

Polar Bear

WWF WILDLIFE AND CLIMATE CHANGE SERIES



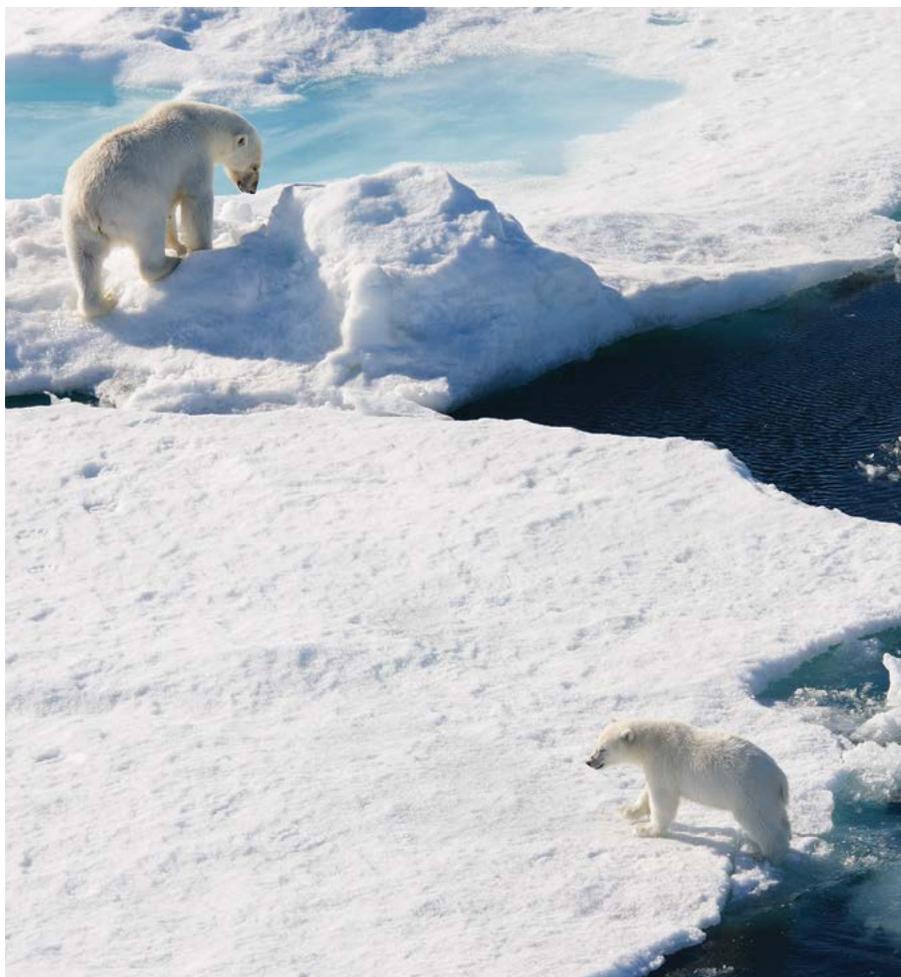
This assessment is one in a series resulting from a WWF study that assesses the vulnerability of numerous species to the effects of climate change. For each species, we also recommend climate-adaptive management strategies.

POLAR BEARS (*Ursus maritimus*) are the poster child for the impacts of climate change on species, and justifiably so. To date, global warming has been most pronounced in the Arctic, and this trend is projected to continue.

Polar bears have relatively high genetic diversity within the species, and can disperse over very long distances, suggesting that they may have some capacity to adapt to the ongoing changes in the Arctic. The impacts of global warming will vary among subpopulations, and some individuals might be able to compensate for the loss of ice-dependent seals by eating other prey.

However, their dependence on sea ice does make them highly vulnerable to a changing climate. Polar bears rely almost entirely on the sea ice environment for traveling, hunting, mating, resting, and in some areas, maternal dens. In particular, they depend heavily on sea ice-dependent prey, such as ringed and bearded seals. Additionally, their long generation time and low reproductive rate may limit their ability to adapt to changes in the environment.

Priorities for climate-informed polar bear conservation should include identifying and protecting the “last ice areas,” the parts of the Arctic that are projected to retain sea ice farthest into the future. It is also important to increase monitoring of polar bear populations, particularly their responses to declining sea ice. As polar bears spend more time on land, we need a better understanding of the drivers of human-polar bear conflict.



