Ursus maritimus. The IUCN Red List of Threatened Species 2015

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The IUCN Red List of Threatened Species™
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Ursus maritimus, Polar Bear

Assessment by: Wiig, Ø., Amstrup, S., Atwood, T., Laidre, K., Lunn, N., Obbard, M., Regehr, E. & Thiemann, G.

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Taxonomy

Kingdom	Phylum	Class	Order	Family
Animalia	Chordata	Mammalia	Carnivora	Ursidae

Taxon Name: *Ursus maritimus* Phipps, 1774

Synonym(s):

- *Thalarctos maritimus*

Regional Assessments:

- Europe

Common Name(s):

- English: Polar Bear
- French: Ours blanc, Ours polaire
- Spanish: Oso Polar

Taxonomic Source(s):

Wilson, D.E. 1976. Cranial variation in polar bears. *International Conference on Bear Research and Management* 3: 447-453.

Taxonomic Notes:

Phipps (1774) first described the Polar Bear as a distinct species and named it *Ursus maritimus*. Other names were suggested including *Thalassarctos, Thalarctos, and Thalatarctos.* Erdbrink (1953) and Thenius (1953) ultimately settled on *Ursus (Thalarctos) maritimus* because of interbreeding between Brown Bears (*Ursus arctos*) and Polar Bears in zoos. Based on the fossil record, Kurtén (1964) recommended the Phipps (1774) name *Ursus maritimus,* which was promoted by Harington (1966), Manning (1971) and Wilson (1976) and is used today (see DeMaster and Stirling 1981, Amstrup 2003, Wilson and Reeder 2005).

Assessment Information

Red List Category & Criteria: Vulnerable A3c ver 3.1

Year Published: 2015

Date Assessed: August 27, 2015

Justification:

Loss of Arctic sea ice due to climate change is the most serious threat to Polar Bears throughout their circumpolar range (Obbard *et al*. 2010, Stirling and Derocher 2012, USFWS 2015). We performed a data-based sensitivity analysis with respect to this threat by evaluating the potential response of the global Polar Bear population to projected sea-ice conditions. Our analyses included a comprehensive assessment of generation length (GL) for Polar Bears; development of a standardized sea-ice metric representing important habitat characteristics for the species; and population projections, over three Polar Bear generations, using computer simulation and statistical models representing alternative relationships between sea ice and Polar Bear abundance.

Our analyses highlight the potential for large reductions in the global Polar Bear population if sea-ice loss continues, which is forecast by climate models and other studies (IPCC 2013). Our analyses also highlight the large amount of uncertainty in statistical projections of Polar Bear abundance and the sensitivity of projections to plausible alternative assumptions. Across six scenarios that projected polar bear abundance three generations forward in time using the median and 95th percentile of estimated GL, the median probability of a reduction in the mean global population size greater than 30% was approximately 0.71 (range 0.20-0.95; see Table 4 in the attached Supporting Material). The median probability of a reduction greater than 50% was approximately 0.07 (range 0-0.35), and the probability of a reduction greater than 80% was negligible. The International Union for the Conservation of Nature Red List Guidelines suggests that assessors consider nearly the full range of uncertainty in potential outcomes, and adopt a precautionary but realistic attitude toward risk tolerance (Section 3.2.3, IUCN 2014). In light of the significant probability, across scenarios, of a reduction in mean global population size greater than 30%, and the relatively low probability of a reduction greater than 50%, we conclude that Polar Bears currently warrant listing as Vulnerable under criterion A3c (IUCN 2014).

For further information about this species, see Supplementary Material.

Previously Published Red List Assessments

2008 – Vulnerable (VU) – http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T22823A9391171.en

2006 – Vulnerable (VU)

1996 – Lower Risk/conservation dependent (LR/cd)

1994 – Vulnerable (V)

1990 – Vulnerable (V)

1988 – Vulnerable (V)

1986 – Vulnerable (V)

1982 – Vulnerable (V)

1965 – Less rare but believed to be threatened-requires watching

Geographic Range

Range Description:

Polar Bears live throughout the ice-covered waters of the circumpolar Arctic (Obbard *et al.* 2010, www.pbsg.npolar.no). Although some occur in the permanent multi-year pack ice of the central Arctic basin, they are most common in the annual ice over the continental shelf and inter-island archipelagos that surround the polar basin. Polar Bears that have continuous access to sea ice are able to hunt throughout the year. However, in those areas where the sea ice melts completely each summer, Polar Bears are forced to spend several months on land, where they primarily fast on stored fat reserves until freeze-up. Use of land by Polar Bears during the ice-free season appears to be increasing at least in some areas where sea ice duration has declined (e.g., Schliebe *et al.* 2008, Herreman and Peacock

2013). The southern extent of the range of Polar Bears occurs off the coast of Newfoundland, Canada in the northwest Atlantic Ocean. The northernmost documented observation of a Polar Bear was at 89°46'N, 25 km from the North Pole (van Meurs and Splettstoesser 2003). Currently, the most southerly known denning area is on Akimiski Island in James Bay, Canada, at about 52°35'N (Kolenosky and Prevett 1983).

The species is found in Canada (Manitoba, Newfoundland, Labrador, Nunavut, Northwest Territories, Quebec, Yukon Territory, Ontario), Greenland/Denmark, Norway (including Svalbard), Russian Federation (North European Russia, Siberia, Chukotka, Sakha (Yakutia), Krasnoyarsk), United States (Alaska). Also, vagrants occasionally reach Iceland.

