unclear. Hunting polar bears is important culturally at the local level so that some hunting would likely continue regardless. Stopping international trade could potentially make some hunters involved in polar bear harvest angry and, in a worst - case scenario, might result in an increase in killing of animals and waste of their carcasses. For example, there was a tragic incident on the coast of Hudson Bay in 2018 where a father was killed when protecting his children. The bear was later shot, but local people apparently also killed an estimated 6-8 additional bears, and allowed them to spoil, in what seemed to be an angry revenge-like action. The harvest in Western Hudson Bay is not sustainable as it is, but I do not know if a ban will stop kills.

Question: What is your assessment of the empirical evidence, on which the harvest quotas are based? Have there been significant changes over the last 10-15 years with respect to the empirical basis for harvest quotas?

Answer: SHB, WHB, SBS, NBS are populations in decline according to the science-based assessments. At present, much of the management seems to be based more on traditional ecological knowledge rather than on independently conducted scientific studies. That said, more recently, both the LEK and science seem to now be more or less in agreement on the size of the populations in WH and SH, though not necessarily on trend.

If there is empirical evidence of population decline, it may not be considered in establishment of quotas, particularly in WH. In general, TEK is very useful for answering many questions about natural history. However, for estimating abundance and trend of polar bear populations, it is not an appropriate method. Management of polar bears without active use of the best available science goes against the Polar Bear Agreement.

Hungry bears may sometimes go close to human settlements to dig out trash or because hunters/fishermen have left out parts of whales or other animals they have caught. This may give the impression of more bears when, in reality, there are only more bears gathering in the vicinity of the human settlement because they are looking for something to eat.

Question: Are harvest quotas based on:

- Empirical data; population size estimated from true population surveys?

Answer: Sometimes based on empirical data though for many areas, those data are outdated. However, sometimes if there is empirical evidence of population decline, these estimates may not be used.

- Empirical data; population size estimated from harvest data?

Answer: Harvest data not used as far as I know; On their own, I doubt they would be sufficient for most statistical assessments.

- Local/traditional (ecological?) knowledge?

Answer: Traditional knowledge is usually included. This kind of knowledge can be quite valid for several things such as determination of denning areas but in general is not reliable for estimating population size or trend.

Question: To what extent is this uncertainty accounted for when determining harvest quotas?

Answer: Uncertainty is not usually accounted for specifically when setting quotas and, in my experience at least, the precautionary principle is not been used or taken into account.

Question: Data deficiency/poor/old data – how serious is this?

Answer: Quite serious. Data deficiency a serious problem for many populations.

Question: Are any subpopulations of special concern due to decline in population size or management conflicts?

Answer: Answered above

Question: Are there any particular challenges related to current management practices?

Answer: Management practices often seem to avoid following article II of the International "1973 Polar Bear Agreement", in that they are not always based on the best available scientific knowledge. As mentioned before, TEK is a good method to use in some situations, for example when studying denning behaviour observations of cub-yearling litter sizes from sightings or track data. In such cases local people may notice the development of new trends long before scientists studying these factors do. However, TEK is not appropriate for estimating the abundance or population trends of polar bears. CMR remains the gold standard for estimating polar bear abundance. Trends can only be detected from scientific studies, preferably longer term ones.

Question: What is your view on potential use of estimated carrying capacity as a basis for quota setting, particularly when considering populations that are in decline?

I can't really comment on this as I am not sufficiently informed of the methodologies and mathematics involved but, generally speaking, it seems to me that this approach may be difficult since we don't know the carrying capacity, and that is likely very difficult or impossible to estimate. Also, we know there is huge amount of natural variation in the marine system that is not well understood. However, to be clear: harvesting from a

Answer: population in decline is not sustainable management.

Question: To what degree does delineation of the management regions (subpopulations) match the ecological relevant boundaries?

Answer: Overall, they are generally fairly good, although some may have changed due to climate change. However, for example, the border between NBS (North Beaufort Sea), and SBS (South Beaufort Sea) was arbitrarily moved further west even though the previous delineation made ecological sense and was based on scientific data on bear distribution and movements from capture/re-capture/harvest data. I suspect the change was made to increase the population size in NBS in order to be able to maintain or increase the total harvest quota. A huge amount of more recent telemetry data was ignored before the change was made. There is a very large amount of satellite collar movement data available, as well as a significant accumulated body of data from the locations where polar bears were first captured and where they were later re-captured or shot, that should be analysed before moving the border of a polar bear population. . In the case of SB and NB, the Canadian management agency refused to do this analysis, which I personally think was wrong and a violation of the Polar Bear Agreement.

