CIRCUMPOLAR ACTION PLAN

Conservation Strategy for the Polar Bear

September 2015




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Preface

The representatives to the Parties that are signatory to the 1973 *Agreement on the Conservation of Polar Bears*, that are collectively known as the Polar Bear Range States (Norway, Canada, Greenland, the Russian Federation and the United States), have a long record of cooperation on polar bear conservation. At the time the Agreement was signed, the most significant threat facing the polar bear was unregulated and unsustainable harvest, and populations in some areas were considered to be substantially depleted. Since that time, measures implemented by the Range States, such as controlled harvest management programs and the establishment of protected areas, have increased polar bear population sizes in those areas where unsustainable hunting was a problem prior to 1973.

Since 1973, however, the nature of the threats facing polar bears has changed. The world now faces what portends to be the greatest challenge to polar bear conservation in the history of the Agreement: human activities are changing the Earth's climate at an accelerating rate with ever greater risk to all ecosystems. One of the consequences of climate change is loss of sea ice habitat that polar bears depend on.

In its Fourth Assessment Report, published in 2007, the Intergovernmental Panel on Climate Change (IPCC) concluded:

> *Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.... most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations.*

In its Fifth Assessment Report, published in 2014, the IPCC further stated:

> *Human influence has been detected in warming of the atmosphere and the ocean, in changes in the global water cycle, in reductions in snow and ice, in global mean sea level rise, and in changes in some climate extremes. This evidence for human influence has grown since AR4 [the Fourth Assessment Report]. It is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.*

Anthropogenic (or human-caused) climate change, and the associated loss and fragmentation of sea ice habitats, threatens the long-term survival of the polar bear. Polar bears evolved in sea ice habitats over hundreds of thousands of years; as a result they are adapted to, and reliant upon, this habitat. While climate variability has been observed throughout the history of the planet, increasing atmospheric concentrations of greenhouse gases (GHGs) as a result of human activities mean that those fluctuations now occur over a higher and rising temperature baseline. Changes are taking place at a greatly accelerated rate, driven largely by anthropogenic warming caused by rising GHG emissions. At the same time, human populations and activities in the Arctic are increasing. In combination, these factors present new challenges for polar bear conservation. Although the current status of the world's polar bears is variable, scientists expect that negative effects will be increasingly common throughout the polar bear's range over the course of the 21st century. It is important to note that climate changes will also affect local, indigenous economies and cultures, as well as the goods, services and social benefits that humans are accustomed to receiving from ecosystems across the Arctic.

At their 2009 Meeting in Tromsø, Norway, the Range States agreed that the impacts of climate change and the continued and increasing loss and fragmentation of sea ice — the key habitat for both polar bears and their main prey species — constitute the most important threat to polar bear conservation. The Range States acknowledged with deep concern the escalating rates and extent of changes in the Arctic induced by climate change to date and noted that future changes are projected to be even larger. The Range States agreed that the long-term conservation of polar bears depends upon successful mitigation, or lessening, of climate change. To address the growing concern over climate change and a number of other emerging issues, the Range States agreed to develop a coordinated plan for polar bear conservation and management — a Circumpolar Action Plan: Conservation Strategy for Polar Bear.

Under this Circumpolar Action Plan, the Range States reaffirm their commitments under the Agreement and recognize that the polar bear is an indicator of the biological health of the Arctic ecosystem and a significant resource that requires additional protections. The Range States recognize that continued international cooperation is essential for the conservation of polar bears for future generations, and consider the Agreement to

be the cornerstone and basis for this Plan[1]. At the 2013 *International Forum on the Conservation of Polar Bears* in Moscow, Russia, representatives to the parties of the Agreement further reiterated these commitments in the Declaration of the Responsible Ministers of the Polar Bear Range States.

Henrik Hansen, Greenland

[1] While this Plan uses the 1973 Agreement as a point of departure, the Plan is not an authoritative interpretation of the 1973 Agreement and does not create rights or obligations under International law.

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Glossary of Terms

Adaptive Management: an approach to environmental management that continually seeks the best way to reach management objectives. This is done through predicting outcomes of potential decisions, monitoring to understand the impacts of actions, and the use of all available information to adjust management objectives as necessary. Adaptive management incorporates learning and collaboration among scientists, managers and other stakeholders.

Apex predator: An apex, ora top-level, organism has no natural predators other than humans.

Biomarkers: biological indicators used to identify a time in a specimen's life when something has changed. These can be extracted from samples in the form of isotopes and fatty acids.

Intraspecific predation: when members of the same species prey upon each other, often due to competition for resources.

Leads: Leads are large fractures within an expanse of sea ice, defining an area of open water that can be used for navigation purposes.

Legacy Pollutants: Legacy pollutants are pollutants that result from activities that are no longer carried out but that remain in the environment.

Maximum Sustainable Yield: the maximum number of a species from a population that can be removed over a given period of time without impacting the overall population size.

Perennial sea ice: Alsoalso called multiyear sea ice. Ice that remains intact for multiple seasons. It is charaterized by its rough surface caused by a mixture of air pockets (from and the overall thickness of the ice.

Polynyas: An area of open water where one would expect to find sea ice. Polynas are caused by both latent (coastal areas) and sensible (open ocean) heat transfer.

Point source: Point source pollution that comes from a clearly defined source such as a leaking oil drum. Non-point sources are diverse and cannot be pinpointed — for example, greenhouse gases in the atmosphere.

Physical Mark-Recapture: The mark-recapturea methodology for studying wildlife typically involves the capture and marking of a subset of individuals in a population (e.g., tattoo and/ or tags). Population estimates can then be obtained through calculations of the proportion of sampled vs. unsampled bears in subsequent capture activities.

Precautionary approach/principle: As set forth in Principle 15 of the Rio Declaration – where there are threats of serious or irreversible damage, lack of scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.

Quantitative fatty acid signature analysis:

Seasonal Refugia: An area where special environmental circumstances enable a species or a community of species to survive in the face of pressures in other regions of their historic distribution.

Satellite telemetry: a form of tracking where transmitters, often attached to wildlife by collars or inserted as implants, emit signals which are captured by satellites. This information is used to help track the movement patterns of wildlife.

Stable isotope analysis: type of analysis is generally done to identify isotopic signatures from a sample which can help identify when a specimen has undergone/ been exposed to changes in its environment or diet.

Viable Population: A viablea population is one that is expected to persist over time and that will not become extirpated due to either internal or external pressures/factors.

Vital rates: measurements of the natural births and deaths. In research vital rates are a way to measure the health of a population.

Executive Summary

In 1973, Canada, Denmark, Norway, the United States and the Union of Soviet Socialist Republics signed the *Agreement on the Conservation of Polar Bears* (hereafter, the Agreement). The representatives of the Parties (Canada, Greenland, Norway, Russia and the United States) note that at that time the largest threat to the polar bear (*Ursus maritimus*) was over-hunting, which had led to the severe depletion of some of the subpopulations within their range. As a result of coordinated international efforts and effective management actions by the Range States, polar bear numbers in some previously depressed populations have grown. In 2009, it was recognized by the Parties that a new and larger threat had emerged: climate change. This Circumpolar Action Plan (hereafter, the Plan) — a collaborative Range States initiative — provides a means of coordinating the management, research and monitoring of polar bear across its range and ensures that the Range States share common goals and approaches to conservation efforts. Recognizing the effective management systems already in place, the Plan focuses on issues that are best handled at the international or bilateral level.

While this first Circumpolar Action Plan is a 10-year plan, it will be revised and renewed as long as is needed. Progress of the Plan will be evaluated and made public every two years.

PLAN VISION AND OBJECTIVES

The overarching vision of the Plan is:

> *To secure the long-term persistence of polar bears in the wild that represent the genetic, behavioral, life-history and ecological diversity of the species.*

The vision reflects the Range States' position that polar bear conservation is a shared responsibility and that it is crucial for ecological reasons, and recognizes the importance of the polar bear to indigenous peoples of the circumpolar Arctic.

In order to realize the vision, the Range States have developed six key objectives:

1. *Minimize threats to polar bears and their habitat through adaptive management based on coordinated research and monitoring efforts, use of predictive models and interaction with interested or affected parties;*

2. *Communicate to the public, policy makers, and legislators around the world the importance of mitigating GHG emissions to polar bear conservation;*

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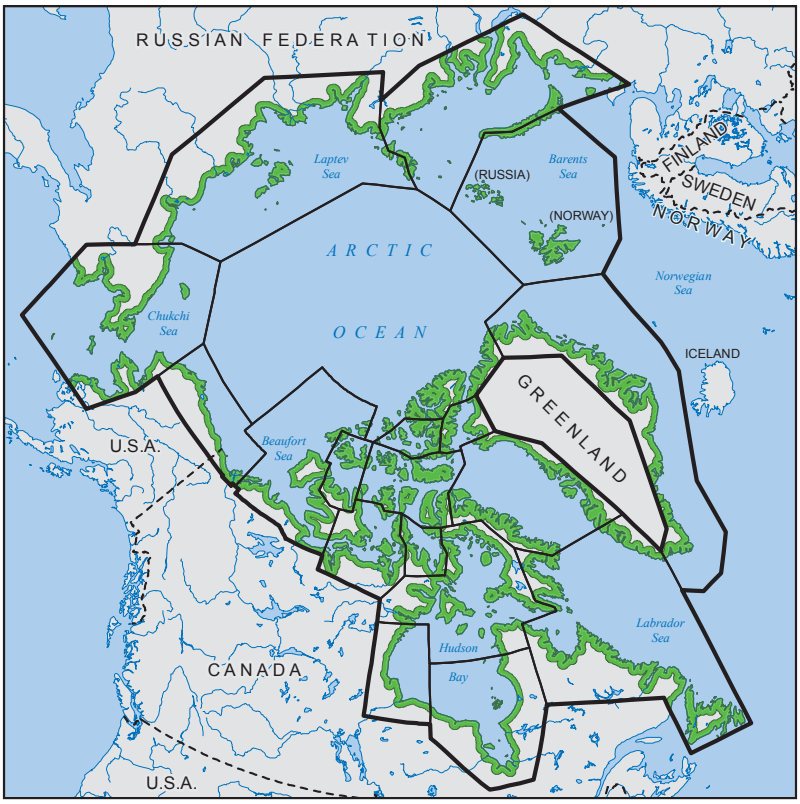

3. *Ensure the preservation and protection of essential habitat for polar bears;*

4. *Ensure responsible harvest management systems that will sustain polar bear subpopulations for future generations;*

5. *Manage human-bear interactions to ensure human safety and to minimize polar bear injury or mortality;*

6. *Ensure that international legal trade of polar bears is carried out according to conservation principles and that poaching and illegal trade are curtailed.*

SPECIES INFORMATION

Classified as *Vulnerable* on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the polar bear, the largest of the bear species, is a circumpolar ice-dependent mammal that has no natural predators. The world population estimate is 20,000–25,000 polar bears, occurring in 19 subpopulations (geographic areas) of varying discreteness, throughout the circumpolar region. Their range represents a total land and marine area of approximately 23 million km^2.

The most carnivorous of all bear species, polar bears feed mainly on ringed seals but also hunt bearded, harp and hooded seals, as well as walrus. They are also known to scavenge on marine mammal carcasses, including whales, and will feed opportunistically on other food sources, such as bird's eggs. Most of a polar bear's life is spent on the sea ice. In areas where sea ice is seasonal, polar bears come ashore to wait until the ice forms in the fall and typically fast during this time. Pregnant females in most areas excavate dens in drifted snow banks on land, often close to shore, but are known to use multi-year pack ice in some regions of the Arctic, and may dig dens in frozen peat, and occasionally gravel, in discontinuous areas of permafrost.

The population growth potential of polar bears is typical of long-lived animals with slow reproduction cycles. Most males begin to breed at about eight-to-ten years of age, while females reach reproductive maturity at four-to-six years. Females typically have litters of one or two cubs, which, if they survive, are usually weaned around the age of two years. Few polar bears live longer than 25 years in the wild.

THREATS TO POLAR BEARS

For the purpose of this Plan, the Range States agreed to consider actions which may be appropriate over the next 10 years. Seven key threats have been identified as already impacting, or most likely to have an impact on the polar bear and its habitat in the next 10 years. These threats need to be addressed within the next decade in order to avoid negative long-term effects to polar bears. These threats are: climate change, disease, human-caused mortality, mineral and energy resource exploration and development, contaminants and pollution, shipping, and tourism-related activities. The threats may interact and have compound effects, so the cumulative impacts will also be addressed in the Plan.

Climate change is the over-arching, long-term and most significant threat facing the polar bear. Projected warming over much of the polar bear's range and associated reductions in the extent and thickness of multi-year and annual sea ice will have both direct (e.g., habitat loss and degradation) and indirect (e.g., changes in prey availability) effects. Earlier melting of sea ice in the summer and later formation of sea ice in the fall will result in greater reliance on terrestrial coastal areas. Importantly, when and where climate change affects polar bear populations is expected to vary. Up-to-date information from scientific studies and other sources is necessary to understand this variation and develop effective conservation measures.

The occurrence of **disease and parasites** in polar bears is considered rare. However, with warming Arctic temperatures, the potential for wide-spread disease outbreaks exists, as does increased exposure and susceptibility to existing and new pathogens. Such impacts may be exacerbated as polar bears experience nutritional stress and given their relatively low levels of genetic diversity.

Total **human-caused mortality** (including legal harvest, poaching, human-bear conflicts, and polar bears killed as a result of other human activities) does not currently threaten the persistence of polar bears at the circumpolar level. Such removals could, however, become a threat to individual subpopulations if lethal take is unregulated or is not sustainable.

Increases in **mineral and energy resource exploration and development**, coupled with increases in shipping as a result of a longer open water season, increase the potential for oil spills in the Arctic marine environment. Polar bears are particularly vulnerable to oil spills as their ability to thermoregulate would be affected by oiling. They may also be poisoned from ingesting oil when grooming or by eating contaminated prey. Although most exploration and mining in the Arctic to date has taken place inland (i.e., outside the normal range of the bears), many mining projects create infrastructure within polar bear habitats that has the potential to have a negative impact if not managed appropriately. As northern communities grow and industrial development increases, areas of interest to offshore hydrocarbon development and mining will occur in polar bear habitat, thereby increasing exposure to contaminants, pollution and human-bear interactions.

Contaminants and pollution from industrialized parts of the world reach the Arctic via both air and ocean currents. In some Arctic regions, top-level predators, like the polar bear, carry high contaminant loads. The presence of contaminants can adversely affect several physiological processes as well as endocrine, immune and reproductive systems which may impact bears at the individual and/or population levels. Being compromised in such a manner may further impede the polar bear's ability to respond to rising temperatures and shrinking sea ice habitat caused by a warming Arctic environment.

Loss of seasonal sea ice and the resulting increase in open water has led to an increase in **shipping** activities within the Arctic, and is expected to increase even more, given projections of an ice-free summer Arctic by 2020-50. Potential effects of shipping on polar bears include disturbance, increased fragmentation of sea ice habitat (from icebreakers), pollution, and the introduction of waste/marine litter, as well as an increase in human-bear encounters and corresponding risk of defence kills.

Effects as a result of **tourism and related activities** are expected to increase given expanded human presence in areas where polar bears exist. This includes increased traffic in prime polar bear habitat, potentially leading to increased human-bear interactions, and disturbance of denning females and females with dependent young.

MANAGEMENT REGIMES

Over the past 40 years, considerable progress has been made to establish domestic and inter-jurisdictional arrangements for polar bear research and management. An adaptive management approach is the cornerstone of these regimes, and ensures that decisions are continually

being updated as new information becomes available. Many of these arrangements have been formalized through both legally and non-legally binding instruments.

Across the circumpolar region, polar bears are managed on a subpopulation basis by governments. For subpopulations that extend beyond national jurisdictions into the high seas, international framework agreements provide some protection. For the subpopulations that transcend more than one country but remain within the exclusive economic zones of each country, bilateral agreements have been established in order to manage these shared populations.

National, state, provincial and territorial governments have established a number of protected areas of various types across the circumpolar region, many of which are situated within the range of polar bears, some of them beneficial to polar bears. Collectively, these designated areas serve to reduce the potential for adverse effects of industrial and other land use activities on polar bears.

According to the Agreement, polar bear management should be conducted in accordance with sound conservation principles based upon the best available scientific data. It should be noted that, the Range States recognize that indigenous peoples have acquired a wealth of knowledge (commonly referred to as Traditional Ecological Knowledge; TEK) about polar bears from centuries of living within the range of the species and its habitat. Their historic and current knowledge can contribute to effective polar bear management, and can make valuable contributions to scientific research and monitoring activities. In some countries, both science and TEK are considered equally in management decisions, in others TEK is considered in management decisions when scientific knowledge is lacking or non-existent and in others TEK may be considered when making scientifically based management decisions. In some polar bear areas there is no indigenous population and TEK is not a source of knowledge that can be considered in management decisions. Furthermore, the Range States recognize that the polar bear is important to Arctic indigenous communities and that their engagement in management and conservation is essential. Consequently, the Range States recognize that both science and TEK should be considered, where appropriate, in each of the strategic approaches identified by the Range States in order to address threats facing the polar bear.

STRATEGIES TO ADDRESS THREATS

Strategies that correspond to the seven key threats have been grouped into four strategic approaches: adaptive management, best management practices, monitoring and research, and communication and outreach. For each of these strategic approaches, actions which are considered important to support the key objectives of the Plan, and which would benefit from cooperation among the Range States have been identified. These actions are listed in the subsections below. The Range States will endeavor to collaborate on, and harmonize, activities and actions on the basis of this list. The list of identified actions is a framework with a time horizon of 10 years. More concrete implementation plans with priority actions for each subsequent two-year period will be agreed upon by the Range States biennially at the Meetings of the Parties to the Agreement.

Adaptive Management Approach

Adaptive management is a planned and systematic process for continuously re-evaluating management decisions and practices by learning from their outcomes and new knowledge. Assumptions can be tested and, if unanticipated adverse effects are detected, actions can be modified before the adverse effects take on major importance. Adaptive management is essential to planning and decision making for polar bear conservation and management throughout the circumpolar region, particularly in addressing the threats posed by climate change and the associated implications for habitat, prey abundance and availability, and disease.

ADAPTIVE MANAGEMENT ACTIONS

Take climate change effects into account in polar bear management:

- Consider the cumulative effects of climate change and human activities on polar bear subpopulations and habitats when making management decisions using tools such as predictive modeling.

- Investigate how climate change effects vary among subpopulations on both temporal and spatial scales and incorporate this knowledge into management actions.

Document and protect essential habitat:

- Identify essential polar bear habitat and redefine it as changes occur over time.

- Disseminate essential polar bear habitat information broadly to Arctic communities and industries. Work with communities and industries to apply the appropriate habitat protection measures so that anthropogenic development and expansion do not adversely affect habitat.

- Conduct research into application of the concept of carrying capacity of polar bear subpopulations to polar bear management.

Consider the impact of diet changes:
- Identify and monitor changes in the availability and use of prey species and other food sources when making management decisions.

- Develop strategies for responding to the potential for large numbers of nutritionally-stressed bears being close to communities and consider the consequences including those for human safety and transmission of disease between bears.

Consider the current and future impacts of disease and parasites:
- Ensure that information on the impacts of disease and parasites in bears is considered when making management decisions.

- Communicate disease findings and predicted disease prevalence information, as well as provide guidelines for consumption of polar bear meat by people and sled dogs, as appropriate.

Best Management Practices Approach

Best management practices (BMPs) are methods, strategies or practices that have demonstrated effective results compared with other approaches, and are often therefore used as a standard. When used appropriately, BMPs will help to ensure that proposed activities are planned and carried out in compliance with applicable legislation, regulations, and policies and such that activities avoid, minimize and mitigate impacts to polar bears and their habitat. Developing, implementing and sharing BMPs has been identified as one of the strategic approaches that will address resource development, contaminants, tourism, shipping and human-bear interactions. The development of BMPs is also going to be the most effective way to consider work done by the Range States Trade Working Group.

BEST MANAGEMENT PRACTICES

- Identify additional BMPs that need to be developed, determine who is best positioned to develop them and support this action as appropriate.

- Examine the efficacy of BMPs as they relate to polar bear conservation and revise as appropriate.

- Consider and implement, as appropriate, recommendations from the Range States Trade Working Group.

***Mineral and energy resource exploration and development*:**
- Assess the adequacy of existing oil and contaminant spill emergency response plans to protect essential polar bear habitat, and prevent polar bears from being exposed to oil.

- Work with appropriate authorities to develop the necessary emergency response plans.

- Provide guidance to the spill response authorities for the handling of bears that have come into contact with oil.

- Compile, and prepare as necessary, international, national, and local BMPs for mineral and energy exploration and development.

- Use regional land-use planning processes, regional strategic environmental assessments and project environmental assessments to mitigate the effects of mineral and energy development activities on polar bears.

Contaminants and pollution:
- Develop and implement BMPs or action plans to mitigate contamination, or debris, and their effect on polar bears in subpopulations where contaminants are a concern.

Tourism and related activities:
- Establish working relationships with tourism organizations.

- Collect occurrence data, and develop BMPs, with the goal of balancing needs of tourism-related activities and their impact on polar bears.

Shipping:
- Examine shipping routes in essential habitat and adjacent areas, and assess the threat posed

by expected activities over the next 10 years and identify appropriate responses, as required.

Human-bear interactions:

- Reduce the risk of injury and mortality to humans and bears as a result of their interactions by:
  - continuing to support the work of the Range States Conflict Working Group;
  - implementing and making available to all Range States the Polar Bear-Human Information Management System (PBHIMS);
  - developing and implementing appropriate data-sharing agreements among the Range States and making the data available to Range State management authorities;
  - entering all available data on human-bear interactions into the PBHIMS database on an ongoing basis;
  - developing BMPs on tools and techniques for use in preventing and mitigating human-bear conflicts.

Monitoring and Research

All jurisdictions have monitoring and research programs in place, some of which could benefit from enhancement and coordination at the bilateral and circumpolar levels.

MONITORING AND RESEARCH ACTIONS

Climate change research:

- Develop models to better understand the potential effects of climate change within the circumpolar region on polar bear subpopulations.
- Validate models based on empirical data and use them to identify high-priority information needs.
- Monitor and quantify changes in sea ice habitat for polar bears using satellite observations or other associated data.

Obtain information on all polar bear subpopulations:

- Develop subpopulation-specific research plans, which include *a priori* study design considerations, based on clearly stated objectives and applied conservation needs and in light of limited resources for research and variation in the ecological and management status of the 19 polar bear subpopulations.
- Share research plans among jurisdictions to encourage consistency of methods and data.
- Coordinate joint research studies of shared subpopulations and of adjacent subpopulations with significant movement of animals.
- Obtain population size estimates for all 19 subpopulations of polar bears according to the inventory schedule provided in this Plan (see Appendix V).
- Obtain information, where possible, on vital rates for all 19 subpopulations of polar bears. Improve methods to evaluate ecological indicators (e.g., reproduction) as proxies for robust estimates of vital rates.
- Improve methods to quantify and mitigate potential bias in estimates of population status and trend.
- Improve methods to use all available information to address management questions.
- Have the relevant scientific authorities conduct regular population assessments.
- Obtain TEK as per the acquisition schedule (Appendix VI) and consider, in conjunction with scientific data, in management decisions, where appropriate.
- Determine what kinds of TEK are most useful for conservation and management and develop objectives, guidelines, and standards for

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collection and reporting of such information to maximize its utility.

Prey abundance and other food sources:

- Evaluate the relationships between sea ice, prey abundance and distribution, and polar bear vital rates.
- Monitor abundance, availability and types of polar bear prey and analyze data for seasonal and regional characteristics and trends.
- Examine the importance of other food sources to the polar bear diet today and those anticipated over the next 10 years.
- Monitor the distribution and abundance of ringed seal over time and space.
- Monitor polar bear diets and nutritional status over time and space.
- Design studies to reassess areas with existing data for comparative purposes and to assess, at intervals, the effect of climate warming, changes in sea ice, and changes in oceanography that influence the prey species of polar bears.

Contaminants and pollution research:

- Compile the state of knowledge on (both global and local source) contaminants affecting polar bears and prey.
- Examine the impact of contaminants and pollution on polar bear life history characteristics.
- Where appropriate, monitor contaminants and pollution to determine temporal and spatial trends, modes of transmission etc.
- Investigate how contaminants interact in order to establish cause-and-effect relationships and assess the hazards from exposure to multiple contaminants.
- Periodically monitor for the presence of new contaminants/pollutants (i.e., those not previously detected in polar bear samples).

Disease research:

- Compile the current state of knowledge of how parasites and diseases affect polar bears.
- Establish sampling methodologies and common protocols to screen for relevant diseases/parasites, and monitor changes over time

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(recommended sampling period is every 10 years).

- Develop baseline occurrence estimates of identified diseases/parasites in each of the 19 subpopulations.
- Investigate the relationships between disease occurrence and changes to sea ice, feeding ecology, nutritional stress, contaminant exposure, etc.
- Measure the impact of diseases and parasites on polar bears at the individual and population level.
- Establish reference intervals for key biomarkers to monitor individual and population health.

Communications and Outreach

The communications and outreach strategy consists of both general and specific actions. Of the general actions, the development of a website for Range States as it relates to the Agreement and the Plan will be a foundational activity of core importance in facilitating the strategic approaches that are outlined in this Plan.

Specific action to reduce GHG emissions is outside the mandate of the Agreement and requires global action; therefore communications and outreach, coupled with results from monitoring and research, will be the main approach to raise awareness of the threat to polar bears from climate change and to encourage the global community to mitigate climate change.

COMMUNICATIONS AND OUTREACH ACTIONS

Website:

- Establish and maintain a Range States' website to disseminate information and provide links to relevant information sources.

- Produce biennial progress reports for release to the public (starting in 2017).

Targeted Outreach:

- Develop and implement a communications plan for outreach that includes regular information updates about the outcomes of this Plan.

Educational materials:

- Develop targeted educational material on BMPs (e.g., posters, fact sheets, website materials) for the shipping, mining and energy sectors and other industries to minimize their interactions with, and impacts on, polar bears.

- Develop educational material on polar bear biology and status, harvest management regimes, levels and control of international trade under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other topics of interest for use in international forums.

- Use the PBHIMS database to produce safety education materials for use throughout the Arctic in order to minimize and mitigate human-bear interactions.

Communication on climate change:

- Develop and implement a communications strategy on climate change in order to bring global focus to the threat to the Arctic and to polar bears and the need for the global community to reduce GHG emissions.