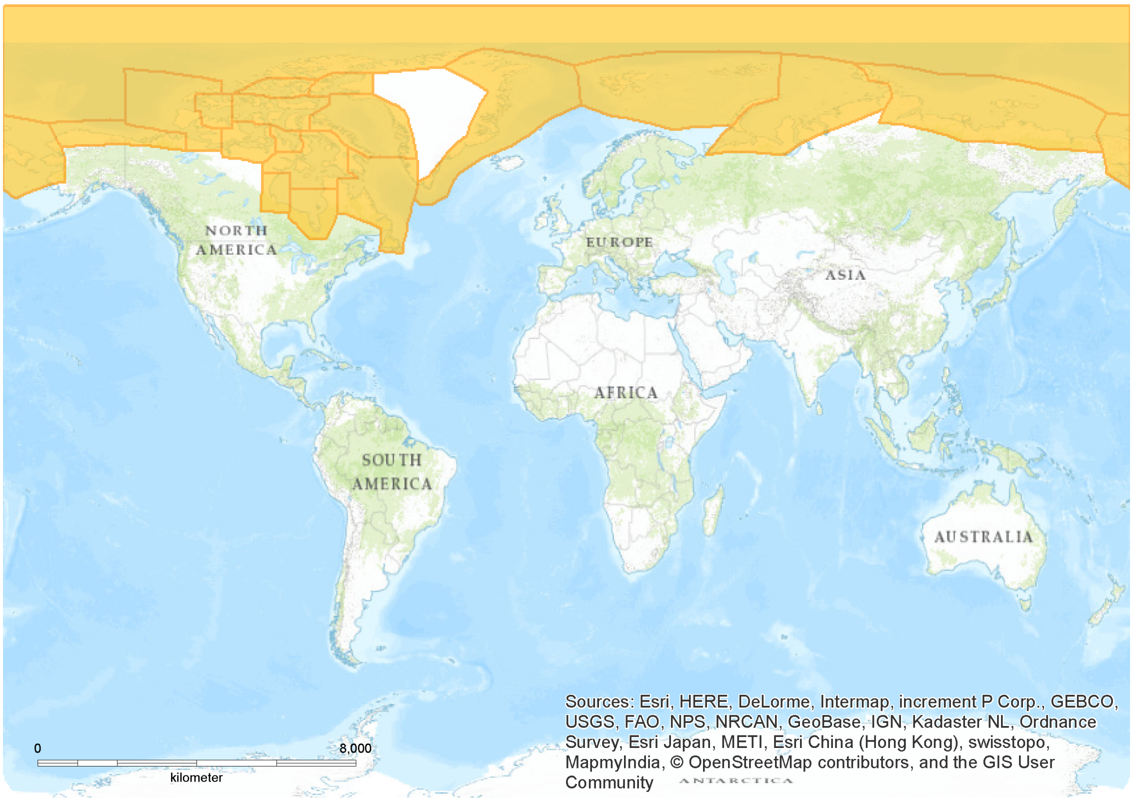
Country Occurrence:

Native: Canada (Labrador, Manitoba, Newfoundland I, Northwest Territories, Nunavut, Ontario, Québec, Yukon); Greenland; Norway; Russian Federation (Krasnoyarsk, North European Russia, West Siberia, Yakutiya); Svalbard and Jan Mayen; United States (Alaska)

FAO Marine Fishing Areas:

Native: Arctic Sea - , Atlantic - northeast, Atlantic - northwest, Pacific - northeast, Pacific - northwest

Distribution Map



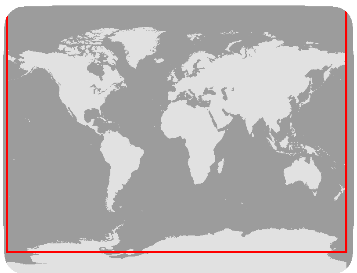
Ursus maritimus

Range

Extant (resident)

Compiled by:
IUCN (International Union for Conservation of Nature)

NE DD LC NT VU VULNERABLE EN CR EW EX



The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

Population

At present, 19 subpopulation units of Polar Bears are recognized by the Polar Bear Specialist Group (PBSG) of the International Union for the Conservation of Nature (Obbard *et al*. 2010). Genetic studies have shown that gene flow occurs among the various subpopulations (Paetkau *et al*. 1999, Crompton *et al*. 2008, Peacock *et al*. 2015) and there is no evidence that any of the units have been evolutionarily separated for significant periods of time. Although demographic exchange may be limited between subpopulations (Mauritzen *et al*. 2002, Crompton *et al*. 2008, Peacock *et al*. 2015), some demographic and genetic exchange occurs. Consequently, the Polar Bear subpopulations cannot be considered as distinct demographic units and the term “management units” may be more accurate. Ongoing reductions in the duration, distribution, and quality of sea ice due to climate change (Sahanatien and Derocher 2012) may result in different levels of genetic and demographic exchange among subpopulations in the future (Derocher *et al*. 2004, Molnár *et al*. 2010), which could lead to new metapopulation dynamics or to functionally isolated subpopulations.

The PBSG summarized the best-available scientific information on the status of the 19 subpopulations of Polar Bears in 2014 (PBSG 2015) including an assessment of current trend (i.e., estimated change in population size over a 12-year period, centred on the time of assessment). The PBSG concluded that one subpopulation (M’Clintock Channel) has increased, six were stable (Davis Strait, Foxe Basin, Gulf of Boothia, Northern Beaufort Sea, Southern Hudson Bay, and Western Hudson Bay), three were considered to have declined (Baffin Bay, Kane Basin, and Southern Beaufort Sea) and, for the remaining nine (Arctic Basin, Barents Sea, Chukchi Sea, East Greenland, Kara Sea, Lancaster Sound, Laptev Sea, Norwegian Bay, and Viscount Melville Sound) there were insufficient data to provide an assessment of current trend. The type, precision, and time span of data used to estimate trends varies among subpopulations (PBSG 2015).