Question: To which degree are managers under political influence – do they risk repercussions for being critical / expressing their personal opinions?

Answer: Wildlife managers often appear to be under a lot of political pressure. I cannot say whether or not there might be repercussions for expressing opinions.

Question: Local management; do you think part of the motivation for shooting polar bears may be predator control (shooting polar bears to decrease polar bear predation on seals)?

Answer: No, but in some cases the reason may relate to concerns about human safety.

Question: Source-sink dynamics – to which degree (seemingly) can increased population size in some areas reflect immigration from other areas, where habitat is no longer suitable/of poorer quality?

Answer: Generally, there is little evidence to suggest that happens. Polar bears exhibit a high degree of fidelity to their home range/areas. Some movement of young males takes place, because young males are generally the dispersers in most species of mammals

Question: Are you aware of any illegal trade in polar bear skins?

Answer: No, not in Canada.

Question: The US ban has caused a boost in trade to China and an increase in prices. Chinese demand could also be met through illegally harvested Russian bears. The increased price has raised the incentive for illegal hunt in Russia. Do you think this is a problem, and are any data available on illegal Russia-China trade?

Answer: There has been some illegal hunting reported from Russia (Chukotka), but I have only second-hand information on this matter.

Question: How are the harvest quotas distributed in the local communities?

Answer: Quotas are established for each community that harvests polar bears and the tags are issued by the management agencies, The individual tags are then distributed in the local communities, and each one decides on its own what the procedure will be for their hunters. In some for example, there may be a lottery. In some, a hunter may be allowed to have a tag for a period of time, such as a week, but if a bear is not shot, you have to turn in tag and the tag may then be taken by another hunter for a period. In Greenland, you have to be a registered hunter. In Canada, it may be just a weekend activity in some places while in others, polar bear hunting may be done more extensively. It can vary with how much other sources of employment there may be in an area.

Question: Is the harvest selective (for example, are larger and more active animals more likely to be harvested)? Can this selection pressure influence future population size?

Answer: Yes, there is more interest in harvesting large adult bears, especially by guided non-resident hunters. On the other hand, sometimes, the tag system may reduce selective harvest (i.e harvesting of the largest and most healthy-looking individuals) because the tag has to be handed over to someone else if the hunt was unsuccessful. Therefore, some local hunters may shoot a smaller bear, or a female, because they know that otherwise they will have to give back and may not have another opportunity.

Question: How are PBSG members appointed? How are disagreements within PBSG resolved?

Answer: PBSG members used to be appointed by national agencies but, now, in order to be an independent specialist group under the IUCN, members must be appointed by the chair Dag Vongraven (Chair) may tell you more about this. Disagreements in the PBSG are usually

solved based on consensus and application of the precautionary principle if the subject is one related to harvest. In cases where differences of opinion remain, properly designed research to address the particular issue is recommended. PBSG bases their assessments and recommendations on scientific evidence.

Question: Regarding Canada's assessment of non-detrimental findings: Opinions/comments on quotations such as:

- "Harvest is managed adaptively"
- "...the management system is adaptive and can adjust harvest levels quickly as needed"

Answer: I am not familiar with PBTC discussions about the NDF.

To be relevant, a Canadian non-detriment finding would need to be made on a sub-population basis, not the total population, and use all available scientific evidence.

Agencies have the potential to respond adaptively but, in my experience, the primary objective appears to be to maintain (or increase) the total population harvest level. When an increased harvest is recommended, it is usually acted on rapidly; less so if a decrease is recommended. Additional points discussed:

The "credit" system is controversial, especially because in some cases, some parts of untaken quotas may be saved for use in a subsequent year. To what extent this is applied – I don't know. But it is a ridiculous system, especially when you do not have firm documentation of population structure in relation to patterns of hunting.

Question: The importance of ringed seals as polar bear food?