Performance Measurements

The performance of the Plan will be measured using indicators for each level of the Plan. At the *vision* level, it is agreed that the best way to measure this overarching goal is in relation to the distribution and abundance of polar bears through assessments of polar bear subpopulations.

At the *objectives* level, each objective has been associated with indicators formulated to describe a desired end-state. The measurement of these will determine the degree to which this end-state has been achieved.

1. *Minimize threats to polar bears and their habitat through developing, implementing and sharing adaptive management practices based on coordinated research and monitoring efforts, use of predictive models and interaction with interested or affected parties*

- Jurisdictions have developed and adopted adaptive management practices, and management decisions are re-evaluated as new information becomes available.

- Human activities are planned and undertaken with consideration of potential impact on polar bears and their essential habitat, and appropriate monitoring and mitigation measures are implemented.

- BMPs and guidelines have been developed and shared.

- Methods and plans for coordinated range-wide monitoring and research have been developed and implemented, and information is shared.

2. *Communicate to the public, policy makers, and legislators around the world the importance of mitigating GHG emissions to polar bear conservation*

- The impacts of climate change on polar bears and the Arctic environment have been documented and communicated to relevant stakeholders and decision-makers.

- There is an increased awareness in the general public — both locally and globally — about the impacts of climate change on polar bear due to insights and information provided by the Range States as it relates to their cooperation on polar bear conservation.

3. *Ensure the preservation of essential habitat for polar bears*

- Essential habitat has been defined and identified within different subpopulations throughout the circumpolar range.

- Localized areas of essential habitat to polar bears have been documented and reported to the Range States as they have become known.
- Essential habitat has been protected.

4. *Ensure responsible harvest management systems that will sustain polar bear populations for future generations*

- Harvest management systems take long-term sustainability into account.
- In subpopulations where there is harvest, it is deemed to be sustainable.

5. *Manage human-bear interactions to ensure human safety and to minimize polar bear injury or mortality*

- Relevant information on human-bear interaction is collected and shared between Range States.
- Communities and sites of human activity have developed and implemented polar bear management plans.
- Bear deterrent training protocols have been established.
- Incidents of human-bear interaction which end in injury or death (to bears or humans) has decreased.

6. *Ensure that international legal trade of polar bears is carried out according to conservation principles and that poaching and illegal trade is curtailed.*

- International trade is carried out in compliance with CITES, and the number of violations has decreased.
- The number of incidents of poaching has not increased.

On the level of *outputs of Plan actions*, each action point has been formulated to contain a deliverable it is set out to produce, which is the output of the action.

Performance Measurment Actions

- Regular reporting of the results of the Plan will be done according to Table 4. The reports will be made public.
  - Biennial reviews will be made before each Meeting of the Parties, measuring progress on the action points.
  - A more in-depth, mid-term review will be made after four years, measuring progress on the objectives.
- Baselines values for reporting on indicators at all levels will be presented prior to the biennial Meeting of the Parties in 2017.
- After the full 10-year period, a final report of results will be made, including an evaluation of the Plan, which will determine the need for renewal of the Plan.

Canada

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1. Introduction

The Circumpolar Action Plan for Polar Bears (hereafter, the Plan) is divided into two parts. Part I describes the vision, objectives and guiding principles of the Plan; provides a brief overview of polar bear biology, distribution and subpopulations; outlines the threats facing the polar bear; and provides brief descriptions of existing circumpolar, bilateral and domestic management plans and bi-national cooperation arrangements. The threats identified in Part I represent those most likely to have an impact on polar bears over the next 10 years or those that need to be addressed in the next 10 years in order to avoid a longer-term effect (e.g., on populations where global warming impacts have not yet occurred but are expected to occur). The threats identified in this document are those that the Range States have agreed are best addressed through collaborative efforts at the international level. Throughout Parts I and II are excerpts from the *Agreement on the Conservation of Polar Bears* (hereafter, the Agreement; Appendix I) and the 2013 Declaration of the Responsible Ministers of the Polar Bear Range States from the *International Forum on the Conservation of Polar Bears* (Appendix II), which illustrate the ways the Plan builds on the commitments of the Range States.

Part II details the actions that could be taken to mitigate the threats identified, methods of monitoring implementation of the actions taken, key performance measures to assess the success of the actions taken, and a description of the biennial reports that will be produced to report on progress made. Overall, this Plan is an adaptive "living" document, and is intended to be updated as necessary, with a full review of the Plan to be undertaken by the Range States every 10 years. A list of suggested readings, related to various sections of the Plan, is included at the end of this document.

Rising temperatures and decreased Arctic sea ice threaten the ecosystem of which polar bears are a part. If sea ice continues to be reduced to the extent of mid-century Intergovernmental Panel on Climate Change (IPCC) projections, using unabated emission scenarios, polar bear populations are likely to be negatively affected in a significant portion of their range. To that end, the Range States recognize the urgent need for an effective global response to address the challenges of climate change by mitigating greenhouse gas (GHG) emissions. Ultimately, opportunities for polar bear conservation will be constrained by the magnitude and rate of change in climate and sea ice conditions.

Mitigating GHG emissions will require global action; however, such global action is outside the scope of this Plan. The Range States will seek opportunities to engage with and provide input to other fora and appropriate national and international mechanisms to encourage action to address climate change. However, the Range States believe that ongoing efforts to negotiate strategies to address climate change should be informed by the significant influence that climate change will have on our ability to conserve polar bears for future generations. In a supporting action, the Range States have committed to develop a communications strategy about the impact of climate change of polar bears.

While nations negotiate and implement long-term solutions to Arctic warming, the Range States will strive to conserve the broad geographical distribution (or range) and ecological diversity of polar bears. To that end, actions that the Range States can take to directly improve the conservation status of polar bears in the short-term are outlined in this Plan. The strategic approaches outlined in Part II of the Plan will provide the best opportunity to secure the long-term persistence of polar bears.

This Plan acknowledges that no single country or agency can address an environmental challenge of global proportions, such as climate change, without allying itself with others in partnerships around the world. This Plan commits the Range States to interdependent, collaborative conservation, and is designed to further facilitate cooperative action by the national agencies of the Range States. Coordinated action, as outlined in this Plan, is necessary for the global conservation of polar bears, and will guide the Range States' management and conservation decisions for the species.

To effectively address the effects of climate change and other threats to polar bears, the Range States must plan for conservation on landscape scales and must be prepared to act quickly, sometimes without the scientific certainty they would prefer. They must adopt the precautionary approach, confident that the actions taken can be changed or adapted as new information becomes available.

1.1 PLAN VISION

The vision of this Plan is:

To secure the long-term persistence of polar bears in the wild that represents the genetic, behavioral, life-history and ecological diversity of the species.

Conserving the broad spatial distribution and ecological diversity of polar bears and their habitat across the Arctic over the near- and mid-term, while nations negotiate longer term solutions to Arctic warming, provides the most opportunity for future conservation actions to secure the long-term persistence of polar bears. This goal reflects a broad societal desire to secure the status of polar bears throughout their range.

At the same time, the Range States recognize the importance of the polar bear to Arctic indigenous peoples, including the opportunity for responsibly managed harvests. Indigenous communities have a long tradition of the subsistence use of polar bears, and the preservation of such practices is important to the identity and perseverance of these communities. The engagement of indigenous communities is integral to the success of polar bear conservation.

Local and global communities benefit from many activities in the Arctic, including tourism, recreation, oil and gas development, mining, shipping and scientific research. In some cases, these activities may be compatible with polar bear conservation; in other cases, there may be conflicts. Finding strategies that accommodate both polar bear conservation and human activities will benefit multiple stakeholders and indigenous communities. The Range States are striving to identify such strategies.

1.2 PLAN OBJECTIVES

The Plan objectives express the fundamental intentions and aspirations of the Range States and will be used to guide management, research, and communication efforts. The objectives to achieve the vision of the Plan are to:

Minimize threats to polar bears and their habitat through developing, implementing and sharing adaptive management practices based on coordinated research and monitoring efforts, use of predictive models and interaction with interested or affected parties.

Polar bear conservation and management will require decision-making in the face of significant uncertainty. The predicted impacts from climate change will be wide-ranging and variable over both space (i.e., from one geographic area to another) and time. In the short term (i.e., tens of years), climate change may even have positive effects on some subpopulations of polar bears, for example by increasing access to prey. Because the future is uncertain, the Range States need to take an adaptive management approach, based on coordinated research and monitoring efforts. In doing so, the Range States maintain the ability to change management approaches if necessary while considering a breadth of potential environmental and social changes and impacts on polar bears.

Communicate to the public, policy makers, and legislators around the world the necessity of mitigating GHG emissions to polar bear conservation.

Climate change presents a global challenge which needs to be resolved in the international arena. The Range States have a special responsibility to communicate to global political leaders the significant contribution that mitigating GHG emissions will have for the conservation of polar bears. This requires the strategic dissemination of information about the vulnerability of polar bears to the impacts of climate change, as well as the bears' current and projected status. The Range States' communication strategy should also convey the impact of climate change on the Arctic environment, including on coastal Arctic people.

Ensure the preservation of essential habitat for polar bears.

Given that the extent of summer sea ice is projected to decline through the 21st century, terrestrial habitat is likely to become an increasingly important refuge for polar bears, at least temporarily until the periods of open water become too long for polar bears to survive on land by fasting on their stored fat reserves. The conservation of polar bears will require measures to address the loss of sea ice and will require the preservation of terrestrial habitats that may act as seasonal refugia. While ice habitat is critical to the ability of polar bears to access their prey, protection of denning and summering habitats is, and may become increasingly, important in supporting the long-term persistence of polar bears in the face of climate change. Increased use of land is likely to heighten the risk of human-bear interactions that could lead to conflicts, particularly if anthropogenic activity in the Arctic increases as projected. Moreover, an ex-

panding anthropogenic footprint has the potential to influence the spatial distribution, connectivity, and quality of terrestrial refugia.

Article II of the Agreement commits the Parties to protect ecosystems of which polar bears are a part, especially habitats related to denning and feeding sites, and migration patterns. The International Union for Conservation of Nature (IUCN)/Species Survival Commission (SSC) Polar Bear Specialist Group (PBSG)[1] has defined essential habitat for polar bear as habitat that is of overall importance for the continuation of viable polar bear populations. Such habitat can be divided into five main classes: feeding areas, mating areas, denning areas, migration corridors (providing connectivity between essential habitats) and summer refugia. Protection and preservation of these habitat types throughout the range will help to ensure the persistence of polar bear in the face of a changing Arctic environment.

Ensure responsible harvest management systems that will sustain polar bear subpopulations for future generations.

The objective of "*responsible harvest management*" intended in this Plan is that the opportunity for harvest of polar bears be available for future generations of indigenous peoples[2] living within the range of the polar bear. Achievement of this objective will require the continued long-term, sustainable management of harvest by Arctic indigenous peoples and the Range States.

Manage human-bear interactions to ensure human safety and to minimize polar bear injury or mortality.

As polar bears spend more time on shore as a result of receding sea ice, and as the number of people across the Arctic increases, the likelihood of interactions between humans and polar bears will increase. It is of paramount concern to the Range States to ensure the safety of people living and working in coastal areas that are frequented by bears, while minimizing defense kills of bears that could have been proactively avoided or are not necessary for human safety or the defense of property. Frequent interactions with people poses a threat to polar bears, both directly (i.e., if bears are killed) and indirectly (e.g., through habituation to humans and/or food conditioning).

Ensure that international legal trade of polar bears is carried out according to conservation principles and that poaching and illegal trade are curtailed.

The Range States are committed to strengthening international cooperation to improve the clarity of legal trade data through the adoption of more effective reporting and monitoring practices. The Range States are also committed to adopting procedures to better identify legally traded specimens and to verify the authenticity of trade documents in order to curtail illegal trade. The Range States will explore mechanisms to counter the threat of poaching and illegal trade in polar bears and polar bear parts, including enhanced cooperation among law enforcement agencies at the regional, national and international levels.

1.3 GUIDING PRINCIPLES

The Range States have established the following set of principles to guide their conservation and management actions within their respective legislative and management frameworks:

1. Recognizing the role of each Range State in polar bear conservation and management, actions are to be undertaken at the appropriate level (local, domestic, circumpolar). Existing management frameworks and authorities will be respected.

2. Recognizing that multilateral initiatives require collaboration, the Range States will continue to consult and collaborate with one another with the objective of giving further protection to polar bears.

3. Recognizing the complexity of the circumpolar region, the Range States will ensure that any industrial development is undertaken responsibly, taking into account the need for polar bear management and conservation actions.

4. Management of polar bear populations will be conducted in accordance with sound conservation practices based on the best available scientific data, taking into consideration Traditional Ecological Knowledge (TEK) where appropriate.

[1] The IUCN/SSC PBSG serves as the independent scientific advisory body to the Range States.

[2] *Indigenous peoples* is not a term used in Greenland. Inuit and descendants of Inuit form the majority of the population in Greenland and are an integral part of society. The integration of indigenous and non-indigenous peoples is therefore not as sharply drawn in Greenland as in the other Range States. For the purposes of this Plan, the term *indigenous peoples* will be used to refer to First Nation and Inuit people (and their descendants) living within the range of the polar bear as defined by the established subpopulation boundaries.

5. Recognizing that the long-term conservation of polar bears is best achieved with the engagement of communities traditionally dependent on the polar bear, and acknowledging the importance of polar bears to indigenous peoples, the Range States will ensure that local Arctic people are engaged in domestic and international management decision-making, where appropriate.

6. The precautionary approach will form the basis of the Range States' conservation efforts. As set forth in Principle 15 of the Rio Declaration: Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing measures to prevent environmental degradation.

7. Having up-to-date information on the status and trends of each polar bear subpopulation is essential for effective management and conservation. In order to better inform management and regulatory decision making by the Range States, the IUCN/SSC PBSG will regularly assess and update the status and trends of each polar bear subpopulation based on the best available scientific information, taking into account results of population.monitoring activities and projected changes in sea ice.

8. Recognizing that local and global threats, including climate change, impact bears and their habitat, the Range States will take into account the cumulative impacts anticipated throughout the lifespan of management decisions and strive to reduce those impacts where possible.

9. The conservation of polar bears requires adaptive management in response to the breadth of future environmental and social changes. The Range States will implement adaptive management, based on coordinated research and monitoring efforts, that considers the uncertainty of the timing and scale of those changes, and the associated responses by polar bears.

United States

2. Species Information

2.1 DESCRIPTION AND TAXONOMY

The polar bear, the largest of the bear species, is a circumpolar, ice-dependent apex predator. Male bears can weigh up to 800 kilograms (kg) and reach 2.8 metres (m) in length; females are smaller, usually not exceeding 400 kg in weight and 2.5 m in length. The polar bear's white appearance provides excellent camouflage for hunting in landscapes characterized by ice and snow.

Polar bears feed mainly on ringed seals but also hunt bearded, harp and hooded seals, as well as walrus. They will feed opportunistically on terrestrial food sources and will scavenge on marine mammals, including whales. Most of their life is spent on the sea ice. In areas where sea ice is seasonal, polar bears come ashore to wait until sea ice forms in the fall. Pregnant females in most areas den on land close to shore, although are known to use multi-year pack ice in some regions. Others are known to den in frozen peat and in a few cases, in gravel.

The polar bear has been classified as Vulnerable on the IUCN Red List of Threatened Species since 1982.[3]

2.2 POPULATION AND DISTRIBUTION

Polar bears occur throughout the circumpolar region but are not evenly distributed and do not constitute a single nomadic population. Rather, they occur in 19 relatively discrete subpopulations (geographic areas defined by the IUCN/SSC PBSG with the recently amended Northern Beaufort/Southern Beaufort population boundary; Figure 1). Subpopulation boundaries are defined according to the best available scientific information and TEK related to the movements and genetics of polar bears, as well as management considerations. For several of these subpopulations, the number of bears is unknown. Based on subpopulation estimates, and presumed densities in areas where numbers are unknown, the IUCN/SSC PBSG estimates that there are approximately 20,000–25,000[4] polar bears across the Arctic. The current range covered by these subpopulations represents a total land and marine area of approximately 23 million km^2. The distribution of polar bears is influenced by the type and distribution of sea ice, as well as the distribution and abundance of prey. Typically, bears spend the majority of their time over productive waters associated with the continental shelf. Table 1 provides information on each subpopulation, including name and population size as of 2014, as provided by the IUCN/SSC PBSG.

2.3 POPULATION TRENDS AND STATUS BY SUBPOPULATION

Determinations of population status and trends for all 19 circumpolar subpopulations are made by the IUCN/SSC PBSG on an annual basis.[5] In Canada, the Polar Bear Technical Committee[6] assesses the status of the 13 Canadian subpopulations, also on an annual basis.

2.4 HABITAT NEEDS AND CHARACTERISTICS

Given the large annual home ranges of polar bears, their habitat requirements vary both spatially and temporally. During a workshop of the IUCN/SSC PBSG held in Norway, February 8–10, 2010, the group outlined types of essential habitat for polar bears. Essential habitat was defined as 'habitat of overall importance for the continuation of viable

[3] The IUCN Red List of Threatened Species™ is a comprehensive, objective global approach for evaluating the conservation status of plant and animal species. The Red List guides conservation activities of governments, non-government organizations and scientific institutions.

[4] The PBSG first provided a global population estimate for polar bears in 1993. The range specified at that time, 21,470 to 28,370 polar bears, included statistically solid estimates for many of the identified polar bear subpopulations, and approximations (based on knowledge of habitat quality and input from scientists) for several other subpopulations. Recognizing the false precision implied by a range of 21,470 to 28,370, the estimate was rounded to 22,000 to 27,000 in 1997. After some new population estimates were developed and after more discussion of the possible numbers in areas without estimates, the range was adjusted to 21,000 to 25,000 in 2001, and further simplified to 20,000 to 25,000 in 2005. The variation in ranges reflect the absence of rigorous estimates of subpopulation sizes in several areas and the consensus desire to express a reasonable round number range that should not be interpreted as more reliable as it really is (http://pbsg.nopolar.no/en/news/archive/2014/pb-global-estimates-news.html).

[5] For the latest population figures, see http://pbsg.npolar.no/en/status/status-table.html.

[6] The Polar Bear Technical Committee is composed of scientific and other experts who provide technical advice on the status and trend of Canadian polar bear subpopulations (based on both science and Traditional Ecological Knowledge) to the Polar Bear Administrative Committee, which, in turn, provides a forum for the collaborative management of polar bear populations by relevant jurisdictions in Canada [http://www.ec.gc.ca/nature/default.asp?lang=En&n=F77294A3-1#pb_pop].

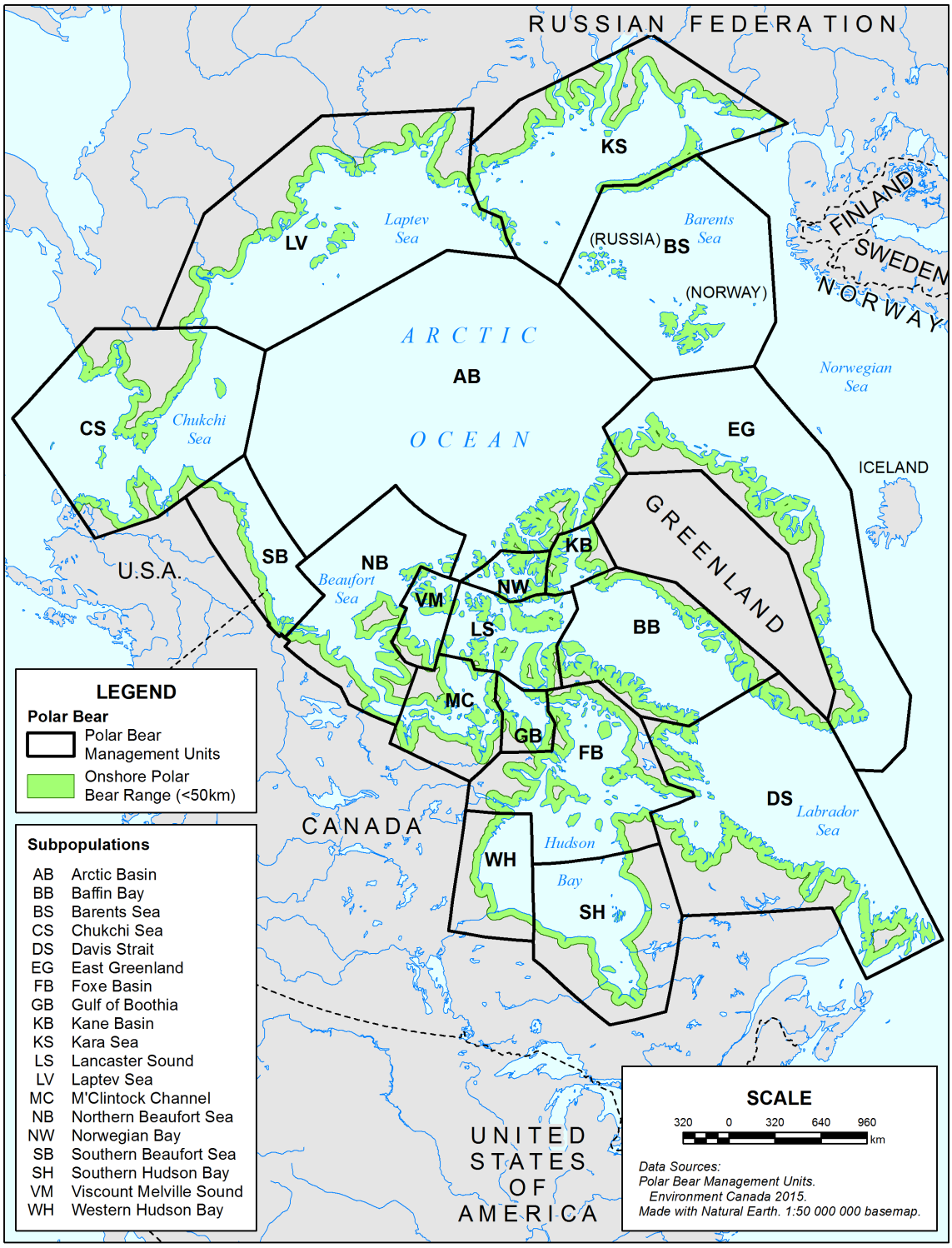

Figure 1: Polar bear subpopulation boundaries, as of July 2015.

Table 1: Information on polar bear subpopulations across the Arctic as reported by the IUCN/SSC PBSG as of 2014. (note: the population estimate of 907 for Southern Beaufort Sea was made in consideration of the previous population boundary between Southern and Northern Beaufort Sea, not the one included in Figure 1).

Subpopulation	Estimate of Population Size*	Year of Estimate	Jurisdiction
Arctic Basin (AB)	Unknown		Circumpolar
Baffin Bay (BB)	1,546	2004	Canada (Nunavut), Greenland
Barents Sea (BS)	2,644	2004	Norway, Russia
Chukchi Sea (CS)	Unknown		Russia, U.S.
Davis Strait (DS)	2,158	2007	Canada (Nunavut, Quebec, Newfoundland and Labrador), Greenland
East Greenland (EG)	Unknown		Greenland
Foxe Basin (FB)	2,580	2009–10	Canada (Nunavut, Quebec)
Gulf of Boothia (GB)	1,592	2000	Canada (Nunavut)
Kane Basin (KB)	164	1994–7	Canada (Nunavut), Greenland
Kara Sea (KS)	Unknown		Russia
Lancaster Sound (LS)	2,541	1995–97	Canada (Nunavut)
Laptev Sea (LV)	Unknown		Russia
M'Clintock Channel (MC)	284	2000	Canada (Nunavut)
Northern Beaufort Sea (NB)	980	2006	Canada (Nunavut, Northwest Territories)
Norwegian Bay (NW)	203	1997	Canada (Nunavut)
Southern Beaufort Sea (SB)	907	2010	Canada (Yukon, Northwest Territories), U.S.
Southern Hudson Bay (SH)	951	2012	Canada (Nunavut, Quebec, Ontario)
Viscount Melville Sound (VM)	161	1992	Canada (Nunavut)
Western Hudson Bay (WH)	1,030	2011	Canada (Manitoba, Nunavut)

*Although numbers are reported as fixed values, they are estimates within an expected range.

polar bear populations'. Using this definition, the PBSG designated four separate classifications of essential habitat: feeding areas (sea ice over continental shelves and predictable terrestrial and coastal feeding sites), mating areas (sea ice over continental shelves), denning areas (terrestrial, multi-year and fast sea ice), migration patterns (areas connecting essential habitats) and summer refugia (both terrestrial and off-shore).

Polar bears frequent the southern edge of the multi-year pack ice of the Arctic Ocean and are commonly found in coastal areas and in the channels between the islands and archipelagos of the Arctic. The type and extent of the sea ice are the main factors that determine the quality of polar bear habitat. The sea ice is where the polar bear's preferred prey, the ringed seal, lives for all or much of the year; hence, the distribution of bears

in most areas follows the seasonal extent of the sea ice. Polar bear habitat varies with the season. In regions where much of the pack ice melts in mid-to-late summer, bears are forced onshore for two to five months, until freeze up. While on shore, bears primarily rely on their fat reserves due to a lack of available prey.

In late-autumn, pregnant females generally excavate maternity dens on land near the coast. Denning habitat is extremely diverse. Dens are dug in snowdrifts or, in areas farther south, in frozen earth or peat. In the Beaufort Sea area, a large proportion of polar bears have traditionally used multi-year ice over, or close to, productive prey denning areas. With a decline in multi-year sea ice in those areas, more bears now den on land. Den locations are very scattered over large areas. In Svalbard (Norwegian Arctic) and the eastern Russian Arctic, some islands with very rough topography allow large snow drifts to form even with low levels of precipitation, and bears may den at very high densities in such restricted areas. Good hunting areas in proximity to denning areas are of importance to female bears when leaving the dens with their cubs. Presence of sea ice is thus important. Likewise, in Svalbard (Norway), some remote islands need sea ice to be present in the autumn to allow bears to reach the denning area.

During the winter, pregnant females remain sheltered in their den, while other bears are active on the pack ice. Polar bears of all sex and age classes may use dens as shelter during very harsh weather or to keep cool during the summer when on land. By altering the extent of the sea ice and the distribution of the seals that reproduce on the sea ice, climate warming will have an impact on the distribution of polar bears.