Estimating Polar Bear abundance is expensive and difficult because the animals often occur at low densities in remote habitats. Although abundance estimates have generally improved in recent decades (Obbard *et al*. 2010), information remains poor or outdated for some subpopulations. Summing across the most recent estimates for the 19 subpopulations (Table 3 in the Supplementary Material) results in a total of approximately 26,000 Polar Bears (95% CI = 22,000-31,000). We note that this number differs from what would be obtained by summing abundance estimates in PBSG (2015), because criteria were not the same for including abundance estimates in the two sources (section Population projections). The total number presented here does not include the Arctic Basin subpopulation, for which no information on abundance is available. The 95% confidence intervals presented here were generated using simulation based on estimates of uncertainty in Table 3 and an assumption that the abundance of every subpopulation is independent of the others (see the section *Population projections* in the Supplementary Material). The mixed quality and even lack of available information on each subpopulation means caution is warranted when establishing and reporting a single estimate of the number of polar bears across the circumpolar Arctic. Therefore we used the abundance data in Table 3 in a relative manner, to scale subpopulation-specific changes to changes in the global population size, rather than in an absolute manner.

For further information about this species, see Supplementary Material.

Current Population Trend: Unknown

Habitat and Ecology (see Appendix for additional information)

Polar Bears occur at low densities throughout the circumpolar Arctic and are more abundant in shallower, ice-covered waters associated with the continental shelf where currents or upwellings increase biological productivity. Seasonally, in the summer open water season, Polar Bears may be found on land in higher densities.

The Polar Bear is a K-selected species with late sexual maturity, small litter size, high maternal investment and high adult survival. The Polar Bear's reproductive rate is among the lowest in all mammals (Bunnell and Tait 1981) although similar to that of other ursids. Females generally mature at 4-5 years, and enter a prolonged oestrus between late March and early June, although most mating occurs in April and early May. Ovulation is induced by mating (Stirling 2009), and implantation is delayed until autumn. The total gestation period ranges between 195-265 days (Uspenski 1977, Amstrup 2003). Whether or not the embryo implants and proceeds to develop is likely determined by body condition. Pregnant females enter dens in snow drifts or slopes on land, close to the sea (Andersen *et al*. 2012), or on sea ice (in the Chukchi and Beaufort seas) as early as September/October, but more typically in late autumn (Lentfer and Hensel 1980, Amstrup and Gardner 1994, Wiig 1998). Females give birth inside the den, usually in late December to early January (Derocher *et al*. 1992, Amstrup 2003). Polar Bears most often give birth to twin cubs; singleton and triplet litters are less frequent. Newborn Polar Bears are blind, sparsely haired and weigh approximately 0.6 kg (Blix and Lentfer 1979). They grow rapidly, fed on rich milk from their mother (36% fat; Derocher *et al*. 1993), and when they emerge from the den sometime between early March and late April (Pedersen 1945, Wiig 1998), they weigh 10-12 kg (Amstrup 2003). In some regions, after emerging from the den, the female may not have fed for a period up to 8 months, which may be the longest period of food deprivation for any mammal (Watts and Hansen 1987).

Cub mortality is high in the first year (Larsen 1985, Amstrup and Durner 1995, Wiig 1998), with the probability of cub survival largely determined by maternal condition. Mothers with larger fat stores in the fall emerge in the spring with larger cubs which are more likely to survive (Atkinson and Ramsay 1995, Derocher and Stirling 1998, Robbins *et al*. 2012a). The young usually stay with their mother for two years (Lønø 1970, Stirling et al. 1976, Amstrup and Durner 1995, Wiig 1998), and consequently females on average do not enter a new reproductive cycle more often than every third year most places (Amstrup 2003). In contrast to their low reproductive rates, adult Polar Bears have high survival rates (Obbard *et al*. 2010).

Polar Bears are the most carnivorous of the extant species of bears. Throughout their range, Ringed Seals (*Phoca hispida*), preferably young-of-the-year, and to a lesser extent Bearded Seals (*Erignathus barbatus*) are their primary prey (Derocher *et al*. 2002, Thiemann *et al*. 2008). In some areas they are also known to take Harp Seals (*Pagophilus groenlandicus*), Hooded Seals (*Cystophora cristata*), and even larger species such as Walrus (*Odobenus rosmarus*) and Beluga (*Delphinapterus leucas*) (Thiemann *et al*. 2008). Polar Bears digest fat more efficiently than protein (Best 1984). Polar Bears are large when compared to other ursid species, which is a consequence of their energy-rich diet. Although birds, fish, vegetation and kelp are eaten where locally available during the ice free-season (Pedersen 1945, Russell 1975, Dyck and Romberg 2007, Born *et al*. 2011, Gormezano and Rockwell 2013), it is unlikely that Polar Bears would be capable of gaining enough nutritional benefit to survive on a primarily terrestrial diet (Ramsay and Hobson 1991, Hobson *et al*. 2009, Rode *et al*. 2010b, Rode *et al*. 2015).