Answer: Ringed seals – and what happens to them at the population level – is extremely important for polar bears. Consequences of changes in sea ice for polar bears have been studied and are pretty well understood, but what happens to the seals has not been taken into consideration in any way close to its critical long-term importance.

Conversation with Andrew Derocher, 30.10.19

Question: In your opinion, is the current Canadian polar bear harvest sustainable? Have there been significant changes over the last 10-15 years?

Answer: In general, most of the Canadian harvest has been ok. A harvest rate of 4.5%, with a sex ratio of 2:1 male: female adult bears, has been the standard since the 1973 polar bear agreement, and this harvest rate has generally been considered sustainable. There have, however, been significant changes over the past 10 years, and there is now an increasing concern among scientists particularly for the polar bear populations in Nunavut and the Northwest Territories, where management protocols have changed a lot.

Question: What is your assessment of the empirical evidence, on which the harvest quotas are based? Have there been significant changes over the last 10-15 years?

Answer: Monitoring of population size has - at least in theory - been carried out with a standard 15 years inventory cycle, and between each cycle population modelling is used to estimate population size and determine quotas. Although not an overly robust method for assessing population size, this approach ensures that harvest quotas are based on scientific evidence. Inventories have greatly surpassed the planned 15-year inventory cycle and in Viscount Melville Sound, the last estimate is from 1992. An inventory completed in 2014 has not been released by the Government of the NWT. It is noteworthy that the 15 year inventory cycle was based on considerations at a time when environmental conditions were not showing a long-term decline due to sea ice loss and thus, this interval is likely inappropriate for managing stocks with declining conditions.

There has been a shift away from basing the harvest quota decisions on scientific evidence, to the current situation, where traditional knowledge and scientific evidence are both used to set harvest level. It is increasingly difficult for scientists to get access to carry out population surveys in most of the management areas. In some areas, quotas are no longer based on scientific data. In some cases, data from inventories on population size exists, however, the reports are not finalised and/or are not released from local governments.

With respect to finalise/ release reports this should include failure to produce results in a timely manner.

Question: Are there any subpopulations of special concern due to serious decline in population size or management conflicts?

Answer: Southern Beaufort Sea: (managed by Canada and Alaska) Serious decline in population size, but the latest population size estimate was not accepted by the local community.

Western Hudson Bay: a 30% decline in population size, based on good empirical data, yet, the management quota was increased.

Southern Hudson Bay: This population is also in decline, based on good and recent scientific data, but with no change in harvest management.

For M'Clintock Channel: Overharvest occurred in the past. New inventory data will provide insights, but the information is lacking so we don't know the status of harvest there.

Question: In your opinion, are there any particular challenges related to current management practices?

Answer: In some areas where inventories are completed, the local management authorities have refused to finalize and/or release reports. This means that management is based on old data and estimates.

There are concerns about changes to the harvest management strategy in Nunavut. The 2:1 male: female sex ratio in harvest management is changed to a 1:1 ratio, but with no reduction in the overall quota. Given a 1:1 harvest strategy, the quota should be reduced to 3%.

Nunavut is looking to reduce the population to a "social carrying capacity level" due to increased human-bear conflict (two fatalities in 2018) as well as for competition for food/resources (e.g. harp seals). Nunavut is the biggest harvester. Want to protect other resources. Focus is on traditional ecological management in the Canadian Arctic, and such knowledge is weighted equally as scientific data.

Quotas are based on what they used to be in the past, when there was traditional Inuit harvest and use. Parts of the animal are still used in some of the communities, but the traditional use of the skin is gone, and the skin is sold (exported). There is not much domestic demand for skins in Canada.

I would adjust to say that traditional use of skins is not gone but the sale of hides is common. Some people still use hides and I have heard many times that if hides could not be commercially sold, they would be used locally.

The implied message is that an international trade ban would not change harvest. I think, however, the response would vary. Some areas are expensive to hunt and without an economic return, these might see less hunting pressure. Other areas, I suspect quotas would still be filled.

Question: What is your view on the use of estimated carrying capacity as a basis for quota setting, particularly when considering populations that are in decline?

Answer: Using estimated carrying capacity as a basis for quota setting (Eric Regher's work): No one knows what the current carrying capacity is, nor what it will be in the future. If harvesting populations in decline is going to work, then it needs to be based on much more empirical data and better population estimates than what we have today. Eric Regher's work suggests we could harvest these populations, but data on recruitment and mortality and several other important factors are missing.