2.5 REPRODUCTION

The growth potential of polar bear populations is low compared with that of most other mammals. Most males begin to breed at about eight-to-ten years of age. Females reach reproductive maturity from four-to-six years of age and typically have litters of one or two cubs. If cubs survive, they are (in most areas) weaned in the spring around the age of two years. Once cubs have been weaned, the mother will mate again. This high maternal investment means that female polar bears usually reproduce every three years, or less often, depending on cub survival. Young polar bears are susceptible to intraspecific predation. The species' low reproductive potential means that populations cannot recover quickly following a population decline. Few polar bears live longer than 25 years in the wild.

Mating can occur from late January or early February to the end of June but peaks between early March through April. Implantation of the fertilized egg does not occur until October, and is thought to be dependent on the female's nutritional condition at that time. Pregnant females enter maternity dens in autumn, and the cubs are born between November and early January. At birth, cubs weigh less than 1 kg and are covered in very fine hair. They are nursed inside the den until sometime between the end of February and late April, when they venture out on the sea ice with their mother. By this time, the cubs weigh about 10 kg. During the months of denning, pregnant females fast. Some females may not eat for up to eight months while required to meet the energy demands of gestation and lactation.

2.6 MOVEMENT/MIGRATION

The length and frequency of seasonal movements undertaken by bears within subpopulations vary according to the attributes of the geographic area occupied—that is, the availability of features such as land masses, multi-year ice and polynyas—and the annual pattern of freezing and break-up of the sea ice.

Data from satellite telemetry transmitters on female polar bears have shown that they do not wander aimlessly, but that their movements and distribution are determined by the way they use the sea ice habitat as a platform for feeding, mating, denning and, in some subpopulations, summer retreat areas. They tend to move on drifting ice to remain in productive habitats (e.g., over the continental shelf where seals are abundant), which often means moving against the direction of drift of the sea ice to remain in the same general geographic location.

2.7 DIET

Polar bears are the most carnivorous of all the bear species. They metabolize fat more efficiently than protein, and their energy-rich diet enables them to have a larger body size than other bears. Polar bears feed primarily on ringed seals, but will also eat bearded seals, harp seals, hooded and harbour seals, when available. While ringed seals make up a considerable proportion of the polar bear diet in most regions, a recent study that used quantitative fatty acid signature analysis and fatty acid carbon

isotope patterns in East Greenland showed that the proportion of ringed seals in the polar bear diet has declined by 14% per decade over the past three decades, while hooded seal consumption has increased over the same period by 9.5%.

Larger prey species such as walrus, narwhal and beluga are occasionally hunted. Polar bears will readily scavenge on marine mammal carcasses. Polar bears will also eat birds, fish, vegetation and kelp, although the caloric contribution of such foods likely contributes little to their overall sustenance. Bears that remain on land during the summer months rely primarily on their fat reserves and conserve their energy by remaining inactive most of the time.

2.8 DISEASE, PARASITES AND PATHOGENS

Polar bears are long-lived animals and, like other bears species, are not generally impacted by disease. Polar bears primarily feed on fat, which is relatively free of parasites; however, larvae of the *Trichinella* parasite have been confirmed in polar bears throughout their range, and antibodies to the protozoan parasite *Toxoplasma gondii* have been found in polar bears in Alaska (U.S.), Greenland and Svalbard (Norway). It is not yet clear how the presence of these parasites might influence the health of polar bears.

Four morbilliviruses (canine distemper, dolphin morbillivirus, phocine distemper and porpoise morbillivirus) have been documented in polar bears from Alaska and Russia. Polar bears in Svalbard (Norway) have been exposed to morbilliviruses and calicivirus, although the nature of these viruses and infections is unknown. One case of rabies in a single polar bear has been confirmed in Canada.

United States

3. Threats to Polar Bears

The threats outlined in this section are those most likely to have an impact on the polar bear in the next 10 years, or those that need to be addressed in the next 10 years in order to avoid long-term effects. The most significant, long-term threat to polar bears across much of their range is the loss of sea ice habitat due to climate change. Disease, human-bear interactions, oil and gas exploration and development, mining, contaminants and pollution, tourism and shipping are other threats that are predicted to increase in severity over time (Table 2).

Given their broad nature and wide-ranging impacts, the threats facing the polar bear should not be considered mutually exclusive. Rather, effects may be cumulative, and the negative impact of one threat may even exacerbate the negative impact of another. For example, bears may become more susceptible to disease if a longer ice-free period, and resulting lack of access to prey species, causes them to become nutritionally stressed. It is especially important to recognize the impact of cumulative effects in light of the rapid environmental changes currently occurring in some regions of the Arctic.

Table 2: Threat assessment for polar bears across circumpolar region

Threat	Extent	Occurrence of threat	Current level of concern
Climate change and extent and composition of sea ice	Widespread	Current and expected to increase	High
Prey abundance or availability	Concentrated in specific areas	Current and expected to increase	Medium
Loss of denning habitat or access to denning habitat	Concentrated in specific areas	Current and expected to increase	Medium to Low
Disease and parasites	Widespread	Anticipated	Low
Poaching	Concentrated in specific areas	Current	Low
Unsustainable harvest	Concentrated in specific areas	Current and anticipated	Low
Human-bear conflicts	Widespread but concentrated near communities	Current and likely to increase	Medium
Mineral and energy resource extraction and development (oil and gas, mining) and associated infrastructure	Localized	Current and likely to increase	Medium to Low
Oil spills	Widespread	Current and anticipated	Medium to Low
Contaminants and pollution	Widespread but higher in some regions	Current and likely to increase	Medium
Shipping (not related to natural resource development)	Concentrated in specific areas	Current and expected to increase	Low
Tourism	Concentrated in specific areas	Current and expected to increase	Low

3.1 CLIMATE CHANGE AND THE EXTENT AND COMPOSITION OF SEA ICE

ACKNOWLEDGE that addressing climate change is important for the long term conservation of polar bears. RECOGNIZE that there is a need to manage polar bear habitat to reduce the vulnerability of polar bear populations, and take into account the projected long-term changes in Arctic Sea ice conditions and the impact of those changes on polar bears and their prey.

2013 Declaration of Representatives of the Parties

Human-caused climate warming is the most critical long-term threat to polar bears and their habitat. Projected warming over much of their range and the associated reductions in the extent and thickness of multi-year sea ice, as well as the duration and thickness of annual sea ice, will have both direct and indirect effects. Direct effects include loss of habitat (i.e., extent and composition of sea ice). Indirect effects include ecosystem-level changes affecting the availability of prey species such as seals as well as the prey species of seals themselves, separation from terrestrial denning areas and refugia, release and transfer of contaminants, and expansion of human activities that will increase the likelihood of human-bear interactions. Earlier melting of sea ice in the summer and later formation of sea ice in the fall will result in greater reliance by bears on terrestrial coastal areas.

3.1.1 Prey abundance and other food sources

Sea ice is the primary platform from which polar bears hunt their prey. Declining ice and snow cover are the greatest challenges to the persistence of ringed seals. Within the century, snow cover is forecasted to be inadequate for the formation and occupation of birth lairs over most of the ringed seal's range. Pups in lairs with poorly constructed snow roofs are more vulnerable to predation. The thickness of the snow surrounding birth lairs is crucial for thermoregulation and, hence, the survival of nursing pups. In previous cases where lack of snow cover forced birthing to occur in the open, nearly 100% of pups died from predation. Besides lack of snow, warm weather and unseasonal rain before or shortly after birth of ringed seal pups can cause high levels of mortality.

There is no evidence that polar bears (at the population level) will be able to compensate for the reduced availability of ringed seals by increasing their take of other species, since changes in snow and ice conditions may also result in an overall reduction in the abundance of other ice-dependent seal and walrus species. Furthermore, there is no evidence that polar bear populations will be able to adapt to a terrestrial-based diet given their reliance on high fat content prey.

3.1.2 Separation from terrestrial refugia and denning areas

Many female polar bears return to specific denning areas on land year after year. Pack ice must drift close enough or freeze sufficiently early in the fall to allow pregnant females to walk or swim to their preferred denning areas by late October or early November. Without mitigating GHG emissions, overall ice availability will diminish. Perennial ice retreat will be prolonged and distances from land to remaining ice will continue to increase. This will compromise the ability of females to access preferred denning locations safely and in a timely manner. For example, distance to the ice edge is one of the factors thought to limit use of terrestrial denning habitat in subpopulations such as Chukchi Sea (shared between Russia and the United States), the Barents Sea (Norway and Russia) and the Southern Beaufort Sea (Canada and the United States). Some researchers have predicted that under future climate change scenarios, pregnant females will not be able to reach many of the most important denning areas in the Beaufort Sea. As the southern boundary of the pack ice in the polar basin retreats farther from shore to the north of Alaska, Svalbard and Russia, it is predicted that pregnant female polar bears will have reduced access to coastal denning regions, while ice conditions offshore will continue to deteriorate.

Insufficient snow could prevent den construction or result in roofs of polar bear maternity dens that are too thin and could therefore collapse. Changes in the amount and timing of snowfall could also affect the thermal properties of the dens. Once born, polar bear cubs need to nurse for three months before emerging from the den; thus, major changes in the thermal properties of dens could negatively affect cub survival. In addition, unusual rain events are projected to increase throughout the Arctic in winter, and increased rain in late winter and early spring could cause den collapse. For example, after unseasonable rain along the Yukon coast in 1989, a female and two small cubs were crushed and presumably suffocated after the snow became saturated with moisture and the den collapsed.

3.2 DISEASE

Diseases and parasites in polar bears are relatively rare. Given the warming Arctic temperatures, the potential for disease outbreaks, exposure to pathogens (from changed diet), and susceptibility to existing and new pathogens may become a more significant threat as polar bears experience nutritional stress and given the relatively low diversity of genes regulating polar bear immune system function.

A warming climate has been associated with an increase in pathogens in other marine organisms. Parasitic agents that have developmental stages outside the bodies of warm-blooded hosts (e.g., nematodes) will likely benefit from the warmer and wetter weather projected for the Arctic. Improved conditions for such parasites have already had significant impacts on some terrestrial mammals. Bacterial parasites also are likely to benefit from a warmer and wetter Arctic.

As the effects of climate change become more prevalent, there is concern about the expansion of existing pathogens within polar bear range, the potential for pathogens to cross human-animal boundaries (e.g., giardia), and new threats from existing pathogens that may be able to infect immuno-compromised/stressed bears. Because of the previous limited exposure of polar bears to diseases and parasites, researchers have as yet been unable to determine whether they are more susceptible to new pathogens. Many different pathogens and viruses have been found in seal species upon which polar bear prey; the potential therefore exists for transmission of these diseases to polar bears. If polar bears become nutritionally stressed, they may eat more of the internal organs of their prey than they do typically, thus increasing potential exposure to parasites and viruses. Increasing use of terrestrial resources may elevate the risk of exposure to terrestrial-based pathogens. In addition, under projected climate change scenarios, new pathogens may expand their range northward. Use of biomarkers (e.g., measuring hematological and biochemical values) may be effective to track the impact of parasites/diseases in polar bears.

3.3 HUMAN-CAUSED MORTALITY

RECOGNIZE that the polar bear is a significant resource and plays an important role in the social and cultural well-being of Arctic local people and FURTHER RECOGNIZING the subsistence needs of Arctic indigenous people, such that conservation will be best achieved with the engagement of communities traditionally dependent on the polar bear management decision making processes.

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There are multiple types of lethal removals of polar bears by people, including harvest, poaching, human-bear conflicts, and polar bears killed as a result of human activity. As of 2015, the best available information suggests that total human-caused removals do not threaten the persistence of polar bears at the circumpolar level. In the future, however, such removals could become a threat to individual subpopulations. Ensuring total removals remains sustainable requires monitoring the level of human-caused removals, having information on population status, and in some cases, regulation of take levels.

Article III of the Agreement upholds the traditional rights of local people to harvest polar bears. Local indigenous communities throughout the Arctic engage in a polar bear harvest that is consistent with long-standing cultural traditions and they have been integral to the success of polar bear conservation activities to date. At the current time, there is a legal harvest of polar bears by indigenous peoples in Canada, Greenland and the United States (Alaska). Hunting of polar bears was banned in Russia in 1956, however, discussions are underway between the United States and Russia that could result in the implementation of a legal quota for the indigenous peoples of Chukotka (Russia). In Norway, hunting of polar bears was entirely banned in 1973 in conjunction with the signing of the Agreement and after high annual levels of hunting were reported. The fundamental concept of a sustainable harvest is to remove a fraction of the population each year, in a manner that does not drive the population far below the environmental carrying capacity, and limits the risks of negative outcomes such as significant depletion of the population below target levels. In theory, this goal is achieved by harvesting the number of individual bears that would normally be added to the population through birth, thereby maintaining the population at the same size. The fraction of a population that can be harvested while maintaining a balance between all sources of mortality and birth defines

the sustainable harvest level for the subpopulation, assuming there is no immigration from or emigration to other subpopulations. Any level of continued take that exceeds the number of individuals that would naturally be added to the population can be characterized as unsustainable in the sense that it causes the population size to decline.

In practice, the recommended approach for sustainably harvesting many wildlife species is to use a specified harvest rate (i.e., a fraction of current population size) rather than a fixed harvest level (i.e., a fixed and unchanging number of animals). Using a harvest rate has a sound basis in theory and practice. Further, it can be responsive to changing conditions, notably, a changing carrying capacity. If a subpopulation declines due to declining carrying capacity, subsistence harvest can continue, but absolute sustainable harvest levels would decline. For example, at a harvest rate of 4.5%, subpopulation sizes of 800 and 400 would lead to harvest levels of 36 and 18 bears per year, respectively. Harvest at a rate, which is adjusted periodically through an adaptive management system based on biological monitoring, represents a sound foundation for harvest management. In Canada, Greenland and the United States, determination of sustainable harvest levels is made through consideration of the best available science and TEK.

3.3.1 Unsustainable harvest

For polar bears, increased variability and loss of habitat associated with climate change represent emerging challenges to identifying and achieving a balance between reducing the risks of harvest and maintaining opportunities for the use of wildlife resources. In some regions of the Arctic, evidence suggests changes to sea ice are already negatively affecting environmental carrying capacity (the maximum population size that the environment can sustain indefinitely, given available food, habitat, water and other necessities), and possibly the maximum potential growth rate of polar bear subpopulations. On the ground management measures cannot stop population declines resulting from climate change induced habitat loss. Efforts to control and reduce all types of human-caused removals, which include both harvest and animals taken in defence of life and property, may lessen the cumulative risks to population persistence or lengthen the expected time to extirpation due to uncontrolled factors (e.g., sea ice loss). It is important to have additional knowledge surrounding the circumstances in which the harvest of polar bears under climate change is additive (e.g., results in accelerated population declines) or compensatory to other sources of mortality.

The harvest management approach for a subpopulation should be based on clear and specific management objectives. When setting harvest rates, the Range States must ensure that an adaptive management approach is followed (for more on adaptive management, see the **Management** section). In many cases, monitoring should be performed through scientific studies, TEK studies, population viability analysis (where appropriate and feasible), and related tools should be used to evaluate the relative effects of different harvest strategies. This information can then be used by wildlife managers to balance the risk associated with human-caused removals with other considerations such as subsistence practices, human safety, and ecological function. In general, risks to polar bear populations (e.g., of declining below some critical threshold) associated with a particular harvest level or rate will be higher when the quality of population data is low. That is, better data on the status of the subpopulation may allow harvest rates to approach maximum sustainable yield, without additional risk of negative outcomes. When population data are poor, lower harvest rates or levels may be required to achieve the same degree of risk. Managers therefore need to consider advice provided by the IUCN/SSC PBSG (in their capacity as science advisors to the Range States) and/or any national technical groups for information on maximum sustainable yield, the relative risks of different harvest rates, and population viability based on scientific input. In countries where TEK is considered in management decisions, efforts also need to be taken to ensure that it is collected in a systematic, robust fashion, and that it is considered in concert with scientific data. When science and/or TEK indicate a cause for concern about harvest levels, the issue should be addressed expediently through the management framework for that subpopulation.

3.3.2 Illegal Take of Polar Bears

Illegal take/poaching of polar bears occurs whenever harvest is in excess of established quotas, or when it is not permitted by law. In Canada, Greenland and the United States (Alaska) there is a legal harvest of polar bears by Indigenous peoples. Illegal take of polar bear occurs when it is beyond the established quota or outside of the legal harvesting season, when the harvester does not possess a valid tag or permit, or when it involves female bears and their cubs (when such actions are prohibited). In Norway, harvesting is not allowed. In Russia, legal harvesting may be allowed by the Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and

Management of the Alaska-Chukotka Polar Bear for Indigenous peoples of the Chukotka. To date harvesting is not allowed. Some cases of illegal take of polar bears in the Russian Arctic have been documented.

3.3.3 Human-bear interactions

A primary goal of the Range States is to ensure the safe coexistence of polar bears and humans in the face of accelerating climate change. When the Range States met in Tromsø, Norway in March 2009 they recognized the need to address increasing human-bear interactions resulting from expanding human activities in the Arctic and a continued increase in the number of bears on land due to retreating sea ice.

Human-bear interactions and resulting defense-of-life kills are expected to increase under projected climate change scenarios resulting in the greater presence of bears on land and increased human activity in the Arctic. Since the late 1990s, the timing of freeze-up in the fall has occurred later and later, resulting in an increased amount of time polar bears spend on land. Projections indicate that the Arctic Ocean may be largely ice free in the summer within the next few decades; this will increase human-bear interactions as bears are forced on shore and closer to people for extended periods of time.

Polar bears are inquisitive animals and often investigate novel odors or sights, especially when they are hungry. This trait can lead to polar bears being killed or injured when they investigate communities, camps or other areas of human activity. Humans often create dangerous situations through attractants near settlements, camps, and cabins, including garbage, harvested animal remains, meat caches, and dog yards. Such attractants suppress polar bears' natural wariness and the probability for negative interactions increases.

3.4 MINERAL AND ENERGY RESOURCES EXPLORATION AND DEVELOPMENT

RECOGNIZE the need to proactively manage the responsible development of economic activities in the Arctic, including transportation and infrastructure, to minimize the negative impact of those activities on polar bears

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3.4.1 Oil and gas activities

*see Annex I for country-specific oil and gas activity information

Potential effects from mineral and energy resource exploration and development activities could include impacts due to the increased presence of humans on the landscape, such as: (1) increased noise disturbance; (2) physical obstructions to preferred habitat; (3) increased human-bear interactions; (4) effects on prey; and (5) exposure to contaminants (e.g., petroleum and waste products).

Exposure to contaminants in the Arctic, especially oil, is of particular concern for polar bears. The expansion of Arctic energy resource development, such as oil and gas activities, coupled with the rise in shipping as a result of the lengthening of the open water season, increases the potential for oil to be released in the marine environment. Petroleum products can enter the Arctic environment from oil and gas facilities, such as oil rigs or pipelines, or vessel accidents on the open water. Oil spills that occur in the fall when the sea ice is forming, or in the spring/summer during sea ice break-up, present the greatest risks because the oil may concentrate and accumulate in leads and polynyas, both of which are areas of high activity for polar bears and seals. Oil spills that occur in ice-covered waters would present significant clean-up challenges, and could have ecosystem-wide implications.

Polar bears are known to be attracted to petroleum products and may investigate oil spills. If exposed, polar bears will be vulnerable to oil because of their inability to effectively thermoregulate when their fur is oiled. They may also be incapacitated from ingesting oil when they groom themselves or eat contaminated prey.

3.4.2 Mining

Minerals and industrial materials can be extracted from hardrock mines and unconsolidated sedimentary deposits. These deposits may be situated on land, in rivers and lakes, or on the sea floor. As of

2014, most exploration and mining has been inland and outside the range of polar bears. That said, many mining projects in the Arctic construct infrastructure from the mine to the coast and rely on ships to supply fuel and equipment to the mine and transport the ore to market. Infrastructure built within the range of the polar bears has the potential to negatively affect polar bears if not managed appropriately.

Although mining is not widespread in the circumpolar region, there has been considerable dredging activity in select areas such as off the coast of Nome, Alaska (gold), in the Canadian Beaufort Sea (aggregates) and off the Russian coast (tin) in the Laptev Sea. Many mineral deposits in the Arctic remain undeveloped because of lack of infrastructure (e.g., inexpensive and abundant electricity, roads, and ports for bringing in supplies and shipping out the product). Other deposits have yet to be discovered owing to the remoteness of the region, cost of exploration, and challenges associated with developing a deposit in the Arctic.

Once a single mine has been built, the associated infrastructure may then be used to develop other mineral deposits nearby. This development in a concentrated area can lead to cumulative effects on wildlife and their habitat, including habitat destruction and interactions/conflict with humans. While the effects of an individual project may be insignificant, the cumulative effects can become significant. It is therefore important to take into account not only the impact of exploration and mining projects, but also all other associated impacts within the area that constitutes polar bear habitat.

As northern communities grow and additional industrial development occurs, it will become increasingly important to give consideration to the cumulative effects of all types of activities on polar bears and their prey. It is also important to be cognizant that new types of resource development activities may occur (e.g., hydro-electric projects) and that effects of those projects are uncertain. Regional land-use planning processes, regional strategic environmental assessments and project environmental assessments can all be used to mitigate the effects of development activities on polar bears.

3.5 CONTAMINANTS AND POLLUTION

EXPRESS concern that long range transport of pollutants into the Arctic environment is shown to affect polar bears and that impacts on some polar bear populations may be significant; RECOGNIZE the need for comprehensive and coordinated monitoring and research on the effects of contaminant loads in polar bears, and synergistic effects of contaminants and climate change, and underline the need for effective global implementation and compliance with existing global and regional obligations with respect to the challenges posed by pollutants

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Contaminant exposure in polar bears can adversely affect several physiological processes, as well as endocrine, immune and reproductive systems. Being compromised in such a manner may further impede the polar bear's ability to respond to rising temperatures and shrinking sea ice habitat. Pollution may therefore reduce the capacity of polar bears to adapt to environmental stress, such as climate change. For example, contaminants influence the functioning of the thyroid hormone system, which regulates the bears' energy metabolism during fasting and plays a vital role in how bears regulate their body temperature.

The potential effects of contaminant exposure on polar bears have been extensively studied in Svalbard and East Greenland. Findings indicate that contaminant exposure compromises immune function, making polar bears more susceptible to infection and disease. Contaminant exposure may also disrupt hormone balance in polar bears. Lower concentrations of testosterone have been found in highly contaminated males. In females with cubs, a high contaminant load has been associated with high blood concentrations of progesterone. Contaminant-related changes in the amount of circulating steroid hormones may disrupt polar bears' reproductive function. Furthermore, studies from East Greenland have associated reduction in size of sexual organs and bone lesions with high exposure to pollutants.

Environmental pollutants from industrialized parts of the world reach the Arctic via air and ocean currents. As a result, a wide range of persistent organic pollutants (POPs) and heavy metals have been detected in Arctic wildlife. Most POPs are lipid-soluble and resistant to biodegradation. As a consequence, they are readily taken up in Arctic marine food webs, where they accumulate in apex predators.

It is recognized that environmental change, such as a warming climate, may alter contaminant pathways; for example, transport and delivery of contaminants to Arctic ecosystems are likely to be enhanced as contaminants that are currently sequestered in glaciers and permafrost are released.

A large part of a polar bear's diet consists of seal fat. Although levels of contaminants in seals are relatively low, by consuming large amounts of fat, polar bears accumulate high pollution loads. Despite the existence of international agreements and the subsequent decline in the concentrations of some pollutants, the contaminant load of polar bears in some parts of the Arctic is considered high enough to cause negative health effects. Moreover, polar bears are simultaneously exposed to a complex mixture of environmental pollutants that may act in concert, increasing the likelihood of adverse effects.

Generally, polar bears in Norway (Svalbard) and East Greenland have higher contaminant concentrations than polar bears in West Greenland, Canada, and the United States (Alaska). Recent studies examining contaminant loads of polar bears from the Russian Arctic are lacking. However, a monitoring survey carried out between 1987 and 1995 over a large region spanning from the Barents Sea to the Chukchi Sea showed that many of the organochloride pesticides measured occurred in higher concentrations in polar bears in the western Russian Arctic than elsewhere.

Legacy pollutants that have generally declined in polar bear subpopulations in the last few decades including polychlorinated biphenyls (PCBs) and their metabolites as well as chlorinated pesticides, while some brominated and fluorinated compounds and mercury show an increasing trend in several polar bear subpopulations. Relatively high levels of legacy pollutants persist in certain polar bear subpopulations, and a complex mixture including "new" chemicals continue to be a concern with respect to the health of polar bears and their habitat.

Petroleum products or hydrocarbons, marine litter and debris may also pose a threat to polar bears by causing alterations in their feeding conditions and feeding habits. Marine debris is increasingly present in Arctic habitats and originates from two sources: land-based debris including litter from beach-goers, as well as debris washed into the ocean with storm water runoff. Ocean-based debris includes garbage disposed at sea by vessels, as well as fishing debris, such as plastic strapping from bait boxes, discarded fishing lines or nets and derelict fishing gear, which takes its toll on the marine environment by entangling marine life.

An estimated 80% of all marine debris stems from land-based sources. Plastics and polystyrene foam comprise 90% of all marine debris that may cause harm by physical or mechanical impacts through ingestion or entangling and by systemic uptake of harmful substances.

3.6 SHIPPING

Shipping within the Arctic falls into several categories: natural resource development, general (shipment of commercial commodities), ice breaking, fisheries and tourism. This section will be specific to general shipping and ice breaking. For the effects of shipping associated with the oil and gas, mining and tourism industries, see the other subsections in the **Threats** section.

Shipping occurs throughout the circumpolar region but is generally infrequent and largely confined to the ice-free season. Except when loading and unloading, most shipping activities occur in relatively deep water a considerable distance from shore. Any increase in shipping—due to a longer ice-free season—is likely to be modest over the life of this Plan and would be expected to be concentrated in particular regions. However, new routes such as the North West Passage and the Transpolar Sea Route may also open up to commercial shipping traffic during the coming decades.

Potential effects of shipping on polar bears include disturbance, pollution and waste. An increase in ships in areas where polar bears occur may also increase human-bear interactions and the risk of defence kills. Icebreakers can cause disturbances to polar bears and their prey by breaking up the ice habitat. Icebreakers also produce louder and more variable sounds than other vessels and may cause noise disturbance to bears and seals. The activities of icebreaking vessels may also have a negative impact on the breeding habitat of ringed seals and consequently on seal reproduction. Conversely, the open water made by icebreakers may provide hunting opportunities for polar bears looking for seal, narwhal and beluga.

Henrik Hansen, Greenland

3.7 TOURISM

RECOGNIZE that increased incidence of human-polar bear interactions are of concern and will likely continue to increase.