Polar bear range

DETERMINING SPECIES VULNERABILITY

The study identified the key vulnerabilities of a species based on four factors:

SENSITIVITY: the inability of the species to persist, as is, under changing climatic conditions. To assess sensitivity, we looked at IUCN Red List status, geographic range, population size, temperature tolerance, reliance on environmental cues (for reproduction, migration, hibernation), symbiotic interactions, diet, abundance of food sources, freshwater requirements, habitat specialization and susceptibility to disease.

ADAPTIVE CAPACITY: the ability of the species to respond to changes in climate. To assess adaptive capacity, we looked at dispersal ability, generation time, reproductive rate and genetic variation.

EXPOSURE: the extent of climatic change and variation that the species encounters and is projected to encounter.

OTHER THREATS: any other relevant threats, such as habitat destruction, poaching, human-wildlife conflict and pollution, as well as the human responses to climate change that exacerbate these threats.

CLIMATE VULNERABILITY OF THE POLAR BEAR

Vulnerability Levels: **H** = High **M** = Medium **L** = Low **U** = Unknown

SENSITIVITY

M IUCN Red List Status Vulnerable¹

G Geographic Range

M **Medium.** Found throughout the ice-covered waters of the Arctic (from 51°N to the North Pole), with their range limited by the southern extent of sea ice (Hudson Bay, Canada).¹ Range countries include Canada, Greenland (Denmark), Norway, Russia, and the USA.¹

M Population Size

Medium. 20,000-25,000 individuals found in 19 subpopulations. As of 2014, 3 populations are declining, 6 are stable, 1 is increasing, and 9 are data deficient.²

M Temperature Tolerance

Medium. They lose over 10 times more heat than they produce when they are wet,³ and young bears in particular are more susceptible in water close to freezing temperatures.⁴ Susceptible to heat stress due to their low surface-area-to-volume ratio. However, they do appear to thermoregulate effectively during the summer months,³ resting on snow to stay cool.

H Does the species rely on environmental cues for reproduction?

Yes. Breeding occurs from March to May, with births occurring from November to January.¹ The fertilized egg attaches and begins development sometime between September and October (delayed implantation), and females give birth to cubs between late November and early January.⁵ Females show high fidelity to denning sites (usually on land), the distribution of which is changing as sea ice decreases.⁵ As a result, females are now expending more energy reaching denning sites when sea ice forms late, thus affecting their fitness and denning success.⁶ When sea ice breaks up early, females emerging with cubs may be forced to spend the summer on land, where food is scarce.

H Does the species rely on environmental cues for migration?

Yes. The timing of migration is linked to seasonal sea ice dynamics, and the bears who spend the summers on land have already been documented arriving earlier, and departing later, in response to changes in sea ice.⁷

M Does the species rely on environmental cues for hibernation?

No. They don't hibernate, but pregnant females occupy snow dens for 5-6 months,¹ while fasting.⁵ During this time they exhibit a reduced metabolic rate and a drop in core body temperature.³ During the summer, bears exhibit moderate declines in activity and body temperature, due to limited access to food.³

M Does the species have any strong or symbiotic relationships with other species?

No. However, polar bears and ringed seals (their primary prey) are intimately connected ecologically.⁸

M Diet

Generalist. They prey mostly on ringed and bearded seals,⁹ but they are opportunistic predators, and occasionally feed on other seals, belugas, narwhals, walrus, birds, bird eggs, fish, animal carcasses,⁵ kelp, food, waste from human settlements, and even other polar bears in a few instances.¹⁰ Some subpopulations and individuals appear to be more capable of feeding on alternative prey than others.⁹ A 200 kg bear needs 2 kg of blubber per day.¹¹ Polar bears feed intensively on seals for a brief period in the spring during the seal pupping season, replenishing fat reserves used up during the winter.⁵ Pregnant females may not have fed for up to 8-9 months at this point.¹²

M Abundance of Food Source

Medium. Individuals that have continuous access to sea ice are able to hunt throughout the year, but those in areas where sea ice melts completely each summer are forced to fast on land using stored fat reserves.¹ Foraging opportunities on land are limited, and it is thus unlikely that bears can replace lost access to marine mammals with land-based prey.¹³ The highest hunting success is between April and July, when ringed seals use the ice for rearing pups and molting.¹⁴ Seal populations may experience rapid decline due to declining sea ice.

L Freshwater Requirements

Low. They rarely drink freshwater, but rely instead on the water they produce as a byproduct of fat metabolism from their diet.