Systems: Terrestrial, Marine

Use and Trade

The US, Canada, and Greenland allow and manage a subsistence harvest of Polar Bears; harvest is prohibited in Norway and Russia. The principal use of Polar Bears is for subsistence purposes (Obbard *et al*. 2010, www.pbsg.npolar.no), including consumption of meat; use of hides for clothing; and small scale handicrafts. Whole hides may be used for subsistence needs, kept as trophies, or sold on open markets. The financial return from the sale of legally taken Polar Bear hides can provide important income for local people in Canada and Greenland. Sport hunting of Polar Bears only occurs in Canada and must be guided by local Inuit hunters. While communities can decide whether or not to allow sport hunts, these hunts must be accounted for within the annual quota assigned to a community; sport hunts are not additive to the quota. Sport hunting can be a major source of income for remote settlements because the financial return from the hunt greatly exceeds that of the hide value (Foote and Wenzel 2009). This often provides an important infusion into local, cash limited, economies.

Annual legal harvest of Polar Bears is between 700 and 800 or 3-4% of the estimated size of the total population of about 20-25,000 animals. The harvest level has been thought to be sustainable in most subpopulations (PBSG 2010). Although poaching, or illegal hunting of Polar Bears, is not thought to be of major concern, recent reports suggest that illegal hunting in eastern Russia may be as high as 100-200 bears per year (Kochnev 2004). At present, the PBSG is assessing the status of this problem in all jurisdictions. Mortality of bears in defence of life and property occur throughout the Polar Bears' range and are probably inevitable in areas where Polar Bears and people co-exist.

Polar Bear based tourism, including public viewing and photography is increasing. Well established in Churchill, Canada, it is increasing in other remote areas, including Svalbard, Norway, and to a some extent in locations on the north coast of Alaska (primarily Kaktovik and to a lesser degree Barrow).

Polar Bear products are in trade. The range of different products and units of measure used in records makes it difficult to relate trade data to number of polar bears in trade. Export of Polar Bear products from Canada, where most polar bear products in trade originate, represented between 207 (2014) and 404 (2013) individuals in the period 2010-2014 (Canadian CITES authorities pers. comm.). Greenland introduced a voluntary temporary ban on export of Polar Bear products in 2007. All international trade in polar bear parts is surveyed and regulated by CITES. The polar bear is listed by CITES on Appendix II.

Threats **(see Appendix for additional information)**

Anthropogenic and natural changes in Arctic environments, as well as recognition of the shortcomings of our knowledge of Polar Bear ecology, are increasing the challenges for Polar Bear conservation and management. Higher ambient temperatures and erratic weather fluctuations, symptoms of anthropogenic climate change, are increasing across the range of polar bears. Polar Bears are dependent upon Arctic sea ice for access to their prey. Their dependence on an ephemeral habitat that exists as a function of sea surface and atmospheric temperatures means that climate warming poses the single most important threat to the long-term persistence of Polar Bears (Obbard *et al*. 2010). Arctic sea ice loss has thus far progressed faster than most climate models have predicted (Stroeve *et al*. 2007) with September sea extent declining at a linear rate of 14% per decade from 1979 through 2011 (Stroeve *et al*. 2012, Stroeve *et al*. 2014). Because changes in sea-ice are known to alter Polar Bear abundance, productivity, body condition, and distribution (Stirling *et al*. 1999, Fischbach *et al*. 2007, Schleibe *et al*. 2008, Durner *et al*. 2009, Regehr *et al*. 2010, Rode *et al*. 2010a, 2012, 2014b, Bromaghin *et al*. 2015), continued climate warming will increase future uncertainty and pose severe risks to the welfare of Polar Bear subpopulations (Stirling and Derocher 2012, Derocher *et al*. 2013). Arctic sea ice extent is linearly related to global mean temperature, which in turn, is directly related to atmospheric greenhouse gas concentrations (Amstrup *et al*. 2010). Population and habitat models predict substantial declines in the distribution and abundance of Polar Bears in the future (Durner *et al*. 2009, Amstrup *et al*. 2008, Hunter *et al*. 2010, Castro de la Guardia *et al*. 2013, Hamilton et al. 2014). Although Polar Bears living in historically colder regions of the Arctic might derive transient benefit from a climate-driven transition away from multi-year ice (Derocher *et al*. 2004), the annual sea ice must persist long enough for Polar Bears to derive benefit from associated changes in seal availability and biological productivity. Recent sea ice simulations suggest large regions of the Canadian Arctic Archipelago will be ice free for >5 months by the late 21st century (Hamilton *et al*. 2014). In other parts of the Arctic, the 5-month ice-free threshold may be reached by the middle of the 21st century (Atwood *et al*. 2015). These studies are based on sea-ice data obtained from the World Climate Research Programme's Coupled Model Intercomparison Project phase 5 (CMIP5) (http://cmip-pcmdi.llnl.gov/cmip5/). An annual ice-free period of ≥5 months is likely to lead to extended fasting, which is predicted to lead to increased reproductive failure and starvation (Molnár *et al*. 2011, 2014a, Robbins *et al*. 2012b). Nevertheless, uncertainty and regional variability in the near-term effects of climate change must be included in Polar Bear management and conservation plans.

Although there have been local and regional studies on polar bear denning habitat (Kolenosky and Prevett 1983, Messier *et al*. 1994, Lunn *et al*. 2004, Richardson *et al*. 2005, Durner *et al*. 2003, 2006, 2013, Andersen *et al*. 2012), large scale mapping of Polar Bear denning habitat across the Arctic has not occurred. It is also unknown how climate change will change denning locations and habitats, though predicted increases in forest fires may have adverse effects on maternity denning habitat in sub-Arctic regions (Richardson *et al*. 2007). Declining sea ice availability can impair the ability of pregnant females to reach traditional denning areas (Derocher *et al*. 2011, Cherry *et al*. 2013) and increases of rain events will be detrimental for denning Polar Bears (Stirling and Derocher 1993, Derocher *et al*. 2004).