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Tourism in itself is not a direct threat to polar bears; however there are many effects that can occur as a result of increasing human presence in areas where polar bears exist. These include increased traffic in prime polar bear habitat, increased human-bear interactions, increased risk of serious human-bear conflicts, and increased disturbance of denning females and females with cubs of the year. Accidental oil spills from large cruise ships, in particular those using heavy bunker oil, should also be considered a risk.

It is unlikely that properly regulated ecotourism will have a significant negative effect on polar bear subpopulations. However, many tourists and tour operators are uninformed or misinformed about polar bears, polar bear behavior, and the potential threat from polar bears during encounters. Polar bears are curious and investigate novel items in their surroundings such as snowmobiles, cabins and tents. Increasing levels of ecotourism and photography in polar bear habitat will lead to increased human-bear interactions; people without the necessary knowledge about bear behaviour and habits may respond inappropriately during an interaction and unnecessarily kill bears. Ecotourists and photographers may also displace bears from preferred habitats through their presence.

Polar bear viewing occurs as ship-based sightseeing, eco-adventures or land-based travel in polar bear country. Such tourism may not have an immediate effect on polar bears but may have a prolonged impact over time as the number of visitors, guides and conveyances increases. Expedition guides and polar bear guards may intentionally or unintentionally harass polar bears to move them into sight of tourist groups. Conversely, ecotourism may have the positive effect of increasing the worldwide constituency of people with an interest in polar bears and their conservation. It is important to be cognizant that increases in tourism-related activities may alter bear behavior in a variety of ways.

Conserving polar bear populations will require the Range States to monitor and lessen the potential for interactions between polar bears and humans in areas where their paths are likely to cross. Education programs, training, regulations and procedures are useful to avoid conflicts between humans and polar bears. Compared with the other threats, the impacts of tourism and related activities are minor and, with good management, can likely be mitigated. However, ongoing monitoring and reporting is still necessary.

4. Management

4.1 ADAPTIVE MANAGEMENT

Adaptive management is a planned and systematic process for continuously improving environmental management decisions and practices by learning about their outcomes. It is a means of making decisions in cases where knowledge gaps exist about the impacts of particular activities on a situation. Adaptive management provides flexibility to identify and implement new measures or to modify existing ones during the life of a project or activity. Assumptions can be tested and, if unanticipated adverse effects are detected, necessary, corrective actions can be taken.

Adaptive management is essential to planning and decision-making for polar bear conservation and management throughout the circumpolar region, since the impacts of climate change and other stressors on polar bears and their ecosystems will be wide-ranging and their timing and significance, highly uncertain. Adaptive management can also be applied to project environmental assessments and associated regulatory approvals that may affect polar bears.

Monitoring the efficacy of mitigation measures and research are key components of an adaptive management framework. One of the primary purposes of monitoring is to reduce the critical uncertainty that impedes the ability to make informed management decisions. Uncertainty can take on many forms. For example, it could be the lack of knowledge regarding the status and trends of a particular subpopulation or it could be associated with a new type of activity (e.g., year-round shipping) within polar bear habitat. Regardless, it is important to be cautious when making management decisions in the face of uncertainty, conflicting or a lack of information.

4.2 KNOWLEDGE SYSTEMS

4.2.1 Scientific research and monitoring

A strengthened knowledge basis through comprehensive monitoring and research is important to adaptive management of polar bears in times of environmental and habitat change and in consideration of cumulative impacts. Increased knowledge and monitoring will also contribute to continuous evaluation and improvement of conservation efforts at both local and circumpolar levels. Targeted research should supplement monitoring in order to explain and assure the quality of time series data, in line with the need for early warning of negative developments on individual or subpopulation levels, thereby contributing to necessary adaptation of management efforts. Monitoring may also help document the effects of conservation measures taken.

The Circumpolar Monitoring Framework for Polar Bears (Appendix III) gives useful guidance to create monitoring plans to detect ongoing patterns, predict future trends, and identify the most vulnerable polar bear subpopulations. Strategies are recommended for monitoring all key parameters of polar bear persistence, such as subpopulation abundance and trends, reproduction, survival, ecosystem change, human-caused mortality, human-bear conflict, prey availability, health, stature, distribution, behavioral change, and the effects of monitoring itself.

4.2.2 Science foundation and TEK

The negotiations leading to the Agreement and the following cooperation between the Parties to the Agreement were founded on scientific principles and concerns. The IUCN was a crucial partner during these negotiations. The IUCN/SSC PBSG spawned from these negotiations, and the group later oversaw all issues including compliance with the Agreement, especially between 1981 and 2009 when the Parties were largely inactive (in a collaborative sense). Thus, there has been a scientific knowledge foundation for the intergovernmental and international cooperation on management and research on polar bears. This is reflected in Article II of the Agreement, where it is stated that polar bear populations shall be managed "*in accordance with sound conservation practices based on the best available scientific data*".

Arctic communities have an alternative, often complimentary and additive knowledge system. This collective information is commonly referred to as TEK. As polar bears have been an important part of Arctic traditional culture for thousands of years, mainly through livelihood support as a crucial part of their harvest, TEK has become a necessary part of all efforts of polar bear conservation. The Circumpolar Monitoring Framework outlines how TEK may be combined with science to provide complementary lines of evidence with respect to management and conservation.

4.3 INVOLVEMENT OF INDIGENOUS PEOPLES AND INCORPORATION OF TRADITIONAL ECOLOGICAL KNOWLEDGE IN POLAR BEAR CONSERVATION

RECOGNIZE the importance and value of Traditional Ecological Knowledge in informing management decisions and ACKNOWLEDGE the need for the range states to develop a common understanding of what constitutes Traditional Ecological Knowledge and how it should be used in polar bear management decisions.

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This Plan provides for the active participation of indigenous peoples in polar bear conservation. Indigenous peoples are represented by various ethnic groups in the circumpolar region. For many indigenous peoples living in Canada, Greenland, Chukotka (Russia), and Alaska (U.S.) the polar bear is a significant source of food and clothing and also contributes to the social, cultural, and in some instances, economic well-being of the communities. The Range States recognize the subsistence needs of Arctic indigenous peoples and understand that polar bear conservation will be best achieved by engaging such communities in management decision-making processes. In addition, in Canada, the implementation of Land Claims Agreements with some Aboriginal groups over the past 30 years has resulted in co-management arrangements that involve governments and Wildlife Management Boards working together. Similarly in the United States, cooperative agreements may be entered into between the federal government and Alaska Native organizations to conserve polar bears and provide co-management subsistence use by Alaska Natives.

4.3.1 Participation of Indigenous Peoples

The majority of polar bear research and management around the circumpolar Arctic is based upon scientific results. Indeed, the Range States formally recognize the IUCN/SSC PBSG as their scientific advisory body and rely upon this group for scientific information and advice. However, as previously stated, the Range States also recognize that the polar bear is important to Arctic local people and that their engagement in management and conservation is essential.

Indigenous peoples observe polar bears year round: while out on the land engaging in hunting activities, while traveling, and in their home communities. Their historic and current knowledge can contribute to effective polar bear management and provide insight into animal behavior, population and denning distribution and ecology. In addition, the participation of indigenous peoples in scientific research and monitoring activities can be beneficial. The knowledge of experienced indigenous hunters can contribute to the collective body of knowledge of the health, reproductive rates, survival rates and diet of polar bears. TEK acquisition can contribute to scientific hypotheses and aid in the interpretation of scientific research and the establishment of research priorities.

4.3.2 Definition of Traditional Ecological Knowledge

There is no universally accepted or standard definition of TEK. Rather, there are many different yet similar definitions used at the national and international levels and in various conventions. The Range States have recognized the need to develop a common understanding of what constitutes TEK and how it should be used in polar bear management decisions.

Irrespective of the definition adopted by the Range States, it is recognized that TEK may be gathered through the use of questionnaires, surveys, interviews and analytic methods. TEK has provided insights into research and monitoring of climate and sea ice, and significant TEK studies on various aspects of polar bear occurrence, distribution and behavior have recently been finalized in Greenland and Canada. Importantly, these studies provide necessary groundwork and suggested methodologies for how TEK can be best collected, documented and analyzed using a standardized approach.

It should be noted that, generally, information obtained from indigenous peoples led to a better understanding of the polar bear's vital activities, relationship with prey species and humans, and effect on abiotic factors. Indigenous organizations, managers, scientists and TEK holders must work together to determine which aspects of the ecology and behavior of the polar bear may be characterized using TEK and science and the respective contributions that each knowledge source can make.

4.3.3 Collecting Traditional Ecological Knowledge through Interviews

Information gathered through interviews provides the opportunity to incorporate the TEK of indigenous peoples on topics such as local and regional land and ice conditions, bear behavior and changes in the environment. Collection of this knowledge also ensures that TEK is considered and incorporated (where appropriate) into wildlife

research and management decisions. The results of interviews with indigenous peoples who have an in-depth knowledge of local areas and polar bear occurrences at particular times of the year, for example, have aided in the design and planning of biological surveys of polar bear subpopulations.

TEK can stand on its own as a form of information as well as help support data collected by conventional scientific methods. In Canada and Greenland, TEK has been successfully collected and analyzed as an independent source of information on polar bears. Furthermore, because indigenous peoples live in the North, they are best positioned to observe changes to polar bear and their habitat throughout the year.

4.3.4 Involvement of Indigenous Peoples in Biological Surveys

In making their assessments of the sizes and demographic trends of subpopulations, biologists often seek and benefit from local expertise. Studies carried out between 2011 and 2014 on the Baffin Bay and Kane Basin subpopulations are examples in which biologists have worked closely with local hunters. Specifically, the knowledge of the hunters was used to help identify the relevant survey areas (i.e., where bears might be expected to occur during the ice-free season), and hunters participated in portions of the field work. Additionally, the hunters were responsible for establishing fuel caches in remote areas and for removing the fuel drums after the surveys were complete.

For over 35 years, polar bear hunters in several jurisdictions within Canada have been required to provide samples from bears that are harvested. A requirement has been in place in the United States to collect data from harvested bears for over 25 years. Non-mandatory similar programs have existed in Greenland for several decades, and starting in 2011 Greenland began to require mandatory samples from all polar bears harvested. While there is some variation by country, these samples typically include some or all of the following: fat samples, the baculum (to confirm the sex), the skull, a vestigial tooth (for aging the individual) and research markings (ear tags, radio telemetry equipment, etc.). The practice of having hunters submit biological samples illustrates the successful cooperation among wildlife managers, researchers and local hunter communities. The information gathered can be used in conjunction with other biological surveys or can directly inform research (e.g., levels of contaminants as assessed from fat samples).

While the Agreement only speaks to the need for parties to collect *scientific data* to inform management decisions, given the above considerations, and recent commitments made by the Range States, it is important to be cognizant of the role that both TEK and direct local engagement can play in informing management decisions and assisting with, or complementing, research.

4.4 CIRCUMPOLAR COOPERATION

4.4.1 IUCN/SSC Polar Bear Specialist Group

Concern among the circumpolar nations about declining polar bear populations and lack of scientific knowledge to effectively manage them led the United States to organize the First International Scientific Meeting on the Polar Bear in Fairbanks, Alaska, in September 1965. In the absence of reliable data (e.g., population estimates, movement and migratory patterns, range and discreteness, denning areas, harvests), participants agreed that each nation should conduct a research program to obtain adequate scientific information for effective management of the species and then exchange and disseminate the resulting research and management information. This forum was subsequently officially established as the Polar Bear Specialist Group (PBSG), which first met in 1968.[7] The authoritative source of scientific information on the world's polar bears, the PBSG is one of more than 100 International Union for Conservation of Nature (IUCN)/Species Survival Commission (SSC) specialist groups that work to produce and compile scientific knowledge about the world's species and that provide independent scientific advice to decision makers and management authorities.

4.4.2 1973 Agreement on the Conservation of Polar Bears

The need for an international convention or agreement on polar bear conservation was originally recognized and pursued in 1965 by delegates from the United States, Canada, Denmark, Norway, Switzerland and the Soviet Union. Increased hunting of polar bears had led to severe pressure on the species in some regions of the Arctic, and there was a recognized need for improved management of the species. The preparations for an agreement were facilitated by the IUCN, in consultation with the respective governments. The IUCN/SSC PBSG was formed following a request for the

[7] Since that time, the PBSG has met regularly to review research and management progress, coordinate members' research activities, and discuss and prioritize future research and management options.

IUCN to provide information on effective management practices for polar bear.

The Agreement was signed in Oslo on November 15, 1973, and entered into force on May 26, 1976. According to the Agreement, the Range States recognize that the polar bear is a significant resource of the Arctic region that requires protection. By signing the Agreement, the Range States agreed to undertake coordinated action pertaining to the management of polar bears throughout the circumpolar range. Since that time, ongoing collaboration among the Range States has largely eliminated the initial primary threat: overharvesting. Range State collaboration through the Agreement has also facilitated the signature of bilateral cooperative arrangements that are now in place for most shared populations (see **Bilateral Cooperation** section below).

Recognizing the success of the Agreement, the parties celebrated its 40th anniversary by participating in the *International Forum on the Conservation of Polar Bears* in Moscow, Russia in December 2013. At that forum, representatives of the parties of the Agreement reaffirmed their commitment to take collaborative action on conserving the polar bear by signing a Declaration of the Responsible Ministers of the Polar Bear Range States. Highlights of the 2013 Declaration include recognition that the Range States share responsibility for conservation and research actions, that the polar bear is an important global resource and an indicator of biological health in the Arctic, that addressing climate change is going to be essential for the long-term conservation of the species, and that the best available information should be shared and taken into account during decision-making. It also acknowledged the important continued role of the IUCN/SSC PBSG as the scientific advisory body for the Range States.

As stated earlier, one of the objectives of this Plan is to minimize threats to polar bears and their habitat through adaptive polar bear management based on coordinated research and monitoring efforts. These initiatives need to be taken at broad levels—circumpolar, bilateral and domestic —as appropriate, and with the engagement of indigenous peoples.

Over the past 40 years, considerable progress has been made to establish domestic and inter-jurisdictional arrangements for polar bear research and management. Many of these arrangements have been formalized through legally binding and non-binding instruments. As a result of the ongoing concerted effort of all Range States, and with the support of the IUCN, an effective polar bear management regime has emerged.

This section describes existing collaborative management efforts, including brief overviews of national management systems that are in place.

4.5 MANAGING INTER-JURISDICTIONAL POPULATIONS (INCLUDING AREAS OUTSIDE NATIONAL JURISDICTIONS)

Across the circumpolar region, polar bears are managed on a subpopulation basis by federal governments and, in the case of Canada, provincial and territorial governments (i.e., jurisdictions) and Wildlife Management Boards. An examination of the 19 subpopulations reveals that four different situations exist, each of which requires specific management approaches:

1. Subpopulation located entirely within one jurisdiction (Gulf of Boothia, M'Clintock Channel, Lancaster Sound, Norwegian Bay, East Greenland, Kara Sea, Laptev Sea)

2. Subpopulation spanning more than one jurisdiction but located entirely within one country (Western Hudson Bay, Foxe Basin, Southern Hudson Bay, Viscount Melville, Northern Beaufort Sea)

3. Subpopulation shared by more than one country but within the exclusive economic zones[8] of each country (Chukchi Sea, Kane Basin, Baffin Bay, Barents Sea, Southern Beaufort Sea, Davis Strait)

4. Subpopulation shared by more than one country and extending into the adjacent high seas (Arctic Basin).

How the Range States have structured themselves to address each of the above situations is described in the **National Management Systems** and **Bilateral Cooperation** subsections, below. None of the Range States have management regimes in place

[8] An area beyond and adjacent to the territorial sea which shall not extend beyond 200 nautical miles from the baselines from which the breadth.of the territorial sea is measured. In this area, a coastal state has sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters superjacent to the seabed and of the seabed and its subsoil, and jurisdiction with regard to the establishment and use of artificial islands, installations and structures, marine scientific research, and the protection and preservation of the marine environment, among other rights and duties.

for the Arctic Basin subpopulation, although there are other international framework agreements in place that can help protect portions of this subpopulation. The *Convention on Biological Diversity* (CBD) and the *United Nations Convention on the Law of the Sea* (UNCLOS) are two such agreements. Under the CBD, each Party (Canada, Norway and Russia are parties, as is Greenland, through Denmark) is required to take action to protect components of coastal and marine biodiversity within its national jurisdiction. The Convention also requires Parties to cooperate to achieve conservation and sustainable use of biodiversity outside national jurisdiction, in the high seas and on the deep sea bed, as well as on other matters of mutual interest. It states that Parties to the Biodiversity Convention shall carry out their obligation to cooperate through competent international organizations, where appropriate.

The CBD also requires as far as possible and as appropriate, Parties to cooperate in respect of areas beyond national jurisdiction and on other matters of mutual interest for the conservation and sustainable use of biological diversity. CBD also states that Parties to it shall carry out their obligation to cooperate directly or, where appropriate, through competent international organizations.

The UNCLOS sets forth a comprehensive framework governing uses of the ocean, specifying rights of access and also duties to conserve living resources and protect and preserve the marine environment. Measures taken are to include those necessary to protect and preserve rare or fragile ecosystems, as well as the habitat of depleted, threatened or endangered species and other forms of marine life.

Under UNCLOS, coastal States conserve and manage the living marine resources under their jurisdiction are obligated to protect and preserve the marine environment within and beyond areas of national jurisdiction, and have the duty to cooperate in the conservation of living resources beyond areas of national jurisdiction, to share monitoring and assessment information, and to promote international cooperation in marine scientific research for peaceful purposes.

4.6 BILATERAL COOPERATION

Bilateral cooperative arrangements have been established to manage most subpopulations that transcend more than one country but remain within the exclusive economic zones of the Range States. The following is a list of the bilateral agreements that are in place. For details of each agreement, see Annex II.

Inuvialuit-Inupiat Polar Bear Management Agreement in the Southern Beaufort Sea
Subpopulation: Southern Beaufort Sea

Memorandum of Understanding between Environment Canada and the United States Department of the Interior for the Conservation and Management of Shared Polar Bear Populations
Subpopulation: Southern Beaufort Sea

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
Subpopulations: Kane Basin and Baffin Bay (note: while the Davis Strait subpopulation is geographically shared between Canada and Greenland, at the first meeting of the Parties of the Canada-Nunavut-Greenland MOU it was noted that given the scarcity of bears from Davis Strait that are harvested in Greenland, the MOU would concern the Kane Basin and Baffin Bay subpopulations only).

Agreement between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population
Subpopulation: Chukchi Sea

Bilateral Environmental Agreement between the Government of Russia and the Government of Norway, including Provisions on Polar Bear Conservation
Subpopulation: Barents Sea

4.7 NATIONAL MANAGEMENT SYSTEMS

Each Range State has developed and implemented its own domestic legislation for the management of polar bears. For all Range States except Canada, this legislation is national in scope. In Canada, polar bear management is primarily dealt with at the provincial or territorial government level; therefore, different laws apply, depending on the jurisdiction where the subpopulation is situated. This section provides an overview of the status of the domestic conservation strategy of each Range State.

4.7.1 Canada

Canada is home to 13 polar bear subpopulations and approximately two-thirds of the global polar bear population. The subpopulations are located in and adjacent to the provinces and territories across the country's north. Three subpopulations are shared with Greenland and one is shared with the United States. Canada's polar bear management system is grounded on both science and TEK. The latter provides invaluable information from those who live in the polar bear habitat about migration patterns, denning habits and observed changes in the movements/habits of polar bears.

Legislation: In 2011, the polar bear was listed as a Species of Special Concern in the Federal *Species at Risk Act* (SARA), which is designed to protect wildlife in Canada. A Special Concern designation is used for species that may become threatened or endangered as a result of a combination of biological criteria and identified threats and warrants the development of a Management Plan. The polar bear is also listed as being at risk under provincial/territorial legislation in Manitoba, Ontario, Quebec, Newfoundland and Labrador, and the Northwest Territories, and various management plans or recovery strategies are either in place or under development in these jurisdictions.

Habitat protection: Within polar bear range, Canada has five national wildlife areas, three marine protected areas, 10 national parks and 58 provincial and territorial parks (as of December 2014).

Management system: Polar bear management is undertaken collaboratively among the federal, provincial and territorial governments and the Wildlife Management Boards. Wildlife Management Boards were established under the various Land Claims Agreements, and are the primary institutes for wildlife management within the territories. Harvest management systems for polar bears are in place across the Canadian Arctic and are based on the best available science and TEK. Decisions on harvest quotas, in those jurisdictions that have a quota system, are made by the relevant Wildlife Management Boards and are implemented and enforced by the responsible Minister. Ultimate decision-making authority lies with the responsible federal/provincial/territorial Minister. The decision-making process is an open one and considers advice provided by a multitude of stakeholders and interested parties, including governments, technical experts (scientists and indigenous peoples) and non-government organizations. The management systems receive broad and overarching support from the federal/provincial/territorial Polar Bear Administrative Committee, which in turn receives technical advice and support from the Polar Bear Technical Committee. Together, the committees work to provide annual assessments on the status of each of Canada's 13 polar bear subpopulations, draft national action plans and provide advice on matters of national concern about the polar bear.

Harvest and trade: Some Aboriginal (Inuit and Cree) groups have an exclusive right to hunt polar bears in Canada. The Aboriginal subsistence harvest produces economic benefits for Arctic communities, and polar bear hunting remains an important part of the traditional culture found in northern Aboriginal communities. In a region where the cost of living is extremely high and economic prospects are scarce, polar bear hunting is a source of nutritious food and provides an opportunity to generate income. Canada permits a controlled, limited harvest of polar bears for subsistence purposes, including profits gained from the sale and international trade of polar bear products. About 2% of Canada's polar bear population is traded annually, providing a culturally significant way in which northern communities can sustain themselves.

Harvest quotas are established at the subpopulation level through discussions among the relevant jurisdictions and with consideration given to conservation. Canada's management system is complex, since polar bear subpopulations often fall within more than one jurisdiction and quotas must be divided among multiple communities. All bears killed by humans are deducted from the quotas in a given region, whether they are killed in defence of life or property, for subsistence, during Inuit-guided hunts (sport hunts) or illegally harvested. Sport hunts occur in Nunavut and the Northwest Territories where Inuit hunters are allowed to transfer their exclusive rights under their Land Claims Agreements to another hunter. Sport hunts constitute a small proportion (< 10% in recent years) of the total number of harvested bears, require an Inuit guide and must be conducted using traditional methods (sled and dog team) and with a locally designated quota tag. All aspects of a polar bear hunt are held in very high regard by the indigenous peoples. Those parts of the bear not used by the harvesters and their families or sports hunters are distributed among other members of the community or are entered into trade. When tags for harvested bears are obtained from Conservation Officers, samples are submitted to the responsible government allowing for the sex, age and genetic information of the animal to be record and to assist with monitoring research.

National Action Plan: The National Polar Bear Conservation Strategy, completed in August 2011, was developed by the Polar Bear Administrative Committee. The goal of the Strategy is to increase the level of coordination and collaboration among all Canadian jurisdictions (provincial, territorial and federal) for the management of polar bears. By increasing collaboration, the Strategy will provide the framework to accomplish the following objectives:

- promote actions that contribute to the long-term maintenance of polar bear subpopulations, both within Canada and shared with other countries;
- minimize threats to polar bears and their habitat that result from human activities; and
- ensure that best practice standards for polar bear management and research are adopted and respected, including the continued development of non-invasive methodologies and the incorporation of TEK.

The Strategy defines the roles and responsibilities of each management partner, recognizes the key threats that face polar bears in Canada, and includes an inventory schedule for subpopulation monitoring. The Strategy acknowledges that climate change is an overarching driver of several threats. Other key threats include contaminants, mineral and energy resource development activities, marine shipping, unsustainable harvest levels and human-bear conflicts.

4.7.2 Greenland

Domestic management: Greenland has sole jurisdiction over the polar bear population along the East Greenlandic coast. Jurisdiction over the Kane Basin and Baffin Bay subpopulations is shared with Nunavut, Canada. The jurisdiction over Davis Strait is not covered by any Memorandum of Understanding.

Legislation: The *Greenland Home Rule Act No. 12 of October 29, 1999, on Hunting and Game* provides the legal framework for wildlife management and sets the legal boundaries for the protection of wildlife. The Executive Order on the Protection and Hunting of Polar Bear (2006) regulates the harvest of polar bears, limiting the harvest to single adult polar bears, and sets the boundaries of polar bear research. Laws on environmental protection and animal welfare also apply to the management of polar bears.

Habitat protection: Among the protected areas, two sites are located within polar bear habitat: Melville Bay (10,500 km^2) in the northwest and Greenland National Park (972,000 km^2) in the northeast. The protection of these areas safeguards biodiversity while providing access to recreational use in designated areas.

Management system: Responsibility for the management of polar bears resides with the Division of Hunting and Game, within the Ministry of Fisheries, Hunting and Agriculture (APNN). The Division manages both marine and terrestrial species hunted in Greenlandic territory. Licences to harvest polar bears are issued by the municipalities, within annual quotas set by either APNN or the national government.

The Greenland Fisheries Licence Control Authority is tasked with enforcing the regulations set by the government and the municipalities.

The Minister of Fisheries, Hunting and Agriculture sets an annual quota of polar bears for subsistence harvest. The Ministry drafts a preliminary allocation of the quota based on the latest scientific advice and harvest results for the preceding harvest season, and then sends the draft to the Hunters' National Association, the municipalities, the Ministry of Nature and Environment and the Greenland Institute of Natural Resources for consultation for a period of not less than five weeks. Based on the resulting consultation, the Ministry prepares a final proposal for presentation to the Minister.

National Action Plan: The Greenlandic Action Plan for the Management of Polar Bear is due to be published at the same time as this Plan. The objective of the Greenlandic Action Plan is to aid the management authority for polar bears (the Division of Hunting and Game) in ensuring their long-term conservation.

4.7.3 Norway

Domestic management: The jurisdiction of the Barents Sea population of polar bears is shared between Russia and Norway. The Svalbard archipelago, with its 12-nautical mile (22 km) territorial waters and the shallow and seasonally ice-covered Barents Sea, represents the main Norwegian part of the population range.

Legislation: The *Svalbard Environmental Protection Act* (2002) is the main legal framework for polar bear management. The Act aims to maintain a virtually pristine environment in Svalbard, while

providing for environmentally sound settlement, research and commercial operations. An accompanying set of regulations and guidelines relevant to management and conservation of polar bears has been developed.