Question: what is the situation for polar bears on Greenland?

Answer: Some populations are shared with Canada; Baffin Bay, Kane Basin, Davies Strait, two other subpopulations a little bit. They have ongoing harvest programs in four populations and has moved to a program like Canada, but are not reporting like Canada. There is more subsistence use in Greenland than Canada.

Question: Would you say that international trade in polar bear skins is a threat to polar bears?

Answer: The more and more pressing situation for the polar bear and publicity around the endangered status resulted in a spike in the price of polar bears, and they doubled in price from 2000-3000 dollars to twice as much. Trade predates the 1973 international agreement.

Question: To what degree does delineation of the management regions (subpopulations) match the ecological relevant boundaries?

Answer: Management boundaries- many of these are outdated and some don't make use of the best available data. They were adequate for management in the past, but do not account for changes in distribution from climate change. This is an area that requires attention.

Question: What are the most important threats to polar bears? Do current harvesting practices pose a threat?

Answer: Climate change is by far the most important threat to polar bears. Even if we had good population estimates, we have no idea what the future carrying capacity will be because of rapid and unpredictable changes in the environment. Ideally, harvest mortality should be compensatory, but it is likely additive; i.e. harvest is pushing the population further down. In addition, strong, healthy bears are more likely to be harvested. We are managing on the point estimates, not taking the considerable uncertainty into account. There may be a quite significant overharvesting going on, which we will not be able to pick up with local/traditional knowledge. The rate of change in population size may be high, and there is not enough staff "to do the work". Nunavut has one polar bear biologist, NWT has one. But this is not only a capacity problem: in several areas, scientists do not get access to carry out population surveys. In Western Hudson Bay, where there is no Inuit community, the empirical evidence shows that harvest is contributing to population decline, but climate change is still the dominant driver.

Locals claim that there are more bears than previously, however melting of sea ice makes the animals migrate north and gather where people live, giving the impression of more bears.

Question: Are you aware of any illegal trade in polar bear skins?

Answer: No, it would be difficult to move a bear skin between territories without a tag and a permit. Harvest is not the main threat to polar bears, but given the pressing threat of climate changes and loss of habitat, harvest imposes an additional threat to an already vulnerable species.

Question: Would it be possible to predict population collapse based on traditional ecological data?

Answer: The McClintock Channel population was down by 60% from overharvest. There was however little indication from TEK that this was about to happen. Bears may appear abundant because they are seen close to settlements. TEK is often documented in an overview / summary perspective rather than in a time series approach.

Question: How is the harvest quota distributed in the local communities?

Answer: It varies between regions, but there may be a lottery where you can win tags (for the polar bear skin) or there may be a rotating tag that each hunter may have for a couple of days before passing it on if they haven't shot a bear within that time period.

Appendix 2

Additional analyses regarding the effects of climate change on polar bear habitat.