The occurrence of diseases and parasites in Polar Bears is rare compared with occurrences in other ursids. However, with warming Arctic temperatures, altered climate could influence infectious disease epidemiology through mechanisms such as novel pathogen introduction due to range expansion of carrier animals and arthropod vectors; modification of host susceptibility; changes in pathogen evolution, transmission, and number of generations per year; host immunosuppression; shifts in main food sources; altered behaviour; and co-infections with multiple agents (Harvell *et al*. 2002, Parmesan 2006, Burek *et al*. 2008, Hueffer *et al*. 2011). As a result, the potential for exposure to pathogens and resulting disease outbreaks may become more significant threats as Polar Bears experience the cumulative effects of multiple stressors (Patyk *et al*. 2015).

The warming climate has been associated with an increase in pathogens in other Arctic marine and terrestrial organisms. Parasitic agents that have developmental stages outside the bodies of warm-blooded hosts (e.g., nematodes: Laaksonen *et al*. 2010) will likely benefit from the warmer and wetter weather projected for the Arctic. Improved conditions for such parasites have already adversely affected the health of some Arctic mammals (Kutz *et al*. 2013). Bacterial parasites also are likely to benefit from a warmer and wetter Arctic (e.g., *Vibrio parahaemolyticus*; Baker-Austin *et al*. 2012). As the effects of climate change become more prevalent, there is concern about the emergence of new pathogens within polar bear range, new threats from existing pathogens that may be able to infect immuno-compromised/stressed bears, and the potential for new and existing pathogens to cross human–animal boundaries (e.g., giardia). Because of the previous limited exposure of Polar Bears to diseases and parasites (Fagre *et al*. 2015), researchers have as yet been unable to determine whether they will be more susceptible to new pathogens. However, concern is exacerbated by the fact that Polar Bears appear to have a naïve immune system (Weber *et al*. 2013), which may make them particularly vulnerable to infection. Many different pathogens have been found in seal species that are Polar Bear prey; the potential therefore exists for transmission of these diseases to Polar Bears (Kirk *et al*. 2010). If Polar Bears become nutritionally stressed, altered foraging behaviours such as increased feeding on the internal organs of their primary prey and use of alternative foods (e.g., Prop et al. 2015) may increase the potential for exposure to pathogens. Ensuring the long-term persistence of Polar Bears will necessitate understanding how a rapidly changing physical environment modulates exposure to disease risk factors and, ultimately, population health.

Persistent organic pollutants, which reach Arctic regions via long range transport by air and ocean currents as well as river run off, also increase uncertainty for the welfare of polar bears (Obbard *et al*. 2010, www.pbsg.npolar.no). Although Polar Bears live in relatively pristine Arctic regions, a variety of industrial toxic substances are brought into Polar Bear management areas from human anthropogenic activities around the world. Polar Bears are apex predators and are therefore exposed to high levels of pollutants, which magnify with each step in the food web resulting in high concentrations in polar bear tissue (Letcher *et al*. 2010). A key characteristic of these pollutants is that they persist in the environment due to low biotic and abiotic degradation. The contaminant burdens among Polar Bears are known to vary among regions (e.g., Letcher *et al*. 2010, McKinney *et al*. 2011). Even where contaminant burdens may be known, their effects on Polar Bear physiology and health are not well understood (Letcher *et al*. 2010, Sonne *et al*. 2012). However, Dietz *et al*. (2015) showed that the risk for reproductive, immune suppressive and carcinogenic effects in polar bear subpopulations across the Arctic are high due to PCB and perflourinated compounds (PFCs) exposure.

Many of the contaminants are lipophilic and bond tightly to lipophilic tissues. Polar Bears are particularly vulnerable to organochlorines because they eat a fat rich diet. Ringed, bearded, and harp seals comprise the main food of Polar Bears and the blubber layer is preferentially eaten by the bears and subsequently, the intake of pollutants is high (Letcher *et al*. 2010). Recent studies have documented new pollutants in polar bear tissues which expose the species to even more toxic and complex combination of industrial chemicals (Verreault *et al*. 2005, 2006; Muir *et al*. 2006; Smithwick *et al*. 2006; McKinney *et al*. 2009, 2011; Gebbink *et al*. submitted). The potential for contaminants to impact Arctic systems is predicted to increase as climate warming alters global circulation and precipitation patterns (Macdonald *et al*. 2005, Jenssen *et al*. 2015) and predicting local and regional effects will become more complicated and uncertain.

A three decade study (1983-2010) of East Greenland Polar Bears revealed both declines of conventional POPs and increases in brominated flame retardants (BFRs) and PFCs (Dietz *et al*. 2008, 2013a,b; Riget *et al*. 2013). The last decade has showed climate related increases in PCBs as well as peaks of BFRs and PFCs due to recent industrial reductions (Dietz *et al*. 2013b McKinney *et al*. 2013).