Habitat protection: The overriding goal of environmental protection in Svalbard is to preserve its unique wilderness. Currently, Nature reserves and National Parks cover 65 % of the land area and 87 % of the territorial waters of Svalbard. Most key terrestrial and coastal habitats for polar are represented within these areas, where regulations provide protection against any significant impact from local human activities. Even in areas that are not protected, human impact on the environment in Svalbard is managed through a comprehensive set of regulations.

Marine management plan: An integrated management plan for the Norwegian part of the Barents Sea was developed between 2002 and 2006 and approved by the Norwegian Parliament in 2006. The management plan covers about 960,000 km² of Norway's northern waters, including the fisheries protection zone around the Svalbard archipelago. The management plan is based on the concept of integrated, ecosystem-based management, and is a tool for both facilitating value creation and maintaining the high environmental value of the area. The Plan was updated in 2011 and will be revised in 2020.

Management system: The Ministry of Climate and Environment, the Environment Agency and the Governor of Svalbard are responsible for the legal management system. The Norwegian Polar Institute is the strategic adviser for the government on polar issues and is the main provider of management-related knowledge.

National Action Plan: The Norwegian Polar Bear Action Plan, published in 2013, has the following overarching goal: *The Barents Sea polar bear population shall be conserved as a viable subpopulation in the longer term, by targeted and knowledge-based management. In Svalbard the polar bear population should develop with minimal impact from local activities*. The Plan will be revised in 2018.

4.7.4 Russia

Legislation: Conservation and management of wildlife and their habitats, including requirements concerning the polar bear and other rare and endangered species, are regulated by a number of environmental and natural resource management laws, decrees of the Russian government, sectoral regulations and other types of law (i.e., civil, criminal and administrative).

The federal law On Fauna regulates relationships in the area of overall conservation and management of wildlife, as well as conservation and restoration of wildlife habitats to ensure biodiversity and sustainability, creating conditions for wildlife to persist over the long term; conservation of genetic diversity; and other forms of wildlife conservation as an integral component of the natural environment.

Legal regulation of the polar bear's protected status is also ensured by the federal laws "On Environment Protection", "On Specially Protected Natural Areas, "On Hunting and Conservation of Game Resources", Forest Code of the Russian Federation, Criminal Code of the Russian Federation, and Federal Decree "On approval of the list of especially valuable wild animals and water biological resources belonging to the species inscribed in the Red Data Book of Russian Federation and/or protected by international agreements of the Russian Federation". Conservation measures for the polar bear are also affirmed in the Order of the Government of the Russian Federation of February 17, 2014, # 212-r "Strategy for Protection of Rare and Endangered Species of Animals, Plants, and Mushrooms for the period up to 2020".

The handling of animals belonging to the species included in the Red Data Book of the Russian Federation (including the polar bear) is regulated by the Russian government's Decree dated February 19, 1996, # 156 "On the Procedure of Issuing Permits (Executive Licenses) for Handling of Wild Animals Belonging to the Species Included in the Red Data Book of the Russian Federation".

Between 2010 and 2014, Russian legislation concerning polar bear conservation was enforced through:

- Amendments to the Federal Law "On Fauna" in terms of the strengthening of state control in the field of protection, recovery and use of wildlife and their habitats.
- Amendments to the Criminal Code of the Russian Federation:
- Penalizing the destruction of critical habitats for animals and plants listed in the Red Data Book of the Russian Federation, including the polar bear;

- Providing greater punishment for illegal extraction, maintenance, purchase, storage, transportation, transfer and trade of the most valuable wildlife and water resources belonging to the species listed in the Red Data Book of the Russian Federation and protected by international agreements, including the polar bear;

- Amendments to the Article 226.1, which criminalize the smuggling of animals and resources listed in the Red Data Book of the Russian Federation;

- A new article 258.1 (2013), provides punishments for illegal actions against high-value wild animals (for these criminal liability of up to seven years in prison is provided).

- The List of the most valuable wildlife and aquatic biological resources related to the species listed in the Red Data Book of the Russian Federation and protected by international agreements (including all big cats) is approved by the Order of the Government of the Russian Federation of October 31, 2013,#978.

- Liability of paying damages or other expenses for illegal hunting on polar bear was significantly increased by a special order of the Ministry of Natural Resources and Environment of the Russian Federation on March 31, 2013.

The three polar bear subpopulations that occur in Russia are included in the Red Data Book of the Russian Federation, with each population assigned a different conservation status:

- Kara-Barents subpopulation—Category 4 (Indeterminate status)

- Laptev subpopulation—Category 3 (Rare)

- Chukotka-Alaska subpopulation—Category 5 (Recovering)

The Red Data Book is updated every 10 years. A new list of wildlife species is developed now (not yet approved), with a higher conservation status for the polar bear: it has been suggested that category 1 (endangered) will be assigned for all such subpopulations (it should be noted that some changes are proposed for the conservation status in the new list taking into account among other criteria a priority of the species protection).

The polar pear is also listed in the Red Data Books of a number of Russian administrative regions, including Republic of Sakha-Yakutia, Arkhangelsk Region, Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, Taymyr (Dolgano-Nenets Autonomous Okrug), and Chukotka Autonomous Okrug.

Conservation and management of two subpopulations of the Polar Bear (Kara-Barents and Chukotka-Alaska) are also conducted under the bilateral agreements: *Bilateral Environmental Agreement between the Government of Russia and the Government of Norway*, including Provisions on Polar Bear Conservation, and *Agreement Between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population*.

In the framework of Russian-Norway Agreement the Ministry of Natural Resources and Environment of the Russian Federation and the Ministry of Climate and Environment of Norway have signed in 2015 a Memorandum on cooperation in the monitoring of Polar Bears in the Barents Sea.

In the framework of Russian-US Agreement a sustainable quota of no more than 58 polar bears per year, 29 of which for each party to Agreement, was established in 2010. Russia does not yet use its part of the quota.

Habitat protection: The key polar bear habitats in the Russian Arctic, including maternity dens and hunting sites, are protected in the following Specially Protected Natural Areas:

State strict nature reserves (zapovedniks):

- Wrangel Island (2,225,650 hectares (ha), including 1,430,000 ha of sea area; Chukotka Autonomous Okrug)

- Great Arctic (4,169,222 ha, including 980,934 ha of sea area; Krasnoyarsk Krai)

- Ust-Lensky (1,433,000 ha; Republic of Sakha-Yakutia)

- Gydansky (878,174 ha; Yamalo-Nenets Autonomous Okrug)

- National parks:

- Russian Arctic (1,426,000 ha, including 793,910 ha of sea area; Archangelsk Region)

- Beringia (1,800,000 ha, including 300,000 ha of sea area; Chukotka Autonomous Okrug)

State federal nature reserves (zakazniks):

- Franz Josef Land (4,200,000 ha, including 2,600,000 ha of sea area; Archangelsk Region)
- Severozemelsky (421,701 ha; Krasnoyarsk Krai)

State regional nature reserves (zakazniks):

- Vaygach (242,778 ha; Nenets Autonomous Okrug)
- Chaunskaya Guba (210,000 ha; Chukotka Autonomous Okrug)
- Yamalsky (1,402,000 ha; Yamalo-Nenets Autonomous Okrug)

Regional natural monument:

- Cape Vankarem (40 ha; Chukotka Autonomous Okrug)

Regional resource reserves in Republic of Sakha—Yakutia:

- Buustaakh (1,464,711 ha)
- Kurdigino Krestovaya (1,067,100 ha)
- Lena Delta (5,932,000 ha)
- Bear Islands (6,000 ha)
- Terpey-Tumus (1,112,000 ha)
- Chaygurino (2,375,600 ha)

It should be noted that projected long-terms effects of climate change on sea ice have not yet been taken into account in planning for Specially Protected Natural Areas for polar bear conservation. Likewise, the impacts of climate change were not taken into account during the projection of important polar bear habitat outlined in the Concept of Development of Federal Specially Protected Natural Areas for the period up to 2020 approved by the Governmental Decree of 22 December, 2011, #2322-r.

Management system: The Ministry of Natural Resources and Environment of the Russian Federation is responsible for the development of state policies on wildlife conservation and recovery, as well as for the wildlife conservation (including Polar Bear conservation) inside the federal Specially Protected Natural Areas.

Some federal powers for wildlife conservation and management (including red listing species) outside the federal Specially Protected Natural Areas has delegated to the regional authorities in the subjects of the Russian Federation.

The Federal Supervisory Service for Natural Resource Management (Rosprirodnadzor) is responsible for overseeing of wildlife protection inside the federal Specially Protected Natural Areas, as well as the execution of powers delegated to the subjects of the Russian Federation.

The handling of polar bears requires a permit issued by the Rosprirodnadzor in accordance with the Administrative Procedure of the Rosprirodnadzor for Issuing Permits (Executive Licenses) for Handling of Wild Animals Belonging to the Species Included in the Red Data Book of the Russian Federation, approved by the Order of the MNR dated January 15, 2008, #4.

National Action Plan: The Action Plan of the Russian Federation up until 2020 on the Implementation of Priority Actions for the Conservation of the Polar Bear is based on the Strategy for Polar Bear Conservation in the Russian Federation, which was approved by the Ministry of Natural Resources and Environment of the Russian Federation, Decree of July 5, 2010, # 26-r. It is based on a careful assessment of the current data for polar bear populations and contains a list of urgent conservation measures in a 10 year period. The Action Plan is an advisory document that reflects the opinions of experts on how to implement the Strategy and focuses on eliminating and decreasing direct and indirect threats for polar bears in Russia.

The other national key policy document provided and supported the special conservation measures for the Polar Bear is the State Program of the Russian Federation "Protection of Environment" for the 2012–2020 period. The Program is coordinated by the Ministry of Natural Resources and Environment of the Russian Federation. The Program's component "Biodiversity of Russia" is focused on sustainable wildlife management and conservation of rare and endangered species, including the Polar Bear. The goal is to protect and restore biodiversity of Russia via (1) strengthening of the legal and regulatory framework and enhancing the scientific and methodological base for biodiversity conservation; (2) enabling improved enforcement and protection of wildlife; (3) conservation of rare and endangered species of flora and fauna and their habitats, and (4) support and expansion of the Specially Protected Natural Areas.

4.7.5 United States

Domestic Management: The U.S. Fish and Wildlife Service (Service) is the Federal agency responsible for managing polar bear populations in the United States. The United States contains portions of two subpopulations of polar bears: the Chukchi Sea, also known as Alaska-Chukotka, and the Southern Beaufort Sea subpopulations. These subpopulations are shared with the Russian Federation and Canada, respectively.

Legislation: In the United States, polar bears are federally protected under the *Marine Mammal Protection Act* (MMPA) of 1972 and the *Endangered Species Act* (ESA) of 1973. The MMPA establishes a general moratorium on the "taking" of polar bears, although certain activities (i.e., scientific research and enhancing the survival of recovery of a species) may be permitted. Additionally, a special exception under the MMPA allows coastal dwelling Alaska Natives to harvest polar bears for subsistence or handicraft purposes so long as the harvest is not wasteful. Alaskan Native handicrafts made from a polar bear may be sold in interstate but not foreign commerce. The Service works cooperatively with the Alaska Nanuuq Commission, the North Slope Borough and the State of Alaska to manage polar bears in Alaska.

On May 15, 2008, the Service announced a final rule listing the polar bear as a threatened species under the federal *Endangered Species Act* (ESA). The listing is based on the best available science, which shows that loss of sea ice threatens and will likely continue to threaten polar bear habitat. This loss of habitat puts polar bears at risk of becoming endangered with extinction in the foreseeable future, defined as 45 years from the time of ESA listing, the standard established by the ESA for designating a threatened species.

Federal management of polar bears in the Chukchi Sea is also conducted under the *Agreement Between the Government of the United States of America and the Government of the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population*. This bilateral agreement applies only to the Alaska-Chukotka polar bear population. In 2010, a sustainable quota of no more than 58 polar bears per year, of which no more than 19 animals may be female, was established for the removal of polar bears from this subpopulation. The Service and the Alaska Nanuuq Commission have agreed to implementation of the harvest quota with phased implementation of enforcement beginning January 1, 2016.

Habitat protection: Both the U.S. MMPA and the ESA have an emphasis on ecosystems. Under the MMPA, the goal is to ensure polar bears are maintained as a significant functioning element in the ecosystems of which they are a part. Further the ESA requires that the Service designate critical habitat, when practicable, for the polar bear. On December 7, 2010, the Service designated approximately 484,734 km^2 (187,157 $miles^2$) as critical habitat for the polar bear in three general categories: sea ice habitat, barrier island resting habitat, and denning habitat. Subsequent litigation vacated the critical habitat designation, and appeals are ongoing.

Additionally, the *Alaska National Interest Lands Conservation Act* (ANILCA) created or expanded National Parks and Refuges in Alaska, including the Arctic National Wildlife Refuge (NWR). The Arctic NWR includes significant polar bear denning and resting habitat areas used by the Southern Beaufort Sea subpopulation of polar bears.

Management system: Conservation activity in the United States is governed by the MMPA and the ESA. An important part of polar bear conservation in Alaska is co-management with Alaska Natives who live in polar bear habitat and harvest polar bears for subsistence purposes. The Alaska Nanuuq Commission is the Service's primary co-management partner and was formed in 1994 to represent Alaska Native subsistence polar bear hunters in Alaska on matters concerning the conservation and sustainable subsistence use of polar bears.

For the Southern Beaufort Sea population, subsistence hunting of polar bears is regulated voluntarily through an agreement between the Inuvialuit of Canada and the Inupiat of Alaska, which calls for management based on sustainable yield. The Service partners with the North Slope Borough on research and harvest management activities which, in turn, further the purposes of the Inupiat/Inuvialuit Agreement of 1988.

Another important component of polar bear conservation is having reliable scientific information upon which to base sound management. In order to better understand the status of polar bears in the U.S., the Service works in partnership with the U.S. Geological Survey and others to better understand polar bear population and status dynamics. The Service has the lead for research on the Chukchi Sea subpopulation and the U.S. Geological Survey has the lead for research on the Southern Beaufort Sea subpopulation.

Harvest: Alaskan Natives may harvest polar bears for subsistence purposes as authorized by the MMPA. The U.S. Fish and Wildlife Service monitors harvest through local taggers in communities hired through the Marking, Tagging, and Reporting Program. Hunters are responsible for tagging the skull and hide of harvested bears within 30 days of harvest.

Harvest management of the Chukchi Sea polar bear subpopulation is addressed by the *Agreement between the United States and the Russian Federation on the Conservation and Management of the Alaska-Chukotka Polar Bear Population*, which entered into force for the United States in 2007. This Agreement allows both the United States and Russia to formally address polar bear harvest issues, including establishment of hunting quotas, with involvement from Native users.

Since 1988, polar bears in the Southern Beaufort Sea have been managed under the *Inupiat-Inuvialuit Agreement* between Alaska North Slope residents and the Inuvialuit Game Council in Canada. This voluntary agreement establishes a harvest quota and calls for management based on sustainable yield. Additionally, this Agreement prohibits hunting using aircraft or large motorized vehicles and calls for the protection of females with cubs and denning bears.

National Action Plan: A Polar Bear Conservation Plan was developed in collaboration with our conservation partners in 1994. This Plan identified key actions that were needed to address threats to polar bears at that time. The 2008 listing of polar bears under the ESA provided a further comprehensive analysis of threats to polar bears. Subsequent to the listing of the polar bear under the ESA, the Service formed a Recovery Team tasked with developing a **Conservation Management Plan for polar bears.** This Team is made up of a diverse group of stakeholders, led by the Service. The Plan will include prioritized research and monitoring actions to address key uncertainties and build upon existing baseline data for the polar bear. It will also identify management actions to address identified threats, including a strong outreach component to build upon existing partnerships with international and domestic agencies, Alaska Native organizations, industries and non-government organizations. A draft was released for public comment in July 2015.

4.8 PROTECTED AREAS AND LAND-USE PLANNING

Each Contracting Party shall take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration patterns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data.

Article II, 1973 Agreement on the Conservation of Polar Bears

National, state, provincial and territorial governments have established a number of protected areas of various types across the circumpolar region. The IUCN defines a protected area as a "clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long term conservation of nature with associated ecosystem services and cultural values." Table 3 lists the types of protection included in the IUCN's system of protected areas.

Table 3: IUCN Protected Areas Categories System

IUCN Category	Type of area
I	a) Strict nature reserve
	b) Wilderness area
II	National park
III	Natural monument or feature
IV	Habitat/species management area
V	Protected landscape/seascape
VI	Protected area with sustainable use of natural resources

Many of these protected areas are situated within the potential range of polar bears. Some areas are closed to industrial activities, while others, although not closed to such activities, have more stringent environmental protection measures imposed than is the norm. As of 2015, the total amount of protected area (land and marine) within the 19 polar bear management units is 1 990 000 km2 or 8.8% based upon analysis of IUCN protected areas categories I to VI (Figure 2). Collectively, these designated areas serve to reduce the potential for adverse effects of industrial activities on polar bears. International conventions and laws also help to protect polar bears and their habitat

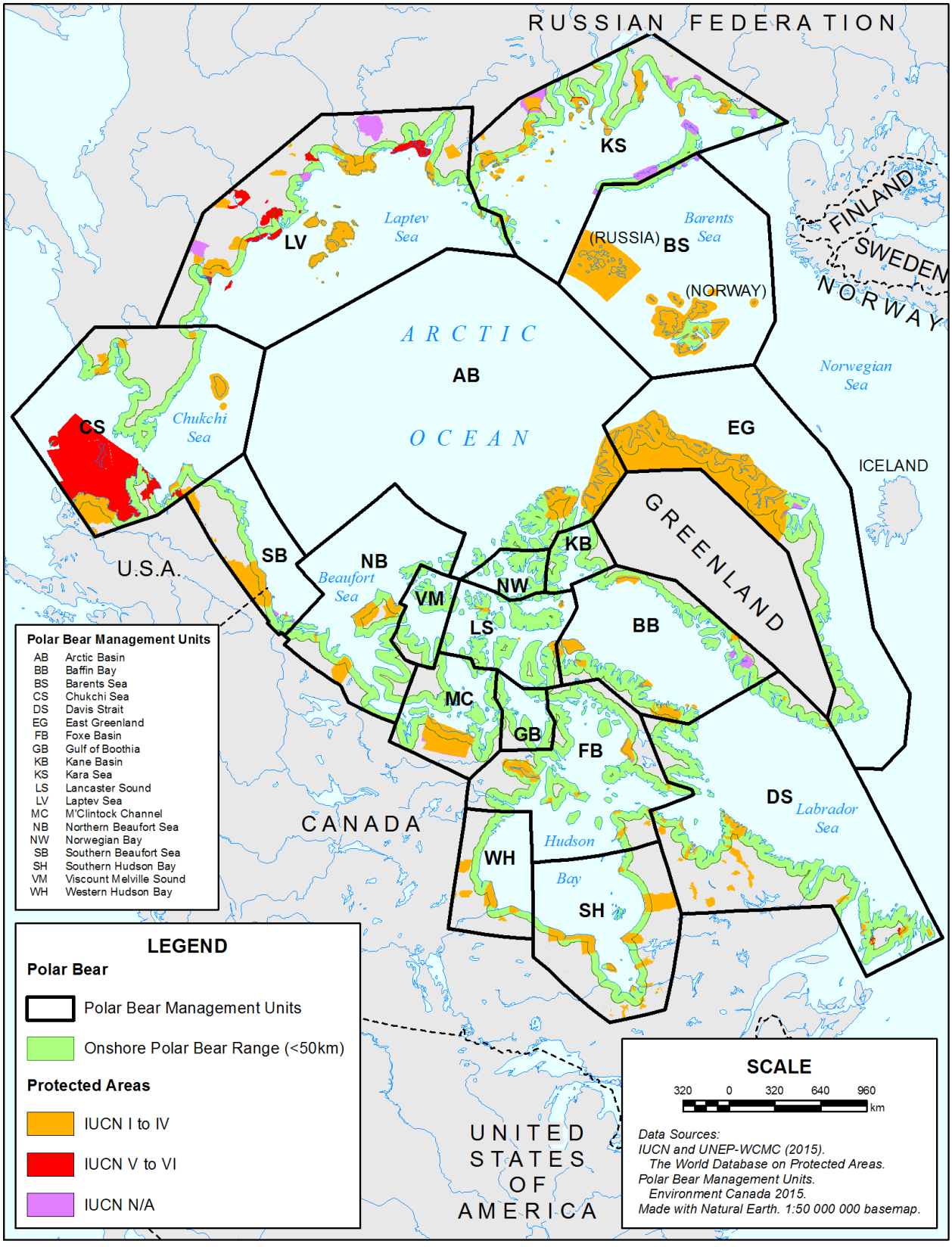

Figure 2: Distribution of protected areas across the circumpolar region that occur in part or in whole within the potential range of polar bear as of July 2015

(for a list of international conventions and laws, see Appendix IV)

Article II of the Agreement instructs the Parties to protect the environment of which the polar bears are a part. The definition and protection of polar bear habitat can pose a challenge given that a large portion of the polar bear's marine habitat—the sea ice—appears and disappears annually, and prey (particularly ice-dependent seals) concentrations can vary in space and time. Onshore, bears tend to return to the same denning areas year after year, in part because of local topography that is favourable to den construction and maintenance. Local disturbances related to human activity can interfere with this pattern. These disturbances can be associated with oil and gas, mining or other human activity during the denning period.

In order to identify areas that are important for polar bears, it is necessary to have an understanding of bear movement patterns over time. This understanding can be acquired from TEK and from the tracking of bear movement patterns. Use of radio satellite tracking collars on female bears has proven very useful for this purpose. Another technique that holds promise is to track the movement of bears using genetic markers either in their scat or hair that is recovered by people on snowmobiles. These non-invasive techniques can provide information on important habitat areas and can also be used to determine appropriate subpopulation boundaries, population estimates and trends over time.

Figure 2 shows the distribution of protected areas across the circumpolar region that occur in part or in whole within the potential range of polar bears. The total amount of land area designated as protected is 787 000 km^2, or 20% of the total land area considered to fall within the onshore range of the polar bears.

The total marine areal extent of the subpopulation across the circumpolar region is estimated at 15 524 000 km^2. Of this total, some 677 000 km2 (4.4%) is protected. The marine area protected equates to approximately two-thirds the size of the protected terrestrial environment.

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5. Introduction to Part II of the Circumpolar Action Plan

This second part of the Plan describes actions that have been designed to meet the key objectives, guided by the principles outlined earlier in the Plan. It introduces the tools and initiatives necessary to address the threats to polar bears at the circumpolar level. Actions to address these threats have been grouped into four main strategic approaches: adaptive management, best management practices, monitoring and research, and communication and outreach. A schedule for implementing the actions is also included. Performance measures for assessing whether the actions have been taken and the objectives met are also described herein.

Each Range State has committed to develop and implement a domestic (national) plan. The actions that are more appropriately taken at the national or bilateral level will complement actions in this circumpolar action plan. Achieving the overarching vision ultimately depends on actions being carried out at the local, regional, national, bilateral and circumpolar levels.

6. Strategic Approaches and Actions to Address Threats

This section contains the actions that the Range States will collaborate on at the circumpolar level in order to achieve the vision and objectives of the Circumpolar Action Plan. Together, the different actions of the Plan form four main strategic approaches. These cross-cutting approaches differ in whether they comprise broader, long-term commitments or targeted, specific efforts, in what kinds of resources or personnel they involve and in the level of polar bear management or conservation they address. These are the four strategic approaches:

- Adaptive management
- Best management practices
- Monitoring and research
- Communication and outreach

The approaches are outlined in separate subsections, where some background, framework and guidelines have been provided. Under each subsection the relevant set of actions and sub-actions to carry out the strategic approaches are listed and described in terms of how they address the threats identified in Part I and how they contribute towards the Plan objectives. The actions are also summarized in Annex III which includes a complete list of bilateral and multilateral actions to be taken over the life of this Plan (10 years). A two-year implementation plan that details actions to be undertaken by the Range States will serve as a companion document to this Plan. The Range States will endeavor to collaborative on, and harmonize, activities and actions that are undertaken.

7. Adaptive Management

UNDERSCORE that the conservation of polar bears requires adaptive management in response to climate change, and that the strategy will be to manage and reduce the other stressors on polar bears and their ecosystems, such as habitat destruction, over harvesting, pollution and other anthropogenic disturbances.

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A key strategic approach to advancing polar bear conservation is use of adaptive management. While it is recommended that an adaptive approach be employed to address threats to polar bears and their habitats, it has been deemed to be particularly essential in addressing the threats associated with climate change and the associated implications for habitat, prey abundance and availability, and disease. Adaptive management requires both up-to-date knowledge (key parameters) and monitoring of the effects of management decisions (e.g., project approvals, harvest levels). If necessary, decisions will be modified or adapted in such a way that the adverse effects are minimized or negated and cumulative effects are considered.

When considered in isolation from each other, actions and activities may not appear to have significant impacts on polar bears; however, when multiple activities are considered together, it will be obvious that their impacts may impair the animal's ability to complete essential life functions and may reduce its fitness. The ability to consider cumulative impacts on polar bears and their habitats will be even more critical as the effects of climate change are realized. Animals stressed by reduced habitat quantity and/or quality are less able to tolerate the impacts from other human activities. As part of the development of the conservation management plan for polar bears, the United States Geological Survey has developed a Bayesian model, which provides a framework for considering the cumulative effects of multiple stressors in time and space.

The IUCN/SSC PBSG has noted that most studies examine the effects of climate change, contaminants, disease, prey variability, industrial development and other stressors independently. The group cites the attempt by Amstrup et al. (2008) to qualitatively consider a wide variety of stressors in addition to a quantitative evaluation of sea ice concentration from climate models, combined with a qualitative assessment of relationships between sea ice and polar bear vital rates, and recommends that updates and improvements be made to this initial effort in order to more quantitatively provide links between multiple stressors.

The development and use of science-based models to predict future population trends, determine management actions and integrate sensitivity analyses into management decisions is an important aspect of adaptive management.