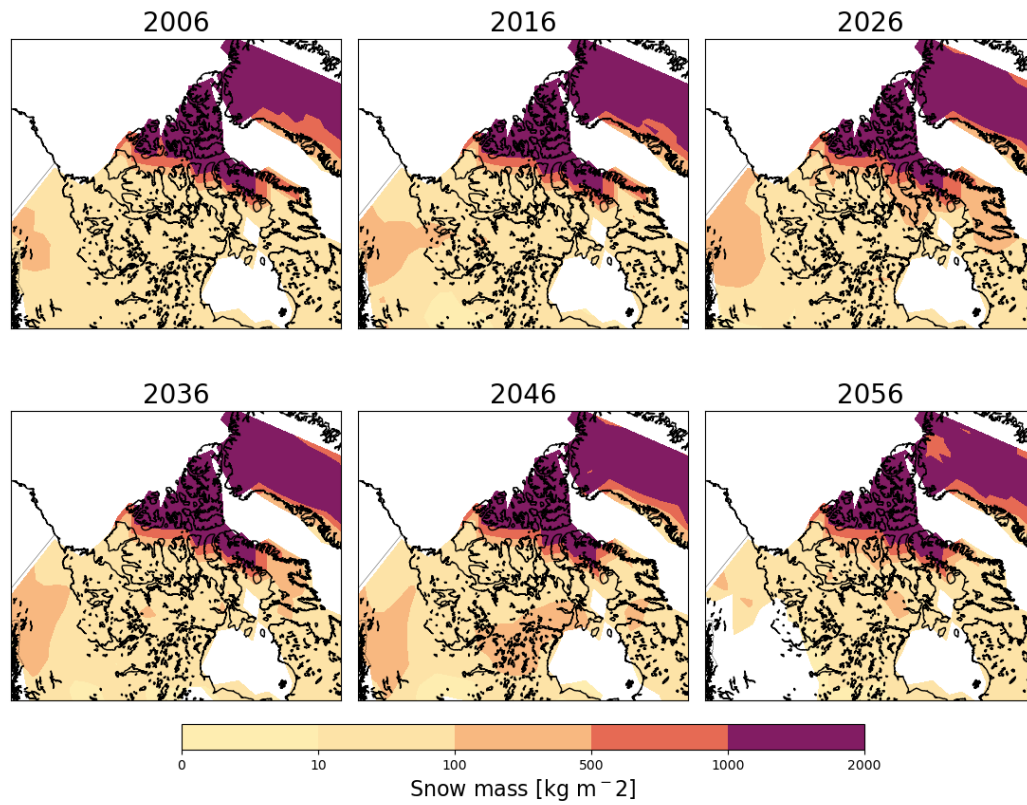


Figure 1 Development of snow mass on land for Northern Canada in November 2006-2056 as projected by the NorESM climate model, RCP4.5 scenario.

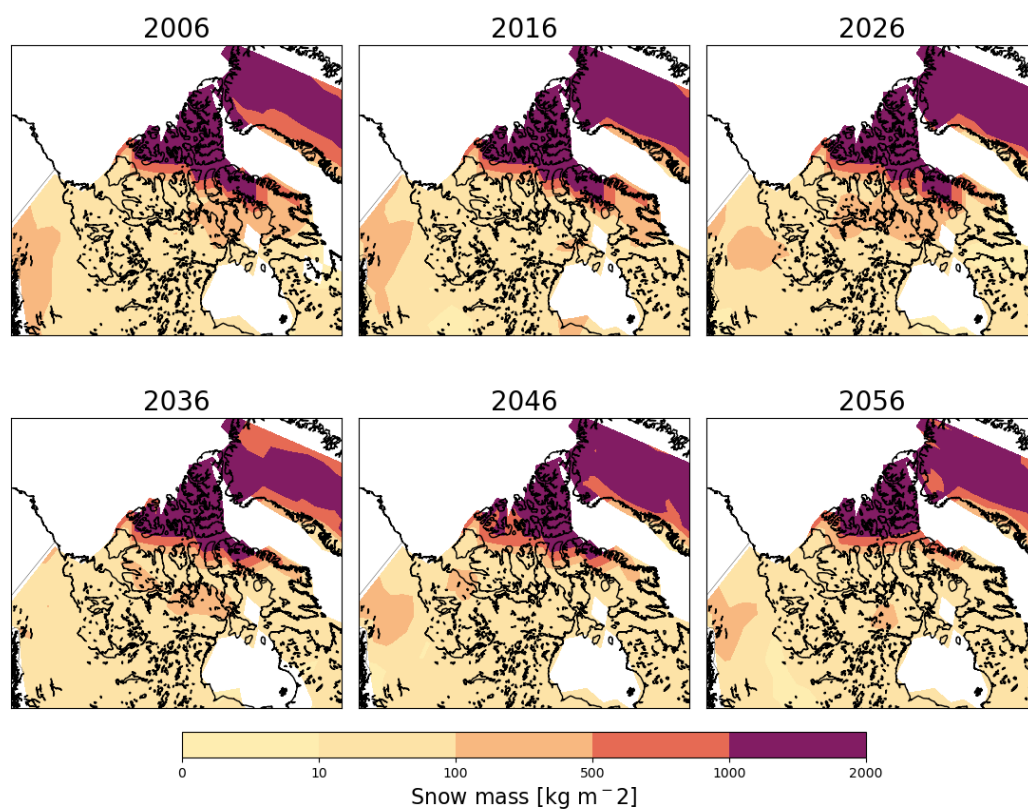


Figure 2 Development of snow mass on land for Northern Canada in November 2006-2056 as projected by the NorESM climate model, RCP8.5 scenario.