Although the effects of pollutants on polar bears are only partially understood, levels of such pollutants in some subpopulations are already sufficiently high that they may interfere with hormone regulation, immune system function, and possibly reproduction (Wiig *et al*. 1998; Bernhoft *et al*. 2000; Skaare *et al*. 2000, 2001; Gustavson *et al*. 2015; Henriksen *et al*. 2001; Derocher *et al*. 2003; Derocher 2005; Dietz *et al*. 2015; Sonne *et al*. 2015). There are suggestions that species with delayed implantation are more vulnerable to the effects of pollution through endocrine (hormone) disruption (Knott *et al*. 2011). Further, because female Polar Bears are food deprived during gestation, their pollution load increases in their blood, when energy and pollutants are mobilized from their adipose tissue. Because the cubs are nursed on fat rich milk they are exposed to very high pollution loads from their mother (Polishuk *et al*. 2002, Bytingsvik *et al*. 2012). This may pose the greatest threat to the species as the vulnerability of pre- and neonatal polar bears is the most sensible to life-long health effects from long-range transported pollution which decreases immunity, survival and reproductive success (Letcher *et al*. 2010, Sonne 2010).

An additional emerging threat to Polar Bears is the increase in resource exploration and development in the Arctic along with increased ice-breaking and shipping. There are currently no data on the effects of ice-breaking on habitat use by Polar Bears. Although some studies suggest that Polar Bears are sensitive to localized disturbance at maternity den sites (Lunn *et al*. 2004, Durner *et al*. 2006), our knowledge about potential effects of large scale development is lacking.

Oil development in the Arctic poses a wide of range of threats to Polar Bears ranging from oil spills to increased human-bear interactions. It is probable that an oil spill in sea ice habitat would result in oil being concentrated in leads and between ice floes resulting in both Plar Bears and their main prey (Ringed Seal and Bearded Seal) being directly exposed to oil. Polar Bears are often attracted by the smells and sound associated with human activity. Polar Bears are known to ingest plastic, styrofoam, lead acid batteries, tin cans, oil, and other hazardous materials with lethal consequences in some cases (Lunn and Stirling 1985, Amstrup *et al*. 1989, Derocher and Stirling 1991). Another concern is that seals covered in oil may be a major source of oil to polar bears. Although the biological threats and impacts of oil and gas activities on Polar Bears are reasonably well understood (Øritsland *et al*. 1981; Hurst and Øritsland 1982; Stirling 1988, 1990; Isaksen *et al*. 1998; Amstrup *et al*. 2006), mitigation and response plans are currently lacking (but see Wilson *et al*. 2014). Moreover, how Polar Bears will be affected by other types of human activity are less well known (Vongraven *et al*. 2012).

Significant portions of the Polar Bear's range already are being developed and exploration is proposed for many other areas. With warming induced sea ice decline, previously inaccessible areas will be exposed to development and other forms of anthropogenic activities (e.g., trans-Arctic shipping, tourism). The direct effects of human activities, the increased potential for negative human-bear encounters, and the potential for increased local pollution are all concerns that must be understood if we are to understand and manage impacts on the future for Polar Bears.

Our understanding of Polar Bear population dynamics has improved with ongoing development and refinement of analytical methods (e.g., Taylor *et al*. 1987, 2002, 2005, 2006, 2008a,b, 2009; Amstrup *et al*. 2001; McDonald and Amstrup 2001; Regehr *et al*. 2007, 2010, 2015; Aars *et al*. 2009; Stapleton *et al*. 2014). These improved and new tools suggest that previous estimates of population parameters and numbers can be biased. Vital rates are subpopulation specific, and different from the generalized rates that were often used to generate previous status reports (Taylor *et al*. 1987). For the two subpopulations (Southern Beaufort Sea, Western Hudson Bay) that are known to have been impacted by climate change and where a long time series of abundance exist, harvest represents an additive impact. Illegal take of polar bears in Russia, combined with legal subsistence harvest in the U.S., may exceed sustainable limits for the Chukchi subpopulation (pbsg.npolar.no). In many cases harvest documentation and the population data necessary to assess the impact of harvest both are insufficient to allow managers to provide the desired balance between potential yield and take. Given the cultural and economic importance of Polar Bear hunting in many regions, understanding the potential for and the impact of hunting continues to be a critical part of management (Obbard *et al*. 2010, Vongraven *et al*. 2012, pbsg.npolar.no).

It is important that subpopulation estimates and projections are based on substantiated scientific data. In some areas, studies to estimate abundance occur infrequently so if the harvest rate is either initially set above the sustainable level or it becomes so, the subpopulation may be reduced before the next inventory is made. In addition, harvest practices may have to be reconsidered given recent knowledge about long-term environmental trends and fluctuations that can affect sustainable removal rates. In some jurisdictions in Canada, the governance system includes aboriginal co-management boards and aboriginal hunting organizations. In some of these co-management systems, both local knowledge and science are to be considered equally in both management and research decisions. Although scientific studies have concluded that the long-term effects of capturing and collaring polar bears are minimal (Ramsay and Stirling 1986, Messier 2000, Thiemann *et al*. 2013, Rode *et al*. 2014a), some local groups nevertheless consider these techniques disrespectful or harmful to the animals. As a result, population inventory and ecological studies have been delayed or not permitted. On the other hand, alternative research techniques such as aerial surveys and genetic biopsy capture-recapture methods were designed and implemented. Reduced monitoring will constrain governments' ability to assess sustainability of harvest especially if abundance is estimated from aerial surveys which cannot provide data on vital rates (Aars *et al*. 2009, Stapleton *et al*. 2014).

Human caused habitat change and increasing human-bear interactions also must be incorporated into polar bear population projections (e.g., Hunter *et al*. 2010) and polar bear harvest management in the future. Due to increased access to previously isolated areas, Polar Bears will face increased risks from a variety of human–bear interactions. New settlements are possible with industrial development, and expansion of tourist visitations is assured. Although the fact of human–bear interactions can be reasonably measured, we have a long way to go to understand the effect of such interactions. The added stresses, resulting from a "more crowded" Arctic, may play an important role in the future welfare of Polar Bears.