7.1 TAKING CLIMATE CHANGE EFFECTS INTO ACCOUNT IN POLAR BEAR MANAGEMENT

ACKNOWLEDGE the 5th Assessment Report of the intergovernmental Panel on Climate Change (IPCC) and EXPRESS concern that it is very likely that the Arctic sea ice cover will continue to shrink and thin as global mean surface temperature rises, and RECOGNIZE that the long term loss of sea ice depends on future emission trajectories

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As stated in Part I, actions that directly address GHG emissions are outside the scope of this Plan, since they require commitment at the global level. However, it is important to note that the Range States are strongly engaged and playing an active role in negotiations under the United Nations Framework Convention on Climate Change to finalize a post-2020 climate change agreement aimed at limiting global temperature rise to 2°C or less. As such, all Range States have submitted their Intended Nationally Determined Contributions (INDCs), identifying post-2020 targets for greenhouse gas emissions reductions. In addition, the Range States are undertaking complementary actions to address climate change, both domestically and internationally. For example, as members of the Arctic Council, the Range States have approved a Framework for Action on Enhanced Black Carbon and Methane Emission Reductions. This work is important to Arctic ecosystems as short-lived climate pollutants significantly impact the northern environment.

While the Range States will continue to make significant efforts to address climate change, managers tasked with the conservation and management of polar bear populations should consider the impacts of climate change on polar bear populations (and their habitat) and evaluate manage-

ment actions in the context of climate change. The development and application of models that take climate change effects into account in management decisions have the potential to help ensure that individual actions are not evaluated in isolation but that cumulative and synergistic effects are considered. Specific actions to communicate the implications of climate change effects on polar bear populations are included in the communication and outreach approach described below.

ACTION:

- Consider the cumulative effects of climate change and human activities on polar bear subpopulations and habitats when making management decisions using tools such as predictive modeling.

- Investigate how climate change effects vary among subpopulations on both temporal and spatial scales and incorporate this knowledge into management actions.

7.2 DOCUMENT AND PROTECT ESSENTIAL HABITAT

RECOGINIZE that there is a need to manage polar bear habitat to reduce the vulnerability of polar bear populations, and take into account the projected long-term changes in Arctic sea ice conditions and the impact of those changes on polar bears and their prey.

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Habitat that is important for the continuation of viable polar bear populations is often referred to as essential habitat. Essential habitat can include sea ice and coastal areas used for feeding, mating, and denning, summer refugia, and corridors between essential habitats. The viability of these areas for polar bear habitat is influenced by human presence and infrastructure, as well as climate conditions together with meteorological and oceanographic variations. Reduction of sea ice duration and cover has the potential to marginalize the habitat needed by bears and may alter seasonal movement patterns. These effects on habitat can serve to reduce the carrying capacity of the arctic ecosystem for polar bears. These declines are expected to vary from region to region and over time. Adverse changes in essential polar bear habitat, caused by both local and widespread sources of impact, need to be mitigated at the circumpolar, national and community levels.

Two other important types of habitat are denning and summer retreat areas/refugia (on-land areas that are utilized once the seasonal ice disappears). Expected changes highlight the importance of ongoing monitoring and having management systems in place that are designed to adapt to such changes.

ACTIONS:

- Identify essential polar bear habitat and redefine it as changes occur over time.

- Disseminate essential polar bear habitat information broadly to Arctic communities and industries. Work with communities and industries to apply the appropriate habitat protection measures so that anthropogenic development and expansion do not adversely affect habitat.

- Conduct research into application of the concept of carrying capacity of polar bear subpopulations to polar bear management.

7.3 CONSIDER THE IMPACT OF DIET CHANGES

Polar bears are dependent on ice adapted seals, particularly ringed seals and bearded seals. In some subpopulations other prey such as harp seal, hooded seal, walrus, harbor seal and sometimes beluga and narwhal can be important as well as other seal species and carrion. Terrestrial mammals, birds, eggs, seaweed, berries and vegetation may provide small amounts of nutrition to a few individuals but are unlikely to make a significant contribution at the population level.

As a result of climate change, the seasonal distribution of ice will change and the duration of ice-free periods (when marine mammals are largely inaccessible to polar bears) will increase. Monitoring changes in the abundance and availability of prey will enable scientists to attempt to predict the changes in survival, reproduction success and population size of individual subpopulations of bears.

Polar bears are also known to consume eggs and chicks. This behavior has been documented to be increasing in some areas where the negative effects of small numbers of individual polar bears on the birds are becoming significant. Such food sources provide little significant nutrition to polar bears at the population level. Changes in abundance, availability and type of prey can have a critical impact on the survival, reproductive success and size of subpopulations of polar bear.

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Seasonal and regional variations in the polar bear diet mean that environmental change may have different consequences on local or regional levels. The local or regional framework of monitoring, analysis and management decision-making should be adapted to take these differences into consideration.

ACTIONS:

- Identify and monitor changes in the availability and use of prey species and other food sources when making management decisions.

- Develop strategies for responding to the potential for large numbers of nutritionally-stressed bears being close to communities and consider the consequences including those for human safety and transmission of disease between bears.

7.4 CONSIDER THE CURRENT AND FUTURE IMPACTS OF DISEASE AND PARASITES

While the impact of disease and/or parasites on polar bears is not understood across the Arctic, it is considered a possible emerging threat. An increase in the number of pathogens or general exposure is expected to occur as invasive species are introduced and as the warming arctic environment permits higher survival of pathogens. While no definite health problems have yet been identified, the presence and frequency of diseases in polar bears is poorly understood. An increase in the prevalence of certain pathogens over time has been documented and this is expected to continue.

It is possible that health and reproductive effects may occur if rates increase, which calls for the need for increased information and monitoring. Furthermore, given the reliance on polar bear as a food source in some indigenous communities, it is important that impacts on humans and other animals (e.g., sled dogs) who consume the meat also be monitored and documented. Such information should be incorporated into management systems. For example, should there be a disease outbreak that would affect humans who consume polar bear meat, a temporary hunting ban could be put in place, or guidelines for cooking the meat could be distributed.

This section describes the management and conservation issues that need to be addressed. Additional actions related to this issue appear in the subsequent section entitled **Monitoring and Research.**

ACTIONS:

- Ensure that information on the impacts of disease and parasites in bears is considered when making management decisions.

- Communicate disease findings and predicted disease prevalence information, as well as provide guidelines for consumption of polar bear meat by people and sled dogs, as appropriate.

8. Best Management Practices (BMPs)

Sharing, developing and implementing BMPs has been identified as the most appropriate strategy at the circumpolar level to address particular threats to polar bears including those that come from natural resource development, contaminants, tourism, shipping and interactions with humans. Additional threats may be handled by BMPs as they emerge.

In many cases, BMPs or guidelines now exist to address a broad range of more general environmental impacts and may offer ancillary benefits for polar bears and their habitats (e.g., guidelines to minimize the impact of tourism on the Arctic ecosystem). In other cases, where activities have a greater likelihood of overlap with polar bears and their habitats, polar bear-specific-BMPs may have been developed or need to be developed.

What is most important is that they are comprehensive in addressing existing and potential threats, that they are implemented fully, and that they are effective. Ideally, BMPs should be monitored to verify their effectiveness and to provide feedback that can result in supplementing or modifying them based on lessons learned.

The issues included in this section have been identified by the Range States as those most in need of sharing of BMPs. Range states will also identify additional BMPs that need to be developed and determine who is best positioned to develop them. The development of BMPs is expected to be the best way to consider the work of the Range States Trade Working Group. The following list of BMP-related actions is expected to evolve over time.

ACTIONS:

- Identify additional BMPs that need to be developed, determine who is best positioned to develop them and support this action as appropriate.
- Examine the efficacy of BMPs as they relate to polar bear conservation and revise as appropriate.
- Consider and implement, as appropriate, recommendations from the Range States Trade Working Group.

8.1 MINERAL AND ENERGY RESOURCE EXPLORATION AND DEVELOPMENT

Oil, gas and mineral exploration and exploitation are present in the circumpolar region, and there is considerable potential for further development. Lessons learned and technological advances have reduced or eliminated the impacts on polar bears and their habitat in some regions; however, use of these improved practices is not consistent across the Arctic, and damage from development continues in some areas.

The threats that natural resource exploration and development pose to polar bears and their habitat are diverse. These activities can result in destruction and/or fragmentation of habitat (largely as a result of the building of roads, railways and power transmission corridors), introduction of pollutants, the displacement of bears from feeding areas, and disturbance in denning areas. That said, the likelihood and severity of such impacts can be reduced in a variety of ways. The optimal approach is to consider and then modify proposed actions to eliminate or minimize the possible impacts from the outset of the project, beginning at the planning stage and moving through project environmental assessment, regulatory approval, operations, and site de-commissioning/restoration. Strategies to minimize or eliminate impacts could include avoiding specific areas (e.g., denning areas) at particular times of the year, training staff so that they know what to do if they encounter a bear, and adopting specific practices so that field camps do not contain attractants for bears (e.g., garbage).

In implementing BMPs, resource managers should provide feedback on oil exploration plans and compliance documents; ensure that responsible parties (companies) have current information on seasonal bear movements, aggregations and essential habitat areas; and develop standard operating procedures for bear deterrence and for the rescue and handling of oiled bears. In addition, resource managers should communicate with companies and operators to raise their awareness of polar bears during their planning and operational phases. There should also be monitoring and enforcement of permit conditions by the appropriate authorities to ensure both compliance and effectiveness.

ACTIONS:

- Assess the adequacy of existing oil and contaminant spill emergency response plans to protect essential polar bear habitat, and prevent polar bears from being exposed to oil.
- Work with appropriate authorities to develop the necessary emergency response plans.
- Provide guidance to the spill response authorities for the handling of bears that have come into contact with oil.
- Compile, and prepare as necessary, international, national, and local BMPs for mineral and energy exploration and development.
  - Document, evaluate and adopt existing Wildlife Safety Site Plans, Polar Bear Interaction Plans, Problem Bear Site Operations Plans, and Project Employee Response Plans, or develop as necessary.
- Use regional land-use planning processes, regional strategic environmental assessments and project environmental assessments to mitigate the effects of mineral and energy development activities on polar bears.

8.2 CONTAMINANTS AND POLLUTION

The introduction of contaminants into the environment can occur from point and non-point sources. Contaminants can be transported long distances by air, ocean currents and rivers and can become concentrated in polar bears, an apex predator. The long-term effect of contaminants on individual polar bears and subpopulations is not well known. Documentation of effects of contaminants, on both individual bears and bear populations, is a challenging undertaking. Coordination at a circumpolar level will contribute to greater efficiency in research and monitoring and will create a more comprehensive knowledge base for management and conservation actions.

ACTION:

- Develop and implement BMPs or action plans to mitigate contamination, or debris, and their effect on polar bears in subpopulations where contaminants are a concern.

8.3 TOURISM

Tourism can affect polar bears by disturbing their natural behaviors, by causing them to become habituated to human presence or, in rare circumstances, through injury or death as a result of actions taken to protect tourists from bear attacks. While polar bear viewing may offer economic opportunities to tour operators, it must be planned and implemented in a manner that ensures that the benefits outweigh the risks to, and impacts on, polar bears and tourists. Available information and BMPs on the potential for impacts, and mechanisms to avoid or minimize adverse impacts of tourism on polar bears need to be compiled and shared. Two international organizations that are addressing ship-related tourism are the Arctic Council's working group on the Protection of the Arctic Marine Tourism Project (PAME) and the Association of Arctic Expedition Cruise Operators (AECO).

ACTIONS:

- Establish working relationships with tourism organizations.
- Collect occurrence data, and develop BMPs, with the goal of balancing needs of tourism-related activities and their impact on polar bears.

8.4 SHIPPING

Shipping occurs throughout the circumpolar region but is generally infrequent and largely confined to the ice-free season. Except for on-loading and off-loading, most shipping activity is in relatively deep water a considerable distance from shore therefore the impact on polar bears is likely to be low. However, with increasing industrial development, tourism, human population growth, and longer ice-free seasons we may witness an increase in shipping activities. The increase in shipping is likely to be modest over the life of this Plan and will be concentrated in particular regions. Throughout the circumpolar Arctic, there currently is a lack of information and experience with this type of activity in areas frequented by bears and, as a result, the impact on bears is largely unknown.

ACTION:

- Examine shipping routes in essential habitat and adjacent areas, and assess the threat posed by expected activities over the next 10 years, and identify appropriate responses, as required.

8.5 HUMAN-BEAR INTERACTIONS

AFFIRM that the polar bear range states' strategy to develop and implement the Polar Bear-Human Information Management System (PBHIMS) is the appropriate mechanism for international cooperation among the range states regarding documentation of human-bear conflicts, and that the PBHIMS will provide an information basis for the design of programs to reduce occurrences of human-caused polar bear mortality.

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A primary goal of the Range States is to ensure the safe coexistence of polar bears and humans in the face of changing lifestyles and environmental change. Managers can help conserve polar bear populations by reducing lethal take of bears during human-polar bear interactions.

Due to a decrease in the availability and suitability of polar bear essential habitat over time, in combination with increased human presence in such areas, the number of interactions between polar bears and people is expected to increase. Such encounters between polar bears and people can lead, at worst, to loss of life for bears and/or people. It is therefore important to prevent such confrontations and ensure that appropriate mitigation measures are in place.

In order to reduce conflict between polar bears and humans, it is imperative that polar bear managers assemble critical information related to human-bear interactions. However, until recently human-polar bear interactions have been poorly documented throughout much of the Arctic. To address this issue, a Range States Conflict Working Group has been formed and has worked closely to develop the Polar Bear-Human Information Management System (PBHIMS) in order to catalogue interactions in a systematic and consistent manner across the Range States.

The PBHIMS enables a data-based assessment of human-polar bear-human interactions and provides a framework for preventing negative human-polar bear-human interactions in the future. It is intended to provide a user-friendly data entry interface and a method for analyzing collected data. Data stored in the system include polar bear-human conflicts, bear observations, and bear natural history data. Scanned images of the original bear information forms, narratives, reports and photographs can be attached to each incident profile to provide additional information that may not be captured in the system. Data can also be entered into geo-reference programs for subsequent spatial analysis, and can be exported into geo-information systems.

The PBHIMS will provide the necessary information to produce BMPs on tools and techniques for use in preventing and mitigating human-polar bear conflicts, as well as consistent science-based safety education materials for use throughout the Arctic. The database should be used to refine bear management strategies at both the local and circumpolar levels, and to develop improved polar bear safety message and tools.

ACTIONS:

- Reduce the risk of injury and mortality to humans and bears as a result of their interactions by:
  - continuing to support the work of the Range States Conflict Working Group;
  - implementing and making available to all Range States the Polar Bear-Human Information Management System (PBHIMS);
  - developing and implementing appropriate data-sharing agreements among the Range States and making the data available to Range State management authorities;
  - entering all available data on human-bear interactions into the PBHIMS database on an ongoing basis;
  - developing BMPs on tools and techniques for use in preventing and mitigating human-bear conflicts.

9. Monitoring and Research

The Contracting Parties shall conduct national research programmes on polar bears, particularly research relating to the conservation and management of the species. They shall as appropriate co-ordinate such research with research carried out by other Parties, consult with other Parties on the management of migrating polar bear populations, and exchange information on research and management programmes, research results and data on bears taken.

Article VIII, 1973 Agreement on the Conservation of Polar Bears

All jurisdictions have ongoing research and monitoring programs, some of which could benefit from an enhanced circumpolar coordinated management approach. In 2012, the IUCN/SCC PBSG framework defined monitoring as '*investigations that repeat the same observations, or data collections, in order to determine the direction of long-term responses to environmental conditions; whether the response of polar bears to key processes proceeds as projected; and whether management actions undertaken (as a result of/or guided by research) for polar bear conservation have achieved the intended goal or objective*'. The IUCN/SSC PBSG also defined research as '*investigations that further the understanding of how polar bears interact with their environment and the key mechanisms that affect individual and population ecology and trends. Information from research is used to inform management decisions and actions*'.

9.1 CLIMATE CHANGE RESEARCH

Climate change has been identified as the primary threat to polar bears and their habitats. There is confidence that sea ice will decrease and that this will impact polar bear populations in a negative way throughout the circumpolar region. There is less certainty of how loss or thinning of sea ice will impact specific polar bear subpopulations in the timespan of the Circumpolar Action Plan. The IUCN/SSC PBSG has identified the need for the development and implementation of a plan that harmonizes local, regional and global efforts in order to detect and understand how climate warming and other stressors may differentially affect populations and habitats. The IUCN/SSC PBSG also notes that remotely collected environmental data (e.g., data that are collected through the analysis of satellite imagery or aerial photographs) lend themselves well to monitoring polar bear habitat and ecosystem change on both a circumpolar and a regional level.

ACTION:

- Develop models to better understand the potential effects of climate change within the circumpolar region on polar bear subpopulations.
- Validate models based on empirical data and use them to identify high-priority information needs.
- Monitor and quantify changes in sea ice habitat for polar bears using satellite observations or other associated data.

9.2 OBTAIN INFORMATION ON ALL POLAR BEAR SUBPOPULATIONS

RECOGNIZE that having up-to-date information on the status and trend of each polar bear subpopulation is essential for effective management and conservation of the species.

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There is a need to have up-to-date information about the population status and trend of each of the 19 circumpolar polar bear subpopulations in order to make informed management decisions. Two population inventory schedules for the period 2015 to 2025 have been created based on input provided by the management authorities in each Range State. The first outlines when Range States anticipate conducting scientific population assessments (see Appendix V) while the second is a TEK acquisition schedule (see Appendix VI). If carried out according to the schedules then we will have up-to-date information on the status and trend of each subpopulation, and ensure that that TEK is available for use in management decisions, where appropriate.

Various scientific methods can be employed to determine population size of polar bear subpopulations, and their use may depend on a variety of factors, including the level of precision in abundance estimates necessary to inform management decisions, topography of a given subpopulation, size of the survey region, logistics, potential population densities, required sample sizes for robust calculations, behavior of bears, availability of funding,

and overall support by the northern communities. Currently used methods of surveying polar bears include physical mark-recapture, aerial surveys and biopsy darting (i.e., genetic mark-recapture). Reasons for using particular methods in the various subpopulations may be related to topography of the region, cost, concerns over the handling of animals by Inuit etc. Methods may change over time as priority information needs and available survey methods change.

Two long-term mark-recapture studies are currently taking place in two subpopulations (Southern Beaufort Sea and Western Hudson Bay) in an ongoing, low-intensity effort by the Canadian and American governments. Information from these long-term data sets is used to generate population estimates, as well as to examine other factors, such as trends in body condition and reproductive parameters over time. As new population estimates are obtained, they will be assessed by the IUCN/SSC PBSG and national technical groups as appropriate.

ACTIONS:

- Develop subpopulation-specific research plans, which include *a priori* study design considerations, based on clearly stated objectives and applied conservation needs and in light of limited resources for research and variation in the ecological and management status of the 19 polar bear subpopulations.
- Share research plans among jurisdictions to encourage consistency of methods and data.
- Coordinate joint research studies of shared subpopulations and of adjacent subpopulations with significant movement of animals.
- Obtain population size estimates for all 19 subpopulations of polar bears according to the inventory schedule provided in this Plan (see Appendix V).
- Obtain information, where possible, on vital rates for all 19 subpopulations of polar bears. Improve methods to evaluate ecological indicators (e.g., reproduction) as proxies for robust estimates of vital rates.
- Improve methods to quantify and mitigate potential bias in estimates of population status and trend.
- Improve methods to use all available information to address management questions.
- Have the relevant scientific authorities conduct regular population assessments.
- Obtain TEK as per the acquisition schedule (Appendix VI) and consider, in conjunction with scientific data, in management decisions, where appropriate.
- Determine what kinds of TEK are most useful for conservation and management and develop objectives, guidelines, and standards for collection and reporting of such information to maximize its utility.

9.3 PREY ABUNDANCE AND OTHER FOOD SOURCES

Monitoring should focus on the distribution and abundance of prey, their reproductive productivity and their importance to polar bears. To date, a number of quantitative surveys, particularly for ringed seals—the primary prey for polar bear - have been conducted. Replicating some of these surveys may provide broad but coarse scale comparisons of ringed seal distribution and abundance over large geographic areas.

For example, ringed seals were included in the Arctic Biodiversity Assessment carried out by the Arctic Council's Conservation of Arctic Flora and Fauna (CAFF) working group, and are one of the target species of the CAFF Circumpolar Biodiversity Monitoring Program ecosystem-based Arctic Marine Biodiversity Monitoring Plan. A Ringed Seal Monitoring Network was established in 2012 with funding from CAFF. Regular assessments of the harp seal stocks are made by the International Council for the Exploration of the Sea/Northwest Atlantic Fisheries Organization Working Group on Harp and Hooded Seals and the North Atlantic Marine Commission (NAMCO).

In areas where ringed seals are harvested, harvest sampling can provide direct and dynamic information on condition and reproduction. Recording changes in composition of harvested polar bear prey species and the systematic collection of tissues from harvested animals, may provide estimates of changes in abundance, distribution and availability of these species that can be compared and contrasted with samples collected during research projects and/or standardized surveys.

An indirect way to study polar bear diets is to analyze samples of fat collected from research-captured or harvested polar bears. These analyses will identify the proportion of various prey species that

have been consumed. If conducted at appropriate temporal intervals, this technique can be used as a proxy to monitor changes in prey accessibility over time.

ACTIONS:

- Evaluate the relationships between sea ice, prey abundance and distribution, and polar bear vital rates.
- Monitor abundance, availability and types of polar bear prey and analyze data for seasonal and regional characteristics and trends.
- Examine the importance of other food sources to the polar bear diet today and those anticipated over the next 10 years.
- Monitor the distribution and abundance of ringed seal over time and space.
- Monitor polar bear diets and nutritional status over time and space.
- Design studies to reassess areas with existing data for comparative purposes and to assess, at intervals, the effect of climate warming, changes in sea ice, and changes in oceanography that influence the prey species of polar bears.

9.4 CONTAMINANTS AND POLLUTION RESEARCH

Research on contaminants and pollution that affect polar bears needs to encompass a wide set of direct and indirect sources and pathways of potential impact. Documentation of effects of contaminants, on both individuals and populations, is a challenging undertaking. Given the trans-boundary nature of contaminants, and their wide-ranging effects, coordination at the circumpolar level is required.

ACTIONS:

- Compile the state of knowledge on (both global and local source) contaminants affecting polar bears and prey.
- Examine the impact of contaminants and pollution on polar bear life history characteristics.
- Where appropriate, monitor contaminants and pollution to determine temporal and spatial trends, modes of transmission, etc.
- Investigate how contaminants interact in order to establish cause-and-effect relationships and assess the hazards from exposure to multiple contaminants.
- Periodically monitor for the presence of new contaminants/pollutants (i.e., those not previously detected in polar bear samples).

9.5 DISEASE RESEARCH

To date, little research has been carried out on the presence and impact of disease on polar bears, and no definitive health problems have been identified. However, antibodies to some viruses have been documented, and it is expected that both the exposure to, and diversity of, pathogens will increase over time. Documenting the presence of key pathogens now will establish a baseline against which future assessments can be compared. This is a challenging task at the circumpolar level, but the screening of certain pathogens can be facilitated by the collection of samples from hunter returns and research handling of bears. The main efforts, to be carried out over the next ten years, consist of the following actions:

ACTIONS:

- Compile the current state of knowledge of how parasites and diseases affect polar bears.
- Establish sampling methodologies and common protocols to screen for relevant diseases/parasites, and monitor changes over time (recommended sampling period is every 10 years).
- Develop baseline occurrence estimates of identified diseases/parasites in each of the 19 subpopulations.
- Investigate the relationships between disease occurrence and changes to sea ice, feeding ecology, nutritional stress, contaminant exposure, etc.
- Measure the impact of diseases/parasites on polar bears at the individual and population level.
- Establish reference intervals for key biomarkers to monitor individual and population health.

10. Communications and Outreach

The communications and outreach strategy of the Plan consists of both general and specific actions. Of the general actions, the development of a website for the Range States as it relates to the Agreement and the Plan will be a foundational activity of core importance in the facilitation of all four strategic approaches.

Long-term polar bear conservation depends on mitigating the rise in atmospheric GHG concentrations. The administrative and policy actions necessary to accomplish such mitigation are beyond the purview of the Agreement, although the Range States acknowledge that climate change is the most significant, long-term threat to the species and that global action is required. The monitoring and research described in this plan, along with the threat identification procedures, will inform efforts to raise awareness, at the policy level, of the link between climate change issues and polar bear conservation and to influence the global community to address climate change.

10.1 WEBSITE

A website is a necessary tool for communication and outreach for this Plan. The website will function as a platform for sharing ideas, providing updates, receiving feedback, disseminating information, and coordinating outreach. The website will target many different audiences, including the Range States (different official sectors/ levels), polar bear managers in each country, and tourism, shipping, resource and other industries and companies that have the potential to affect polar bears and their habitats, inter-governmental organizations, non-government organizations, indigenous communities, academics, hunters, hunting organizations, other stakeholders and the interested public. The website will be designed to serve these multiple purposes and audiences.

The website will function as a standalone site for the Range States, independent of other organizations and entities. The responsibility for management and costs will be shared by the Range States. The website will strive to have its core material available in the official languages of each Range State.

United States

Website content will include:

- Information and documents such as:
  - The Circumpolar Action Plan for Polar Bear
  - Biennial progress reports, as presented at the biennial Meetings of the Parties
- Links to the IUCN/SSC PBSG, and relevant agreements, documents, organizations and partners
  - 1973 *Agreement on the Conservation of Polar Bears*
  - National polar bear conservation strategies and action plans
  - Best Management Practices
  - Monitoring results
  - Maps
  - Reports
  - Educational materials and fact sheets
- Information on the biennial Range States Meetings of the Parties.

ACTION:

- Establish and maintain a Range States' website to disseminate information and provide links to relevant information sources.
- Produce biennial progress reports for release to the public (starting in 2017).

10.2 TARGETED OUTREACH

Issues and activities related to polar bears are often addressed by other international/non-governmental organizations and in other forums. Connections need to be made with these organizations to ensure that they are well informed, and the Range States remain willing to engage in collaborations on relevant issues, as required. The nature of the connection may include providing them with access to accurate and timely information on the health of polar bears, the threats facing the species, and actions being taken to minimize or mitigate these threats. It is also essential to provide information on the importance of polar bears to indigenous peoples and how polar bears are managed by each of the Range States. Furthermore, these connections should be explored to find potential areas of synergy or cooperation, and whether these organizations have resources or activities that can be beneficial to polar bear conservation or aid the Range States in carrying out the action points of the Plan. The development and implementation of a communications strategy can contribute to an effective and efficient outreach program.