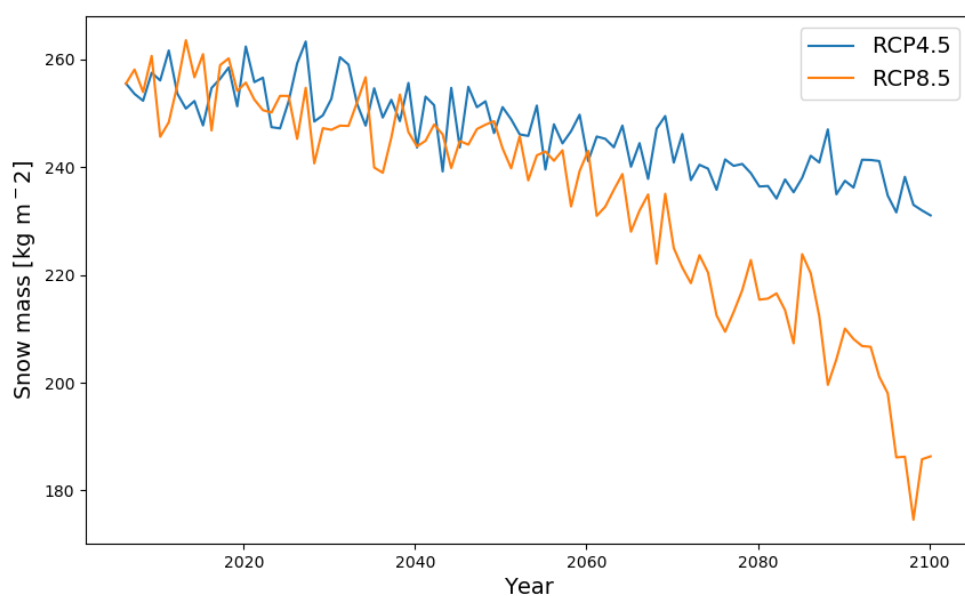


Figure 3 Projected development of average snow mass on land in Northern Canada for the month of March in the 21st century for RCP4.5 and RCP8.5 climate scenarios.

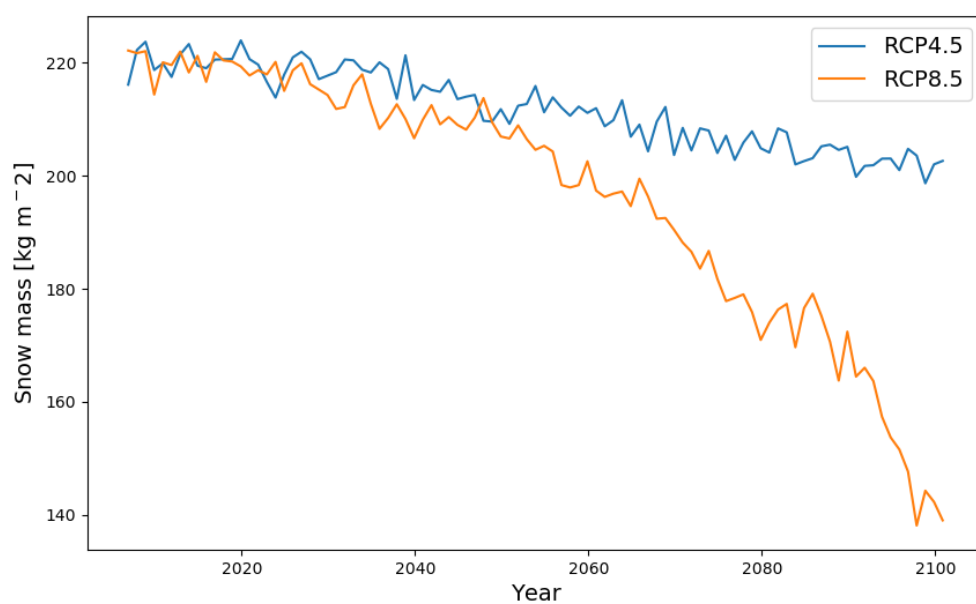


Figure 4 Projected development of average snow mass on land in Northern Canada for the month of November in the 21st century for RCP4.5 and RCP8.5 climate scenarios.