Conservation Actions **(see Appendix for additional information)**

Conservation actions for Polar Bears vary by jurisdiction and detailed information can be found in Obbard *et al*. (2010) and at www.pbsg.npolar.no. The International Agreement on the Conservation of Polar Bears that was signed in 1973 by the five nations Canada, Denmark (Greenland) Norway, Soviet Union (Russian Federation) and USA, provides guidance. Article II of the Agreement states that each contracting party "…shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data,…" and according to Article VII, "The Contracting Parties shall conduct national research programs on Polar Bears…" and "...consult with each other on the management of migrating Polar Bear populations...". These articles have been important for stimulating governments to support applied research to answer management questions regarding Polar Bears throughout their range.

In light of the growing concern over Polar Bear conservation in relation to climate change and a number of other issues, such as oil- and gas activities, shipping and tourism, the five Parties have agreed to initiate a process that would lead to a coordinated approach to conservation and management strategies for Polar Bears. A key aspect of this approach is the recognition that plans for action should be developed at a national level leading up to development of comprehensive circumpolar plan for action that address Polar Bear conservation. The Circumpolar Action Plan for Polar Bear is planned to be signed by the parties in autumn 2015.

The Parties recognize that Article VII of the Agreement calls for all Parties to conduct national research programs, particularly relating to the conservation and management of Polar Bears, and that they shall coordinate such research and exchange information on research programs, results, and data on bears taken. The Parties continue to be committed to carrying out research in support of Polar Bear conservation. The Parties also recognize that the technical support and scientific advice on Polar Bear conservation provided by the PBSG supports the 1973 Agreement and is a vital part of the decision making process that the competent authorities should consider in making management decisions. The PBSG has accepted to serve as an independent science advisory body to the Parties.

The PBSG regards the 1973 Agreement as the cornerstone and basis for any action plan on Polar Bears. The PBSG has identified the following research elements to be included in all action plans (Vongraven *et al*. 2012):

- Assessment of subpopulation size and/or trend and projection of future status
- Monitoring harvest and other removals
- Understanding movements and distribution patterns and how they are changing with ongoing habitat changes
- Establishing trends in physical condition and why they are changing
- Documenting human-bear conflicts
- Documenting trends in habitat use, availability and trends
- Documenting trends in pollution and disease
- Vital rates estimation, evaluating trends and projection

The PBSG recognizes that particular elements (for example, monitoring of pollution and sea ice habitat) are of inter-jurisdictional concern and would benefit from multi-jurisdictional cooperation. Further, the Parties shall consult with each other on the management of shared Polar Bear subpopulations, and exchange information on research and management programs. The PBSG has reiterated that all management actions be based on the best scientific information. The PBSG has identified these management elements to be included in all action plans (Vongraven *et al*. 2012):

- Protection of essential habitats
- Use of scientific evidence
- Monitoring, prevention and sound management of human-bear conflicts
- Development of inter-jurisdictional agreements for shared populations
- Development of management strategies to minimize impacts of human activities (e.g. mining, shipping, oil and gas activities, tourism and other human-caused disturbance)
- Management of sustainable harvest
- Ensure the active involvement of the local public living in polar bear areas in developing and achieving

the goals of the action plan

Credits

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Disclaimer

External Resources

For Supplementary Material, and for Images and External Links to Additional Information, please see the Red List website.

Appendix

Habitats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Habitat	Season	Suitability	Major Importance?
1. Forest -> 1.1. Forest - Boreal	Breeding	Suitable	No
3. Shrubland -> 3.1. Shrubland - Subarctic	Non-breeding	Suitable	No
4. Grassland -> 4.1. Grassland - Tundra	Non-breeding	Suitable	Yes
10. Marine Oceanic -> 10.1. Marine Oceanic - Epipelagic (0-200m)	Resident	Suitable	Yes
12. Marine Intertidal -> 12.1. Marine Intertidal - Rocky Shoreline	Resident	Suitable	Yes
12. Marine Intertidal -> 12.2. Marine Intertidal - Sandy Shoreline and/or Beaches, Sand Bars, Spits, Etc	Resident	Suitable	Yes
12. Marine Intertidal -> 12.3. Marine Intertidal - Shingle and/or Pebble Shoreline and/or Beaches	Resident	Suitable	Yes
12. Marine Intertidal -> 12.4. Marine Intertidal - Mud Flats and Salt Flats	Resident	Suitable	Yes
13. Marine Coastal/Supratidal -> 13.1. Marine Coastal/Supratidal - Sea Cliffs and Rocky Offshore Islands	Non-breeding	Suitable	Yes
13. Marine Coastal/Supratidal -> 13.3. Marine Coastal/Supratidal - Coastal Sand Dunes	Non-breeding	Suitable	No
0. Root -> 17. Other	Resident	Suitable	Yes

Threats

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Threat	Timing	Scope	Severity	Impact Score
1. Residential & commercial development -> 1.2. Commercial & industrial areas	Ongoing	Majority (50-90%)	Causing/could cause fluctuations	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation		
1. Residential & commercial development -> 1.3. Tourism & recreation areas	Ongoing	Minority (50%)	Causing/could cause fluctuations	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.3. Indirect ecosystem effects 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
3. Energy production & mining -> 3.1. Oil & gas drilling	Ongoing	Minority (50%)	Causing/could cause fluctuations	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		