The Range States will engage with organizations that deal with polar bear management and threats to polar bears, including but not limited to:

- United Nations Framework Convention on Climate Change.
- The Arctic Council working groups and other bodies.
- Conventions addressing biodiversity issues, such as the Convention on Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), World Heritage, and Convention on the Conservation of Migratory Species of Wild Animals (CMS).
- International Union for the Conservation of Nature (IUCN).
- Inter-jurisdictional organizations involved in setting regulations and BMPs related to shipping, including the International Maritime Organization (IMO), the Association of Arctic Expedition Cruise Operators (AECO).
- The Stockholm Convention on Persistent Organic Pollutants, and other conventions and international agreements that address potential concerns regarding the impacts of contaminants on polar bears.
- Non-governmental organizations and academics, where appropriate.

ACTION:

- Develop and implement a communications plan for outreach that includes regular information updates about the outcomes of this Plan.

10. 3 EDUCATIONAL MATERIALS

In order for outreach efforts to be effective, it is necessary to develop and share information related

to polar bears, their habitat, threats facing the species and ways in which they can be mitigated. Making this information readily available and accessible to people who reside within the range of the polar bear and the general public will greatly facilitate outreach efforts and will ease the integration of polar bear conservation and management into other international forum discussions.

ACTIONS:

- Develop targeted educational material on BMPs (e.g., posters, fact sheets, website materials) for the shipping, mining and energy sectors and other industries to minimize their interactions with, and impacts on, polar bears.
- Develop educational material on polar bear biology and status, harvest management regimes, levels and control of international trade under the CITES and other topics of interest for use in international forums.
- Use the PBHIMS database to produce safety education materials for use throughout the Arctic in order to minimize and mitigate human-bear interactions.

10.3.1 Communication on climate change

Communications and outreach about the impacts of climate change, coupled with communication of results from monitoring and research, will be the main approach to raise awareness about the link between the changing Arctic environment and polar bear conservation and to influence the global community to address GHG emissions. It is important to support awareness of climate change and to advocate for strong decisions within the United Nations Framework Convention on Climate Convention (UNFCCC) and other relevant forums through scientific and strategic intervention with supporting documentation and communications material. The impact that climate change has and will have on the Arctic ecosystem is a powerful communications asset in itself, which may be used effectively on a global scale to prompt actions to mitigate climate change.

The strategy should communicate the impact of climate change on the Arctic ecosystem and on indigenous peoples who derive cultural, nutritional and economic benefit from polar bears. A decrease in sea ice also means that polar bears spend more time on shore. This fact, coupled with increasing human activity in the Arctic, will likely lead to an increase in human-polar bear interactions. The communications strategy should also recognize that Arctic indigenous communities have co-existed with the polar bear for millennia and are key partners in polar bear conservation. In addition, the communications strategy should address the need for adaptive management approaches.

ACTION:

- Develop and implement a communications strategy on climate change in order to bring global focus to the threat to the Arctic and to polar bears and the need for the global community to mitigate/reduce GHG emissions.

11. Performance Measurement

11.1 GOAL HIERARCHY

As stated in Part I the vision of the Circumpolar Action Plan is:

To secure the long-term persistence of polar bears in the wild that represents the genetic, behavioral, life-history and ecological diversity of the species.

In order to contribute towards this vision, six objectives of the Plan have been identified and are described in Part I.

These objectives will be achieved through focusing the cooperation of the Range States into four separate strategic approaches to guide management and conservation, which all consist of a range of cooperative actions that will be carried out. These actions have been listed and described in the preceding sections of Part II.

11.2 MEASUREMENT OF RESULTS

The performance of the Plan will be measured on all levels of its goal hierarchy, using different indicators and with different frequency. At the vision level, an indicator is needed that takes its broad and long-term nature into account. On the concrete and short-term level of the actions, measurement needs to be specific and targeted.

The key to measuring results is to use appropriate indicators that allow for change to be tracked and confirmed over time. That change should be attributable to actions taken or results achieved on a lower level of the goal hierarchy. Importantly, change in an indicator will only be measureable if a baseline value exists. The establishment of baseline values will be an important task in the early phase of the plan, in order to be able to document results.

All in all, the goal hierarchy forms a system of planned results and impacts linked together and building on each other to help realize the vision of the plan. Therefore the measurement system will mirror this structure. The measurement of the different levels of the goal hierarchy are shown in Table 4.

On the *vision* level, it is agreed that the best stand-alone way to measure this broad and overarching goal relating to the distribution and abundance of polar bears at both the jurisdictional and circumpolar levels, is through circumpolar assessment of the polar bear population. The success in attaining the vision will therefore be measured by building on the global assessment of polar bear subpopulations based on all available information by the IUCN/SSC PBSG. Measurement on the vision level will be relevant at the end of the timespan of the plan, and will form part of the final report, which in addition to documenting relevant results will also contain an evaluation of the Plan as a whole.

On the *objective* level, each of the objectives is listed below with associated indicators. The indicators have been formulated to describe a desired end state. The measurement of these will need to determine the degree to which this end state has been achieved. The performance on the objectives will be reported on after the first four years of the Plan, in a mid-term review. At the time of the first biennial review, there will be a preliminary review

Table 4: Summary table of how and when the performance on the different levels of the goal hierarchy of the Plan will be measured.

Goal level/object of measurement	Measurement tools/ indicators	Context where measurement takes place	Frequency of measurement (years)
Plan vision	IUCN/SSC PBSG assessment of polar bear populations	Final report and evaluation	after 10
Plan objectives	List of indicators answering to each objective (see below)	Mid-term review and final report	after 4 and 10
Outputs of plan actions	Deliverables are formulated in each action point (see action table)	Biennial review	2-4-6-8-10

of the performance measures on the objective level to establish baseline values and reconfirm relevance of the indicators.

On the level of *outputs of plan actions*, each action point has been formulated to contain a deliverable it is set out to produce, which is the output of the action. In some cases, baseline values are already described in the text of the action plan, either in the text describing the strategic approaches and actions in Part II or in some cases in Part I. In the first biennial review, a list of all relevant baseline values for the outputs of plan actions will be presented.

11.3 MEASURING RESULTS ON THE LEVEL OF OBJECTIVES—LIST OF INDICATORS

1. Minimize threats to polar bears and their habitat through developing, implementing and sharing adaptive management practices based on coordinated research and monitoring efforts, use of predictive models and interaction with interested or affected parties

- Jurisdictions have developed and adopted adaptive management practices, and management decisions are re-evaluated as new information becomes available.

- Human activities are planned and undertaken with consideration of potential impact on polar bears and their essential habitat, and appropriate monitoring and mitigation measures are imposed.

- Best Management Practices and guidelines have been developed and shared.

- Methods and plans for coordinated range-wide monitoring and research have been developed and implemented, and information is shared.

As this first objective is broad and cross-cutting, the measurement of it will also be aided by the more specific indicators of the other objectives below. The indicators listed above will be addressed and measured respectively through a report on management practices and in an assessment of the follow-up and results of the monitoring and research initiatives of the Plan.

2. Communicate to the public, policy makers, and legislators around the world the importance of mitigating GHG emissions to polar bear conservation

- The impacts of climate change on polar bears and the Arctic environment have been documented and communicated to relevant stakeholders and decision-makers.

- There is an increased awareness in the general public—both locally and globally—about the impacts of climate chance on polar bear due to insights and information provided by the Range States as it relates to their cooperation on polar bear conservation.

The measurement of this indicator will be carried out through regular reporting on communication activities undertaken to provide publically accessible up-to-date information about Range State initiatives, polar bear population assessments and information that may help to support the cause to reduce GHG emissions. This should include an update on climate change research and an assessment of the implementation of the climate communication strategy and climate outreach initiatives in the plan.

3. Ensure the preservation of essential habitat for polar bears

- Essential habitat has been defined and identified within different subpopulations throughout the circumpolar range.

- Localized preclusions of essential habitat to polar bears have been documented and reported to the Range States as they have become known.

- Essential habitat has been protected.

The indicators on essential habitat will be measured by regular reporting on habitat, including developments in research on and identification of essential habitat throughout the range and status and development in habitat protection.

4. Ensure responsible harvest management systems that will sustain polar bear populations for future generations

- Harvest management systems take long-term sustainability into account, based on science and TEK.

- In subpopulations where harvest occurs, it is deemed to be sustainable.

The measurement of this will be accomplished through regular reporting on harvest management systems, including updates on new or previously shared BMPs, updates on any changes made to

regulations or management of subsistence or sport hunting and actions taken to incorporate indigenous communities who are traditionally dependent on the polar bear for subsistence and economic purposes.

5. Manage human-bear interactions to ensure human safety and to minimize polar bear injury or mortality

- Relevant information on human-bear interaction is collected and shared
- Communities and sites of human activity have developed and implemented polar bear management plans
- Bear deterrent training protocols have been established
- Percentage of incidents of human-bear interaction which end in injury or death has decreased

These indicators will be measured through regular reporting on issues related to managing human polar-bear interactions, including a review of the frequency of human-bear incidents and updates on the PBHIMS database.

6. Ensure that international legal trade of polar bears is carried out according to conservation principles and that poaching and illegal trade are curtailed.

- International trade is carried out in compliance with CITES, and the number of violations has decreased
- The number of incidents of poaching has not increased

The measurement of this will take place through a review of the legal trade of polar bear, as well as any legislation or measures being taken to decrease or eliminate poaching and illegal trade. This should include an update on how states are working to minimize illegal trade and any relevant BMPs.

11.4 PERFORMANCE MEASUREMENT ACTIONS:

- Regular reporting of the results of the Plan will be done according to Table 4. The reports will be made public.
  - Biennial reviews will be made before each Meeting of the Parties, measuring progress on the action points.
  - A more in-depth, mid-term review will be made after four years, measuring progress on the objectives.
- Baseline values for reporting on indicators on all levels will be presented prior to the biennial meeting in 2017.
- After the full 10-year period, a final report of results will be made, including an evaluation of the Plan, which will determine the need for renewal of the Plan.

12. Structure for the Biennial Report

The following is a suggested structure for the biennial report of the Plan to be prepared before meetings of the Range States. Each country will provide a national progress report which includes updates on the items below. These reports will be provided to the host country prior to the meeting. The host country will then consolidate the reports and present the information.

- report on research, monitoring, and any management practices that have been adopted through an adaptive management approach to support the conservation or protection of polar bears and their habitat, including:
  - an update on all Actions listed in this action plan.
  - the sharing of BMPs for mineral and energy development, tourism, shipping, contaminants and human-bear interactions (BMP should be based on findings from analysis of PBHIMS data).
  - a description of actions taken to incorporate northern communities/indigenous peoples in polar bear management. This should include actions informed by both science and TEK.

United States

13. Implementation framework

The Plan has a timeframe of 10 years, and the comprehensive list of actions and commitments contained within it (Annex III) should be read with this in mind. Over a period of 10 years, the Range States will endeavor to collaborate on, and to harmonize, their national activities to contribute to carrying out the identified actions. However, it will be difficult to allocate resources and responsibilities and to plan activities in detail for the full 10 year period. Therefore, the list of actions in the Plan will serve as a strategic framework, under which the Range States will draft a series of implementation plans, each with a two-year time horizon. The implementation plans will contain prioritized actions, which will be carried out or initiated over the following two-year period. These actions will be assessed in terms of costs and resources and commitments needed, will include the division of responsibilities, and contain more detailed descriptions of the content and purpose of the actions. The shorter duration of these implementation plans will make it easier for the Range States to carry out collaborative actions that align with national activities, priorities and strategies. The implementation plans will be updated and agreed upon biennially at the Meetings of the Parties to the Agreement. These biennial plans will serve as the implementation schedule of the Plan, and will allow the Range States to ensure progress, flexibility and efficiency in their circumpolar cooperation.

14. Suggested Reading

14.1 BACKGROUND AND GENERAL INFORMATION

Agreement on the Conservation of Polar Bears. (1973). Oslo, Norway. http://pbsg.npolar.no/en/agreements/agreement1973.html

Amstrup, S.C., Durner, G.M., Stirling, I., Lunn, N.J., and F. Messier. 2000. Movements and distribution of polar bears in the Beaufort Sea. *Canadian Journal of Zoology* 78:948–966.

Amstrup, S.C., Marcot, B.G., and D.C. Douglas. 2008. A Bayesian network modeling approach to forecasting the 21st century worldwide status of polar bears. In E.T. DeWeaver, C.M. Bitz, & L-B. Tremblay (Eds), *Arctic sea ice decline: Observations, projections, mechanisms, and implications* (pp. 213-268). Geophysical Monograph 180. Washington, DC: American Geophysical Union.

Best, R.C. 1985. Digestibility of ringed seals by the polar bear. *Canadian Journal of Zoology* 63(5):1033-1036.

Bunnell, F.L., and D.E.N. Tait. 1985. Mortality rates in North American bears. *Arctic* 38(4):316–323.

Burek, K.A., Gulland, F.M.D., and T.M. O'Hara. 2008. Effects of climate change on Arctic marine mammal health. *Ecological Applications* 18:S126–S134.

Derocher, A., and W. Lynch 2012. *Polar bears: A complete guide to their biology and behavior.* Baltimore, MD: The John Hopkins University Press.

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

Durner, G.M., Douglas, D.C., Nielson, R.M., Amstrup, S.C., McDonald, T.L., Stirling, I., Mauritzen, M., Born, E.W., Wiig, Ø., DeWeaver, E., Serreze, M.C., Belikov, S.E., Holland, M.M., Maslanik, J., Aars, J., Bailey, D.A. and A.E. Derocher. 2009. Predicting 21st century polar bear habitat distribution from global climate models. *Ecological Monographs* 79(1):25–58.

Forbes, L.B. 2000. The occurrence and ecology of Trichinella in marine mammals. *Veterinary Parasitology* 93:321–334.

Garner, G.W., Evermann, J.F., Saliki, J.T., Follmann, E.H., and A.J. McKeirnan. 2008. Morbilivirus ecology in polar bears (*Ursus maritimus*). *Polar Biology* 23(7):474–478.

Intergovernmental Panel on Climate Change. 2007. *Climate change 2007. Synthesis report.* Contribution of working groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. (Core Writing Team, Pachauri, R.K., and Reisinger, A. [Eds.]). Geneva, Switzerland: IPCC. http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

Intergovernmental Panel on Climate Change. 2013. *Climate change 2013. The physical science basis.* Working group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, U.K.: Cambridge University Press. http://www.ipcc.ch/report/ar5/wg1/

International Meeting Under the Polar Bear Agreement. 2009. Meeting of the parties to the 1973 *Agreement on the Conservation of Polar Bears*. Tromsø, Norway, 17-19 March 2009. http://www.polarbearmeeting.org/content.ap?thisId=500038172

IUCN/SSC Polar Bear Specialist Group official website. http://pbsg.npolar.no/en/index.html

The IUCN Red List of Threatened Species. http://www.iucnredlist.org

Kutz, S.J., Hoberg, E.P., Polley, L., and E.L. Jenkins. 2005. Global warming is changing the dynamics of Arctic host-parasite systems. *Proceedings of the Royal Society of London. Series B, Biological Sciences* 272(1581): 2571–2576.

Larsen, T.S., and I. Stirling. 2009. *The agreement on the conservation of polar bears—its history and future.* Report No. 127. Tromsø, Norway: Norsk Polar Institute.

Miller, S., Proffitt, K., and S. Schliebe. 2004. *Demography and behavior of polar bears feeding on marine mammal carcasses. OCS study, MMS 2004*. Anchorage, Alaska: U.S. Department of the Interior.

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

Peacock, E., Derocher, A.E., Thiemann, G.W., and I. Stirling. 2011. Conservation and management of Canada's polar bears (Ursus maritimus) in a changing Arctic. *Canadian Journal of Zoology* 89(5): 371–385.

Schliebe, S., Rode, K.D., Gleason, J.S., Wilder, J., Proffitt, K., Evans, T.J., and S. Miller. 2008. Effects of sea ice extent and food availability on spatial and temporal distribution of polar bears during the fall open-water period in the Southern Beaufort Sea. *Polar Biology* 31:999–1010.

Schweinsburg, R.E., Lee, L.J., and P.B. Latour. 1982. Distribution, movement and abundance of polar bears in Lancaster Sound, Northwest Territories. *Arctic* 35(1):159–169.

Stirling, I. 1974. Midsummer observations on the behavior of wild polar bears (*Ursus maritimus*). *Canadian Journal of Zoology* 52(9):1191–1198.

Stirling, I. 2011. *Polar Bears*: *The Natural History of a Threatened Species*. Fitzhenry and Whiteside. Markham, ON. 334 pp.

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

Taylor, M., Elkin, B., Maier, N., and M. Bradley. 1991. Observation of a polar bear with rabies. *Journal of Wildlife Diseases* 27:337–339.

Thiemann, G.W., Iverson, S.J., and I. Stirling, I. 2008. Polar bear diets and arctic marine food webs: Insights from fatty acid analysis. *Ecological Monographs* 78: 591–613.

Sermitsiaq. 2011. Isbjorn beslaglagt. Politiet i Sisimiut har beslaglagt en ulovligt fanget isbjorn af to mand. Sermitsiaq News. http://sermitsiaq.ag/node/78930

14.2 THREATS TO POLAR BEARS

Amstrup, S.C. 1993. Human disturbances of denning polar bears in Alaska. *Arctic* 46(3):246–250.

Amstrup, S.C., and C. Gardner. 1994. Polar bear maternity denning in the Beaufort Sea. *Journal of Wildlife Management* 58:1–10.

Amstrup, S.C, DeWeaver, E.T., Douglas, D.C., Marcot, B.G., Durner, G.M., Bitz, C.M., and D.A. Bailey. 2010. Greenhouse gas mitigation can reduce sea ice loss and increase polar bear persistence. *Nature* 468:955–958.

Amstrup, S.C., Marcot, B.G., and D.C. Douglas. 2008. A Bayesian network modeling approach to forecasting the 21st century worldwide status of polar bears. In E.T. DeWeaver, C.M. Bitz, & L-B. Tremblay (Eds), *Arctic sea ice decline: Observations, projections, mechanisms, and implications* (pp. 213-268). Geophysical Monograph 180. Washington, DC: American Geophysical Union.

Amstrup, S.C., Durner, G.M., McDonald, T.L., Mulcahy, D.M., and G.W. Garner. 2001. Comparing movement patterns of satellite-tagged male and female polar bears. *Canadian Journal of Zoology* 79:2147–2158.

Arctic Climate Impact Assessment. 2005. *Arctic Climate Impact Assessment.* Cambridge, U.K.: Cambridge University Press.

Aubail, A., Dietz, R., Rigét, F., Sonne, C., Wiig, Ø., and F. Caurant. 2012. Temporal trend of mercury in polar bears (Ursus maritimus) from Svalbard using teeth as a biomonitoring tissue. *Journal of Environmental Monitoring* 14(1):56–63.

Belikov, S.E. 1995. Status of Polar Bear Populations in the Russian Arctic 1993. In: Wiig, Ø., Born, E.W., and Garner, G.W. (Eds), Polar Bears: Proceedings of the 11th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, 25-27 January, 1993, Copenhagen, Denmark. IUCN, Gland, Switzerland. Pp. 115-119.

Belikov, S.E., Boltunov, A.N., Ovsyanikov, N.G., Belchanskiy, G.I., and A.A. Kochnev. 2006. Polar bear management and research in Russia 2001-2004. In: Obbard, M.R., Thiemann, G.W., Peacock, E. and DeBruyn, T.D. (Eds), Polar Bears: Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, 29 June -3 July, 2009, Copenhagen, Denmark. IUCN, Gland, Switzerland. Pp. 165-169.

14. Suggested Reading

Belikov, S.E., Boltunov, A.N., Ovsyanikov, N.G., Mordvintsev, I.N., and V.V. Nikiforov. 2010. Polar bear management and research in Russia, 2005-2009. In: Aars, J., Lunn, N.J. and Derocher, A.E. (Eds), Polar Bears: Proceedings of the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, 20-24 June, 2005, Seattle, Washington, USA. IUCN, Gland, Switzerland. Pp. 153-156.

Braathen, M., Derocher, A.E., Wiig, Ø., Sørmo, E.G., Lie, E., Skaare, J.U., and B.M. Jenssen. 2004. Relationships between PCBs and thyroid hormones and retinol in female and male polar bears. *Environmental health perspectives* 112(8):826–833.

Bytingsvik, J., Lie, E., Aars, J., Derocher, A.E., Wiig, Ø., and B.M. Jenssen. 2012. PCBs and OH-PCBs in polar bear mother-cub pairs: A comparative study based on plasma levels in 1998 and 2008. *Science of the Total Environment* 417-418:117–128.

Canada's northernmost mine. 1980. *Polar Record* 20(125):174–175.

Cattet, M.R., Bourque, A., Elkin, B.T., Powley, K.D., Dahlstrom, D.B., and N.A. Caulkett. 2006. Evaluation of the potential for injury with remote drug-delivery systems. *Wildlife Society Bulletin* 34(3):741–749.

Cattet, M.R.L., Caulkett, N.A., and N.J. Lunn. 2003. Anesthesia of polar bears using xylazine-zolazepam-tiletamine or zolazepam-tiletamine. *Journal of Wildlife Diseases* 39:655–664.

Cattet, M.R.L., Caulkett, N.A., Polischuk, S.C., and M.A. Ramsay. 1997. Reversible immobilization of free-ranging polar bears with medetomidine-zolazepam-tiletamine and atipamezole. *Journal of Wildlife Diseases* 33:611–617.

Cattet, M.R.L., and M.E. Obbard. 2010. Use of hyaluronidase to improve chemical immobilization of free-ranging polar bears (*Ursus maritimus*). *Journal of Wildlife Diseases* 46:246-250.

Clarkson, P.L., Gray, P.A., McComiskey, J.E., Quaife, L.R., and J.G. Ward. 1986. Managing bear problems in northern development areas. Northern hydrocarbon development environment problem solving. *Proceedings of the Annual Meeting of the International Society of Petroleum Industry Biologists* 10:47–56.

Clarkson, P.L., and I. Stirling. 1994. Polar Bears. In S.E. Hygnstrom, R.M. Timm, & G.E. Larson (Eds.), *Prevention and control of wildlife damage*. Lincoln, Nebraska: University of Nebraska-Lincoln.

Derocher, A.E., and I. Stirling. 1991. Oil contamination of polar bears. *Polar Record* 27(160):56–57.

Derocher, A.E., and I. Stirling. 1995. Temporal variation in reproduction and body mass of polar bears in western Hudson Bay. *Canadian Journal of Zoology* 73:1657–1665.

Derocher, A.E., Lunn, N.J., and I. Stirling. 2004. Polar bears in a warming climate. *Integrative and Comparative Biology* 44(2):163–176.

Dietz, R., Rigét, F.F., Sonne, C., Born, E.W., Bechshoft, M.A., McKinney, A. and R.J. Letcher. 2013. Three decades (1983–2010) of contaminant trends in East Greenland polar bears (*Ursus maritimus*). Part 1: Legacy organochlorine contaminants. *Environment International* 59:485–493.

Durner, G.M., D.C. Douglas, R.M. Nielson, S.C. Amstrup, T.L. McDonald, I. Stirling, M. Mauritzen, E.W. Born, Ø Wiig, E. DeWeaver, M.C. Serreze, S.E. Belikov, M.M. Holland, J. Maslanik, J. Aars, D.A. Bailey, and A.E. Derocher. 2009. Predicting 21st century polar bear habitat distribution from global climate models. *Ecological Monographs* 79:25–58.

Dubey, J.P., Zarnke, R., Thomas, N.J., Wong, S.K., Van Bonn, W., Briggs, M., Davis, J.W., Ewing, R., Mense, M., Kwok, O.C.H., Romand, S., and P. Thulliez. 2003. *Toxopolama gondii, Neospora canium, Sarcocystis neurona, and Sarcocystis canis*-like infections in marine mammals. *Veterinary Parasitology* 116:275–296.

Duignan, P.J., Nielson, O., House, C., Kovacs, K.M., Duffy, N, Early, G., Sadove, S., St-Aubin, D.J., Rima, B.K., and J.R. Geraci. 1997. Epizootiology of morbillivirus infection in harp, hooded, and ringed seals from the Canadian Arctic and western Atlantic. *Journal of Wildlife Diseases* 33(1):7–19.

Dyck, M.G., and R.V. Baydeck. 2004. Vigilance behaviour of polar bears (*Ursus Maritimus*) in the context of wildlife-viewing activities at Churchill, Manitoba Canada. *Biological Conservation* 116(3):343-350.

Environmental Monitoring of Svalbard and Jan Mayen website [Miljøovervåking Svalbard og Jan Mayen]. Tromsø, Norway: Norwegian Polar Institute. http://mosj.npolar.no/no

Ferguson, S.H., Stirling, I., and P. McLoughlin. 2005. Climate change and ringed seal (*Phoca hispida*) recruitment in Western Hudson Bay. *Marine Mammal Science* 21(1):121–135.

Fischbach, A.S., Amstrup, S.C., and D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes. *Polar Biology* 30:1395–1405.

Garner, G.W., Amstrup, S.C., Stirling, I., and S.E. Belikov. 1994. Habitat considerations for polar bears in the North Pacific Rim. *Transactions of the North American Wildlife and Natural Resources Conference* 59:111–120.

Gabrielsen, G.W., and L.K. Sydnes. 2009. Pollution in the Barents Sea. In E. Sakshaug, G. Johnsen, & K.M. Kovacs (Eds.), *Ecosystem Barents Sea* (pp. 497-544). Trondheim, Norway: Tapir Academic Press.

Kochnev, A.A. 2004. A polar bear on Chukotka: troubles and hopes. Russian Conservation News, #3(29). http://www.biodiversity.ru/publications/odp/archive/29/st02.html. Viewed July 1, 2013.

Mining and Petroleum Environmental Research Group. 2008. *Guidelines for industrial activity in bear country for the mineral exploration, placer mining and oil & gas industries*. Whitehorse, Yukon: Author.

Gutleb, A.C., Cenijn, P., van Velzen, M., Lie, E., Ropstad, E., Skaare, J.U., and G.W. Gabrielsen. 2010. In vitro assay shows that PCB metabolites completely saturate thyroid hormone transport capacity in blood of wild polar bears (*Ursus maritimus*). *Environmental Science and Technology* 44(8):3149–3154.

Haave, M., Ropstad, E., Derocher, A. E., Lie, E., Dahl, E., Wiig, Ø., Skaare, J.U., and B.M. Jenssen. 2003. Polychlorinated biphenyls and reproductive hormones in female polar bears at Svalbard. *Environmental Health Perspectives* 111(4):431–436.

Hale, P. B. 1990, Offshore hard minerals. In Arthur Grantz, L. Johnson, & J.F. Sweeney (Eds.), *The Arctic Ocean region: The geology of North America* (pp. 551-65). Boulder, Colorado: Geological Society of America.