4. Transportation & service corridors -> 4.3. Shipping lanes	Ongoing	Minority (50%)	Causing/could cause fluctuations	Low impact: 5
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.1. Intentional use (species is the target)	Ongoing	Majority (50-90%)	Slow, significant declines	Medium impact: 6
	Stresses:	2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.6. Skewed sex ratios		
5. Biological resource use -> 5.1. Hunting & trapping terrestrial animals -> 5.1.3. Persecution/control	Ongoing	Minority (50%)	Causing/could cause fluctuations	Low impact: 5
	Stresses:	2. Species Stresses -> 2.1. Species mortality		
6. Human intrusions & disturbance -> 6.1. Recreational activities	Ongoing	Minority (50%)	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
7. Natural system modifications -> 7.1. Fire & fire suppression -> 7.1.1. Increase in fire frequency/intensity	Future	Minority (50%)	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
8. Invasive & other problematic species & genes -> 8.1. Invasive non-native/alien species -> 8.1.1. Unspecified species	Future	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
8. Invasive & other problematic species & genes -> 8.2. Problematic native species	Ongoing	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
9. Pollution -> 9.2. Industrial & military effluents -> 9.2.1. Oil spills	Ongoing	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance		
9. Pollution -> 9.3. Agricultural & forestry effluents -> 9.3.3. Herbicides and pesticides	Ongoing	Whole (>90%)	Causing/could cause fluctuations	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		
9. Pollution -> 9.6. Excess energy -> 9.6.3. Noise pollution	Ongoing	Unknown	Unknown	Unknown
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.2. Species disturbance		

11. Climate change & severe weather -> 11.1. Habitat shifting & alteration	Ongoing	Whole (>90%)	Causing/could cause fluctuations	Medium impact: 7
	Stresses:	1. Ecosystem stresses -> 1.1. Ecosystem conversion 1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality 2. Species Stresses -> 2.2. Species disturbance 2. Species Stresses -> 2.3. Indirect species effects -> 2.3.7. Reduced reproductive success		
12. Other options -> 12.1. Other threat	Ongoing	Majority (50-90%)	Causing/could cause fluctuations	Medium impact: 6
	Stresses:	1. Ecosystem stresses -> 1.2. Ecosystem degradation 2. Species Stresses -> 2.1. Species mortality		

Conservation Actions in Place

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions in Place
In-Place Research, Monitoring and Planning
Action Recovery plan: No
In-Place Land/Water Protection and Management
Conservation sites identified: Yes, over part of range
Occur in at least one PA: Yes
Area based regional management plan: Yes
In-Place Species Management
Harvest management plan: Yes
In-Place Education
Included in international legislation: Yes
Subject to any international management/trade controls: Yes

Conservation Actions Needed

(http://www.iucnredlist.org/technical-documents/classification-schemes)

Conservation Actions Needed
1. Land/water protection -> 1.1. Site/area protection
1. Land/water protection -> 1.2. Resource & habitat protection
2. Land/water management -> 2.1. Site/area management
3. Species management -> 3.1. Species management -> 3.1.1. Harvest management
3. Species management -> 3.1. Species management -> 3.1.2. Trade management
3. Species management -> 3.2. Species recovery

Conservation Actions Needed
4. Education & awareness -> 4.1. Formal education
4. Education & awareness -> 4.2. Training
4. Education & awareness -> 4.3. Awareness & communications
5. Law & policy -> 5.1. Legislation -> 5.1.1. International level
5. Law & policy -> 5.1. Legislation -> 5.1.2. National level
5. Law & policy -> 5.1. Legislation -> 5.1.3. Sub-national level
5. Law & policy -> 5.1. Legislation -> 5.1.4. Scale unspecified
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.1. International level
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.2. National level
5. Law & policy -> 5.4. Compliance and enforcement -> 5.4.3. Sub-national level

Research Needed
(http://www.iucnredlist.org/technical-documents/classification-schemes)

Research Needed
1. Research -> 1.2. Population size, distribution & trends
1. Research -> 1.3. Life history & ecology
1. Research -> 1.5. Threats
1. Research -> 1.6. Actions
2. Conservation Planning -> 2.1. Species Action/Recovery Plan
2. Conservation Planning -> 2.2. Area-based Management Plan
2. Conservation Planning -> 2.3. Harvest & Trade Management Plan
3. Monitoring -> 3.1. Population trends
3. Monitoring -> 3.2. Harvest level trends
3. Monitoring -> 3.3. Trade trends
3. Monitoring -> 3.4. Habitat trends
0. Root -> 4. Other

Additional Data Fields

Distribution
Estimated area of occupancy (AOO) (km^2): 24000000
Extreme fluctuations in area of occupancy (AOO): No

Population
Extreme fluctuations: No
Population severely fragmented: No
No. of subpopulations: 19
Continuing decline in subpopulations: No
Extreme fluctuations in subpopulations: No
All individuals in one subpopulation: No
Habitats and Ecology
Generation Length (years): 9.8-13.6,11.5
Movement patterns: Nomadic

The IUCN Red List Partnership

The IUCN Red List of Threatened Species™ is produced and managed by the IUCN Global Species Programme, the IUCN Species Survival Commission (SSC) and The IUCN Red List Partnership.

The IUCN Red List Partners are: BirdLife International; Botanic Gardens Conservation International; Conservation International; Microsoft; NatureServe; Royal Botanic Gardens, Kew; Sapienza University of Rome; Texas A&M University; Wildscreen; and Zoological Society of London.