Hammill, M.O., and T.G. Smith. 1991. The role of predation in the ecology of the ringed seal in the Barrow Strait, Northwest Territories, Canada. *Marine Mammal Science* 7(2):123–135.

Harington, C.R. 1968. Denning habits of the polar bear (*Ursus maritimus* Phipps) Canadian Wildlife Service Report Series No.5. Ottawa: Queen's Printer.

Harvell, C.D., Mitchell, C.E., Ward, J.R., Altizer, S., Dobson, A.P., Ostfeld, R.S., and M.D. Samuel. 2002. Climatic warming and disease risks for terrestrial and marine biota. *Science* 296:2158–2162.

Herrero, J., and S. Herrero. 1997. *Visitor safety in polar bear viewing activities in the Churchill region of Manitoba, Canada*. Bios Environmental Research and planning Associates Ltd., Calgary.

Hughes-Hanks, J.M., Richard, L.G., Panuska, C., Saucier, J.R., O'Hara, T.M., Rolland, R.M., and L. Dehn. 2005. Prevalence of Cryptosporidium spp. and Giardia spp. in five marine mammal species. *Journal of Parasitology* 95:1225–1228.

Intergovernmental Panel on Climate Change. 2013. *Climate change 2013. The physical science basis.* Working group I contribution to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, U.K.: Cambridge University Press. http://www.ipcc.ch/report/ar5/wg1/

Jensen, S.K., Aars, J., Lydersen, C., Kovacs, K.M., and K. Åsbakk. 2009. The prevalence of T*oxoplasma gondii* in polar bears and their marine mammal prey: evidence for a marine transmission pathway? *Polar Biology* 33(5):599–606.

Keeling, A. 2011. *The Rankin Inlet nickel mine research project. Part of the abandoned mines project at Memorial University of Newfoundland* [Poster]. ArcticNet. http://www.abandonedminesnc.com/wp-content/uploads/2011/08/Rankin-poster.pdf

Kelly, B.P. 2001. Climate change and ice breeding pinnipeds. In Walther, G.R., C.A. Burga and P.J. Edwards (Eds.), *"Fingerprints" of climate change: adapted behaviour and shifting species' ranges* (pp. 43-55). New York and London: Kluwer Academic/Plenum Publishers.

Kelly, B.P., Bengtson, J.L., Boveng, P.L., Cameron, M.F., Dahle, S.P., Jansen, J.K., Logerwell, E.A., Overland, J.E., Sabine, C.L., Waring, G.T. and J.M. Wilder. 2010. *Status review of the ringed seal (Phoca hispida)*. U.S. Department of Commerce. NOAA [National Oceanic and Atmosphereic Administration] Technical Memorandum NMFS-AFSC-212.

Kuiken, T., Kennedy, S., Barrett, T., Van de Bildt, M.W.G., Borgsteede, F.H., Brew, S.D., Codd, G.A, Duck, C., Deaville, R., Eybatov, T., Forsyth, M.A., Foster, G., Jepson, P.D., Kydyrmanov, A., Mitrofanov, I., Ward, C.J., Wilson, S., and A.D.M.E. Osterhaus. 2006. The 2000 canine distemper epidemic in Caspian seals (*Phoca caspica*): Pathology and analysis of contributory factors. *Veterinary Pathology* 43:321–338.

14. Suggested Reading

Kumlien, L. 1879. *Contributions to the natural history of the Arctic America, made in connection with the Howgate Polar Expedition, 1877-78.* Bullet of the U.S. National Museum, No. 15. Washington, DC: Government Printing Office.

Kutz., S.J., Hoberg, E.P., Polley, L., and E.L. Jenkins. 2005. Global warming is changing the dynamics of Arctic host-parasite systems. *Proceedings of the Royal Society of London. Series B, Biological Sciences* 272(1581): 2571-2576.

Kutz, S.J., Hoberg, E.P., Nagy, J., Polley, L., and B. Elkin. 2004. "Emerging" parasitic infections in Arctic ungulates. *Integrative and Comparative Biology* 44(2):109-118.

Lentfer, J.W. 1990. Workshop on measures to assess and mitigate the adverse effects of Arctic oil and gas activities on polar bears. Final report to the U.S. Marine Mammal Commission. Washington, D.C.: National Technical Information Service.

Letcher, R.J., Bustnes, J.O., Dietz, R., Jenssen, B.M., Jørgensen, E.H., Sonne, C., Verreault, J., Vijayan, M.M., and G.W. Gabrielsen. 2010. Exposure and effects assessment of persistent organic contaminants in arctic wildlife and fish. *Science of the Total Environment* 408(15):2995–3043.

Lie, E., Bernhoft, A., Riget, F., Belikov, S.E., Boltunov, A.N., Derocher, A.E., Garner, G.W., Wiig, Ø., and J.U. Skaare. 2003. Geographical distribution of organochlorine pesticides (OCPs) in polar bears (*Ursus maritimus*) in the Norwegian and Russian Arctic. *Science of the Total Environment* 306(1):159–170.

Lie, E., Larsen, H.J.S., Larsen, S., Johansen, G.M., Derocher, A.E., Lunn, N.J., Norstrom, R.J., Wiig, Ø., and J.U. Skaare. 2005. Does high organochlorine (OC) exposure impair the resistance to infection in polar bears (*Ursus maritimus*)? Part II: Possible effect of OCs on mitogen- and antigen-induced lymphocyte proliferation. *Journal of Toxicology and Environmental Health*, *A* 68(6):457–484.

Lindenmayer, D.B., and G.E. Likens. 2009. Adaptive monitoring: a new paradigm for long-term research and monitoring. *Trends in Ecology and Evolution* 24:482–486.

Lunn, N.J., Stirling, I., Andriashek, D., and E. Richardson. 2004. Selection of maternity dens by female polar bears in western Hudson Bay, Canada, and the effects of human disturbance. *Polar Biology* 27:350–356.

Lydersen, C., Jensen, P.M., and E. Lydersen. 1987. Studies of the ringed seal population in the Van Mijen fjord, Svalbard, in the breeding period 1986. *Norwegian Polar Institute Rapport Series* 34:91–112.

Lydersen, C., and T.G. Smith. 1989. Avian predation on ringed seal *Phoca hispida* pups. *Polar Biology* 9(8):489–490.

Macdonald, R.W., Harner, T., and J. Fyfe. 2005. Recent climate change in the Arctic and its impact on contaminant pathways and interpretation of temporal trend data. *Science of the Total Environment* 342(1-3):5–86.

McCracken, A.D., Poulton, T.P., Macey, E., Gray, J.M.M., and G.S. Nowlan. 2007. *Arctic Oil and Gas*. Ottawa, ON: Natural Resources Canada.

McKinney, M.A., Letcher, R.J., Aars, J., Born, E.W., Branigan, M., Dietz, R., Evans, T.J., Gabrielsen, G.W., Peacock, E., and C. Sonne. 2011. Flame retardants and legacy contaminants in polar bears from Alaska, Canada, East Greenland and Svalbard, 2005-2008. *Environment International* 37(2):365–374.

Measures, L.N., and M.E. Olson. 1999. Giardiasis in pinnipeds from eastern Canada. *Journal of Wildlife Diseases* 35:779–782.

Messier, F., 2000. Effects of capturing, tagging, and radio-collaring polar bears for research and management purposes in Nunavut and the Northwest Territories. Report to the Government of Nunavut. SK: Department of Biology, University of Saskatchewan.

Messier, F., Taylor, M.K., and M.A. Ramsay. 1992. Seasonal activity patterns of female polar bears (*Ursus maritimus*) in the Canadian Arctic as revealed by satellite telemetry. *Journal of Zoology* 226(2):219–229.

Mikkola, H., and J. Kapyla. 2013. *Arctic ecnomic potential. The need for a comprehensive and risk-aware understanding of Arctic dynamics.* Finnish Institute of International Affairs briefing paper 127. Helsinki, Finland: Finnish Institute of International Affairs.

Morrell, G.R., Fortier, M., Price, P.R., and R. Polt. 1995. *Petroleum exploration in northern Canada: A guide to oil and gas exploration and potential.* Ottawa, ON: Northern Oil and Gas Directorate, Indian and Northern Affairs Canada.

Neff, J.M. 1990. Composition and fate of petroleum and spill-treating agents in the marine environment. In J.R. Geraci & D.J. St. Aubin (Eds.), *Sea mammals and oil: confronting the risks* (pp. 1-33). San Diego, California: Academic Press.

Nyman, M., Bergknut, M., Fant, M.L., Raunio, H., Jestoi, M., Bengs, C., Murk, A., Koistinen, J., Bäckman, C., Pelkonen, O., Tysklind, M., Hirvi, T., and E. Helle. 2003. Contaminant exposure and effects in Baltic ringed and grey seals as assessed by biomarkers. *Marine Environmental Research* 55(1):73–99.

Obbard, M.E., Cattet, M.R.L., Moody, T., Walton, L.R., Potter, D., Inglis, J., and C. Chenier. 2006. Temporal trends in the body condition of southern Hudson Bay polar bears. *Climate Change Research Information Note* 3:1–8.

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

Oskam, I.C., Ropstad, E., Dahl, E., Lie, E., Derocher, A.E., Wiig, Ø., Larsen, S., Wiger, R., and J.U. Skaare. 2003. Organochlorines affect the major androgenic hormone, testosterone, in male polar bears (*Ursus maritimus*) at Svalbard. *Journal of Toxicology and Environmental Health, A* 66(22):2119–2139.

Hansen, B. 2013. *Overview of polar bear defence of life and property kills and polar bear interactions with industrial operations 2000-2013, Nunavut*. Nunavut: Nunavut Department of Environment.

Packer, T. 1988. *Survey of foreign development activities for offshore non-fuel mineral resources.* Ottawa: Department of Energy, Mines and Resources.

Pedersen, A. 1945. *Der Eisbar. Verbreitung und Lebemweise*. Kebenhavn, Denmark: E. Bruun & Co.

Ragen, T.J., Huntington, H.P., and G.K. Hovelsrud. 2008. Conservation of Arctic marine mammals faced with climate change. *Ecological Applications* 18(2):S166–S174.

Ramsay, M.A., and I. Stirling. 1990. Fidelity of female polar bears to winter-den sites. *Journal of Mammalogy* 71(2):233–36.

Ramsay, M.A., and I. Stirling. 1986. Long-term effects of drugging and handling free-ranging polar bears. *Journal of Wildlife Management* 50:619–626.

Rescan Environmental Services Ltd. 2012. *The Back River project: Project description*. Sabina Gold & Silver Corp.

Rode, K.D., Amstrup, S.C., and E.V. Regehr. 2007. *Polar bears in the Southern Beaufort Sea III: Stature, mass, and cub recruitment in relationship to time and sea ice extent between 1982 and 2006.* U.S. Geological Survey Administrative Report. Reston, Virginia: U.S. Geological Survey.

Routti, H., Arukwe, A., Jenssen, B.M., Letcher, R.J., Nyman, M., Bäckman, C., and G.W. Gabrielsen. 2010. Comparative endocrine disruptive effects of contaminants in ringed seals (Phoca hispida) from Svalbard and the Baltic Sea. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology* 152(3):306–312.

Routti, H., Jenssen, B.M., Lydersen, C., Bäckman, C., Arukwe, A., Nyman, M., Kovacs, K.M., and G.W. Gabrielsen. 2010. Hormone, vitamin and contaminant status during the moulting/fasting period in ringed seals (*Pusa [Phoca] hispida*) from Svalbard. *Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology* 155(1):70–76.

Ryan, C.W., Vaughan, M.R., Meldrum, J.B., Duncan, R.B., and J.W. Edwards. 2009. Retention time of Telazol in black bears. *Journal of Wildlife Management* 73(2), 210–213.

Savinov, V., Muir, D.C., Svetochev, V., Svetocheva, O., Belikov, S., Boltunov, A., Alekseeva, L., Reiersen, L-O., and T. Savinova. 2011. Persistent organic pollutants in ringed seals from the Russian Arctic. *Science of the Total Environment* 409(14):2734–2745.

Schliebe, S., Evans, T., Johnson, K., Roy, M., Miller, S., Hamilton, C., Meehan, R., and S. Jahrsdoerfer. 2006. *Range-wide status review of the polar bear (Ursus maritimus).* Anchorage, Alaska: U.S. Fish and Wildlife Service.

Schliebe, S., Rode, K.D., Gleason, J.S., Wilder, J., Proffitt, K., Evans, T.J., and S. Miller. 2008. Effects of sea ice extent and food availability on spatial and temporal distribution of polar bears during the fall open-water period in the Southern Beaufort Sea. *Polar Biology* 31(8):999–1010.

Schweinsburg, R.E., and L.J. Lee. 1982. Movement of four satellite-monitored polar bears in Lancaster Sound, Northwest Territories. *Arctic* 35(4):504–511.

Schweinsburg, R.E., Spencer, W., and D. Williams. 1984. Polar bear denning area at Gateshead Island, Northwest Territories. *Arctic* 37(2):169–171.

Semple, H.A., Gorecki, D.K., Farley, S.D., and M.A. Ramsay. 2000. Pharmacokinetics and tissue residues of Telazol in free-ranging polar bears. *Journal of Wildlife Diseases* 36(4):653–662.

Sermitsiaq. 2011. Isbjorn beslaglagt. Politiet i Sisimiut har beslaglagt en ulovligt fanget isbjorn af to mand. Sermitsiaq News. http://sermitsiaq.ag/node/78930. Viewed July 15, 2013.

Smith, T.G., and C. Lydersen. 1991. Availability of suitable land-fast ice and predation as factors limiting ringed seal populations, *Phoca hispida,* in Svalbard. *Polar Research* 10(2):585–594.

St. Aubin, D.J. 1990. Physiologic and toxic effects on polar bears. In J.R. Geraci & D.J. St. Aubin (Eds.), *Sea Mammals and Oil: Confronting the Risks* (pp. 235–240). San Diego, California: Academic Press.

Stirling, I. 2002. Polar Bears and Seals in the Eastern Beaufort Sea and Amundsen Gulf: A Synthesis of Population Trends and Ecological Relationships over Three Decades. *Arctic* 55,Supplement 1:59-76.

Stirling, I., and P.B. Latour. 1978. Comparative hunting abilities of polar bear cubs of different ages. *Canadian Journal of Zoology* 56(8):1768–1772.

Stirling, I., and A.E. Derocher. 1993. Possible impacts of climatic warming on polar bears. *Arctic* 46(3): 240–45.

Stirling, I., and N.A. **Øritsland**. 1995. Relationships between estimates of ringed seal and polar bear populations in the Canadian Arctic. *Canadian Journal of Fisheries and Aquatic Sciences*, 52:2594–2612.

Stirling, I., and T.G. Smith. 2004. Implications of warm temperatures and an unusual rain event for the survival of ringed seals on the coast of southeastern Baffin Island. *Arctic* 57(1):59–67.

Stirling, I., Spencer, C., and D. Andriashek. 1989. Immobilization of polar bears (*Ursus maritimus*) with Telazol® in the Canadian Arctic. *Journal of Wildlife Diseases* 25(2):159–168.

Taylor, M.K. 1986. The effect of radio transmitter harnesses on free-ranging polar bears. In *Bears: Their biology and management, Vol. 6. A selection of papers from the sixth international conference on bear research and management, Grand Canyon, Arizona, February 1983* (pp. 219-221).

Tetra Tech, Inc. *Ocean discharge criteria evaluation for the Alaska pollutant discharge elimination system. Norton Sound large dredge placer miners general permit (AKG374000)—Final.* Anchorage, Alaska: Alaska Department of Environmental Conservation Wastewater Discharge Authorization Programs.

Tonge, M.B., and Pulfer, T.L. 2011. *Recovery strategy for polar bear (Ursus maritimus) in Ontario.* Ontario Recovery Strategy Series. Peterborough, ON: Ontario Ministry of Natural Resources.

Tryland, M., Krafft, B.A., Lydersen, C., Kovacs, K.M., and S.I. Thoresen. 2006. Serum chemistry values for free-ranging ringed seals (*Pusa hispida*) in Svalbard. *Veterinary Clinical Pathology* 35(4):405–412.

Villanger, G.D., Lydersen, C., Kovacs, K.M., Lie, E., Skaare, J.U., and B.M. Jenssen. 2011. Disruptive effects of persistent organohalogen contaminants on thyroid function in white whales (*Delphinapterus leucas*) from Svalbard. *Science of the Total Environment* 409(13):2511–2524.

Villanger, G.D., Jenssen, B.M., Fjeldberg, R.R., Letcher, R.J., Muir, D.C.G., Kirkegaard, M., Sonne, C., and R. Dietz. 2011. Exposure to mixtures of organohalogen contaminants and associative interactions with thyroid hormones in East Greenland polar bears (*Ursus maritimus*). *Environment International* 37(4):694–708.

Vongraven, D., and E. Peacock. 2011. *Development of a pan-Arctic monitoring plan for polar bears. Background paper.* Circumpolar Biodiversity Monitoring Program, CAFF [Conservation of Arctic Flora and Fauna] Monitoring Series Report No.1, Akureyri, Iceland: CAFF International Secretariat.

14.3 MANAGEMENT, BILATERAL COOPERATION AND PROTECTED AREAS

Amstrup, S.C, DeWeaver, E.T., Douglas, D.C., Marcot, B.G., Durner, G.M., Bitz, C.M., and D.A. Bailey. 2010. Greenhouse gas mitigation can reduce sea ice loss and increase polar bear persistence. *Nature* 468:955–958.

Beever, E.A., and A. Woodward. 2011. Design of ecoregional monitoring in conservation areas of high-latitude ecosystems under contemporary climate change. *Biological Conservation* 144(5):1258–1269.

Belikov, S.E. 1995. Status of polar bear populations in the Russian Arctic 1993. In Ø. Wiig, E.W. Born, & G.W. Garner (Eds.), *Polar Bears: Proceedings of the 11th Working Meeting of the IUCN/SSC Polar Bear Specialist Group* (pp. 115–119). Gland, Switzerland, and Cambridge, U.K.: IUCN.

Belikov, S.E., Boltunov, A.N., Ovsyanikov, N.G., Belchanskiy, G.I., and A.A. Kochnev. 2006. Polar bear management and research in Russia, 2001-2004. In J. Aars, N.J. Lunn, & A.E. Derocher (Eds.), *Polar Bears: Proceedings of the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, 20-24 June, 2005, Seattle, Washington, USA* (pp. 153–156). Gland, Switzerland and Cambridge, U.K.: IUCN.

Belikov, S.E., Boltunov, A.N., Ovsyanikov, N.G., Mordvintsev, I.N., and V.V. Nikiforov. 2010. Polar bear management and research in Russia, 2005-2009. In M.E. Obbard, G.W. Thiemann, E. Peacock, & T.D. DeBruyn (Eds.), *Polar Bears: Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June–3 July 2009* (pp. 165–169). Gland, Switzerland, and Cambridge, U.K.: IUCN.

Born, E.W., Heilmann, A., Kielsen Holm, L., and K.L. Laidre. 2011. Polar bears in Northwest Greenland: An interview survey about the catch and the climate. University of Copenhagen, Denmark: Museum Tusculanum Press.

Brower, C.D., A. Carpenter, M. Branigan, W. Calvert, T. Evans, A. Fischbach, J. Nagy, S. Schliebe, and I. Stirling. 2002. The polar bear management agreement of the southern Beaufort Sea: an evaluation of the first ten years of a unique conservation agreement. *Arctic* 55(4):362-372.

Convention on the International Trade of Endangered Species of Wild Fauna and Flora. http://www.cites.org/eng/prog/ndf/index.php

Dowsley, M. 2005. Inuit knowledge regarding climate change and the Baffin Bay polar bear population. Final wildlife report 1. Iqaluit, Nunavut: Government of Nunavut, Department of Environment.

Harington, C.R. 1968. Denning habits of the polar bear (*Ursus maritimus* Phipps) Canadian Wildlife Service Report Series No.5. Ottawa: Queen's Printer.

International Union for Conservation of Nature Protected Areas Categories System. http://www.iucn.org/about/work/programmes/gpap_home/gpap_quality/gpap_pacategories/

Kalxdorff, S.B. 1997. *Collection of local knowledge regarding polar bear habitat use in Alaska.* U.S. Fish and Wildlife Service Technical Report. Anchorage, Alaska: U.S. Fish and Wildlife Service.

Kochnev, A.A. 2004. A polar bear on Chukotka: troubles and hopes. *Russian Conservation News* 3(29).

Larsen, T.S., and I. Stirling. 2009. *The agreement on the conservation of polar bears—its history and future.* Report No. 127. Tromsø, Norway: Norsk Polar Institute.

Margoluis, R., and N. Sakafsky. 1998. *Measures of success: designing, managing, and monitoring conservation and development projects.* Washington, D.C.: Island Press.

Oakley, K.L., Thomas, L.P., and S.G. Fancy. 2003. Guidelines for long-term monitoring protocols. *Wildlife Society Bulletin* 31(4):1000-1003.

Peacock, E., Derocher, A.E., Lunn, N.J., and M.E. Obbard. 2010. Polar bear ecology and management in Hudson Bay in the face of climate change. In S.H. Ferguson, L.L. Loseto, & M.L. Mallory (Eds.), *A little less Arctic: Top predators in the world's largest northern inland sea, Hudson Bay* (pp. 93–116). New York, NY: Springer Science+Business Media.

Runge, M.C. 2011. An introduction to adaptive management for threatened and endangered species. *Journal of Fish and Wildlife Management* 2(2):220–233.

Reynolds, J.H., Thompson, W.L., and B. Russell. 2010. Planning for success: Identifying effective and efficient survey designs for monitoring. *Biological Conservation* 144(5):1278–1284.

Salafsky, N., and R. Margoluis. 2001. Threat-reduction assessment: A practical and cost-effective approach to evaluating conservation and development projects. *Conservation Biology* 13(4):830-841.

Salafsky, N., Margoluis, R., Redford, K.H., and J.G. Robinson. 2002. Improving the practice of conservation: A conceptual framework and research agenda for conservation science. *Conservation Biology* 16(6):1469–1479.

Shadbolt, T., York, G., and E.W.T. Cooper. 2012. *Icon on ice: International trade and management of polar bears.* Vancouver, B.C.: TRAFFIC North America and World Wildlife Canada.

Tetra Tech, Inc. *Ocean discharge criteria evaluation for the Alaska pollutant discharge elimination system. Norton Sound large dredge placer miners general permit (AKG374000)—Final*. Anchorage, Alaska: Alaska Department of Environmental Conservation Wastewater Discharge Authorization Programs.

U.S. Fish and Wildlife Service. 2010. Endangered and threatened wildlife and plants; designation of critical habitat for the polar bear (*Ursus maritimus*) in the United States. *Federal Register* 75(234):76085-76137.

Vongraven, D., J. Aars, S. Amstrup, S. N. Atkinson, S. Belikov, E. W. Born, T. D. DeBruyn, A. E. Derocher, G. Durner, M. Gill, N. Lunn, M. E. Obbard, J. Omelak, N. Ovsyanikov, E. Peacock, E. Richardson, V. Sahanatien, I. Stirling and Ø. Wiig. 2012. A circumpolar monitoring framework for polar bears. *Ursus Monograph Series* 5:1-66.

Vongraven, D., Ekker, M., Wiig, Ø., and J. Aars. 2010. Management of polar bears in Norway, 2005-2009. In M.E. Obbard, G.W. Thiemann, E. Peacock, & T.D. DeBruyn (Eds.), *Polar Bears: Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June–3 July 2009* (pp. 149-155). Gland, Switzerland, and Cambridge, U.K.: IUCN.

Zdor, E. 2007. Traditional knowledge about polar bear in Chukotka. *Etudes/Inuit/Studies* 31(1-2):321–323.

14.4 RESEARCH

Aars, J., N.J. Lunn, and A.E. Derocher, editors. 2006. *Polar Bears: Proceedings of the 14th working meeting of the IUCN/SSC Polar Bear Specialist Group, 20-24 June 2005*, Seattle, USA. Occasional Paper of the IUCN Species Survival Commission, No. 32. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland and Cambridge, UK.

Amstrup, S.C., Marcot, B.G., and D.C. Douglas. 2008. A Bayesian Network Modeling Approach to Forecasting the 21st Century Worldwide Status of Polar Bears. Pages 213-268 In E.T. Deweaver, C.M. Bitz, and L. B. Tremblay (Eds). Arctic Sea Ice Decline: Observations, projections, mechanisms, and implications. Geophysical Monograph 180. American Geophysical Union. Washington, DC.

Lunn, N.J., S. Schliebe, and E.W. Born, editors. 2002. *Polar Bears: Proceedings of the 13th working meeting of the IUCN/SSC polar bear specialist group, 23–28 June 2001*, Nuuk, Greenland. Occasional Paper of the IUCN Species Survival Commission, No. 26. IUCN Gland, Switzerland and Cambridge, UK.

Obbard, M.E., G.W. Thiemann, E. Peacock, and T.D. DeBruyn, editors. 2010. *Polar Bears: Proceedings of the 15th working meeting of the IUCN/SSC Polar Bear Specialist Group, 29 June–3 July 2009*, Copenhagen, Denmark. Occasional Paper of the IUCN Species Survival Commission, No. 43. International Union for Conservation of Nature and Natural Resources (IUCN), Gland, Switzerland and Cambridge, UK.

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

Stirling, I., and A.E. Derocher. 2012. Effects of Climate Warming on Polar Bears: A Review of the Evidence. (invited review) *Global Climate Biology* 18:2694-2706.

Taylor, M.K., Laake, J., McLoughlin, P.D., Born, E.W., Cluff, H.D., Ferguson, S.H., Rosing-Asvid, A., Schweinsburg, R., and F. Messier. 2005. Demography and viability of a hunted population of polar bears. *Arctic* 58:203–214.

Thiemann, G.W. Iverson, S.J., and I. Stirling. 2008. Polar bear diets and arctic marine food webs: insights from fatty acid analysis. *Ecological Monographs* 78:591–613.

Vongraven, D., J. Aars, J., Amstrup, S., Atkinson, S.N., Belikov, S., Born, E.W., DeBruyn, T.D., Derocher, A.E., Durner, G., Gill, M., Lunn, N.J., Obbard, M.E., Omelak, J., Ovsyanikov, N., Peacock, E., Richardson, E., Sahanatien, V., Stirling, I., and Ø. Wiig. 2012. A circumpolar monitoring framework for polar bears. *Ursus Monograph Series* 5:1-66.