H Habitat Specialization

Specialist. They rely almost entirely on the sea ice environment¹ for traveling, hunting, mating, resting, and in some areas, maternal dens.⁵ They are most abundant in shallow water areas near shore,¹ or near the highly productive sea ice areas over the continental shelves.¹⁵ When sea ice retreats north in the summer, polar bears either follow the ice, or go on land until the sea ice returns.⁵ Over most of their range, they remain on the sea ice year-round; however, they are spending increasing amounts of time on land in the summer due to declining sea ice.¹ Even those that stay on land for longer periods still depend on the sea ice for hunting.⁵ Seal species are also heavily dependent on sea ice.

L Susceptibility to Disease

Low. Polar bears are currently not very prone to disease, though there are some known parasitic (e.g., *Trichinella* sp.)¹⁶ and viral (e.g., morbilliviruses)¹⁷ infections. As they spend more time on land, extended periods in close proximity to other polar bears may increase their susceptibility to disease.

ADAPTIVE CAPACITY

M Dispersal Ability

Medium. Wide-ranging and highly mobile animals, though their movement is largely dictated by sea ice dynamics.⁵ Males are known to wander over vast distances; females are more restricted, as they den once every 3 years to give birth. On average, the range of female polar bears is 125,100 km²,¹⁸ but it can be as great as 600,000 km².¹⁹ Polar bears can swim long distances, but can drown if they have to swim too far.²⁰

H Generation Time

Long. Approximately 15 years.²¹ Age at first reproduction is 5-6 years.¹ The maximum lifespan on record is about 30 years.⁵

H Reproductive Rate

Low. Litter size is 1 to 2 cubs, most often 2, and occasionally 3.^{1,5} Females typically keep offspring for 2.5 years, and therefore breed every third year.⁵ Cub mortality rates can be as high as two-thirds.⁵ If the body mass of a female drops below 189 kg, she will be unable to reproduce successfully.²²

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M Genetic Variation

Medium. Polar bears have relatively high genetic diversity within the species. Genetic data suggest that populations are divided into four clusters (Eastern Polar Basin, Western Polar Basin, Canadian Archipelago, and Southern Canada). There is evidence of gene flow within the last 1-3 generations toward the Canadian archipelago and Western Polar Basin, possible climate refugia for polar bears.²³

EXPOSURE

M What degree of climate variability is the species currently exposed to?

Medium. Over the past hundreds of millennia, polar bears have been exposed to temperatures higher than those they presently experience, and also to extreme periods of cooling,⁵ but there hasn't been an ice-free Arctic in the last 800,000 years.²⁴ There has been substantial warming in the Arctic over the last 50 years. From 1979 to 2012, annual sea ice area in the Arctic has decreased 3.5%-4.1% per decade, and summer minimum sea ice area has decreased by 11.5% per decade.²⁵

H What level of change in temperature and precipitation is projected across the species' range?

High. Warming is projected to be highest in the Arctic, well above that of the projected global average. There will be further thinning and retreat of Arctic sea ice, and a nearly ice-free Arctic in the summer (September) is likely before mid-century.²⁵

OTHER THREATS

M Other Threats

Medium. Environmental toxins (e.g., persistent organic pollutants), shipping, tourism, oil and gas exploration and development, over-harvesting, and poaching (particularly in Russia). Longer ice-free seasons could increase shipping activity, resource exploration, and development. Additionally, an increase in the number of polar bears occurring near or on land has resulted in increased human-wildlife conflict, and given hunters easier access to bears.⁵

RECOMMENDED CLIMATE-ADAPTIVE MANAGEMENT STRATEGIES

Based on the vulnerability assessment, we recommend these climate-adaptive management strategies for polar bears:

1. Identify and protect key areas which might remain viable for polar bears in the long term. This includes seasonal habitat areas and suitable sites for denning. Efforts should focus on regions that are projected to retain ice habitat farther into the future than other areas. The "last ice area" is projected to remain in northeastern parts of the Canadian Archipelago and northern Greenland,²⁶ and adjacent parts of the polar basin.²⁷
2. Increase monitoring of population range shifts, changes in phenology, changes in population abundance, changes in behavior, and the correlation of any of these with changes in weather and climate. Different subpopulations may respond in different ways, and it is important to better understand this.²⁰
3. Monitor population differences in response to sea ice loss in particular. These could include
 - Spending more time on shore vs. ice.
 - Differences in survival and condition.
 - Changes in prey abundance, notably ice-dependent seal species.
 - Prey switching.
4. Increase efforts to conserve polar bear prey, to maximize the chances that polar bears will have continued access to their natural prey base.
5. Increase the extent of protected areas to include stepping stones, movement corridors, and climate refugia.²⁸ Consider mobile protected areas, which shift depending on sea-ice coverage at any given time.
6. Monitor disease. This becomes increasingly important as polar bears spend more time on land and are exposed to new pathogens.
7. Reduce pressures from other threats, many of which are likely to be exacerbated by climate change, through increasing the capacity of humans to manage the effects of climate change. Examples include
 - Reduce human-polar bear conflict. As polar bears spend more time on land, we need a better understanding of the drivers of human-polar bear conflict. Community monitoring and reporting could be a useful tool here.
 - Monitor the effects of increasing human activity in the Arctic, including the effects of shipping, resource exploration and extraction, and ecotourism disturbance.
 - Minimize habitat loss and fragmentation, particularly in critical polar bear habitat (e.g., denning areas, migration routes, and feeding areas).
 - Monitor trends (such as an increase in poaching) that might indicate that communities facing increased hardships are turning to methods of earning income that adversely affect polar bears and other wildlife.
 - Help people adapt to the changing climate by promoting alternative livelihoods that conserve ecosystem services and do not negatively impact polar bears.
 - Monitor changes in polar bear subpopulation numbers, determine how those changes might affect current hunting quotas, and ensure that the quotas do not exceed sustainable harvest of the populations.

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For this and other species assessments, visit worldwildlife.org/wildlife-and-climate.

Acknowledgments: Abigail Hehmeyer, Femke Koopmans, Elisabeth Kruger, Brandon LaForest, Shaun Martin, and Gert Polet (all of WWF). **All Photos:** © Florian Schulz/visionsofthewild.com. **References:** 1. Schliebe S et al. (IUCN SSC Polar Bear Specialist Group), 2008. *Ursus maritimus*. The IUCN Red List of Threatened Species 2008: e.T22823A9391171. 2. IUCN SSC Polar bear specialist group. 3. Whiteman J et al., 2015. Summer declines in activity and body temperature offer polar bears limited energy savings. *Science* 349 (6245): 295-298. 4. Blix A & Lentfer J, 1979. Modes of thermal protection in polar bear cubs - at birth and on emergence from the den. *Am. J. Physiol.* 236: 67-74. 5. Wiig O et al., 2008. Effects of climate change on polar bears. *Science Progress* 91(2): 151-173. 6. Stirling I & Derocher A, 2012. Effects of climate warming on polar bears: a review of the evidence. *Global Change Biology* 18(9): 2694-2706. 7. Cherry S et al., 2013. Migration phenology and seasonal fidelity of an Arctic marine predator in relation to sea ice dynamics. *Journal of Animal Ecology* 82: 912-921. 8. 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. 9. Thiemann G et al., 2008. Polar bear diets and Arctic marine food webs: Insights from fatty acid analysis. *Ecological Monographs* 78(4): 591-613. 10. Amstrup S et al., 2006. Recent observations of intraspecific predation and cannibalism among polar bears in the southern Beaufort Sea. *Polar Biol.* 29: 997-1002. 11. Best R, 1985. Digestibility of ringed seals by the polar bear. *Can. J. Zool.* 63: 1022-1036. 12. Derocher A & Stirling I, 1992. The population dynamics of polar bears in western Hudson Bay. In *Wildlife 2001: Populations*, pp. 1150 - 1159. Elsevier, London. 13. Rode K et al., 2015. Can polar bears use terrestrial foods to offset lost ice-based hunting opportunities? *Front. Ecol. Environ.* 13(3): 138-145. 14. Amstrup S, 2003. In *Wild Mammals of North America: Biology, Management, and Conservation*, pp. 587-610. The Johns Hopkins Univ. Press, Baltimore, ed. 2. 15. Oakley K et al., 2015. Changing Arctic Ecosystems. U.S. Geological Survey, 4210 University Drive, Anchorage, Alaska 99508. 16. <http://www.polarbearsinternational.org/status-and-threats/disease> 17. Tryland M et al., 2005. Serologic survey for selected virus infections in polar bears at Svalbard. *Journal of Wildlife Diseases* 41(2): 310-316. 18. Ferguson S et al., 1999. Determinants of home range size for polar bears (*Ursus maritimus*). *Ecology Letters* 2: 311-318. 19. Amstrup S et al., 2000. Movements and distribution of polar bears in the Beaufort Sea. *Canadian Journal of Zoology* 78(6): 948-966. 20. U.S. Fish and Wildlife. 2015. Polar Bear (*Ursus maritimus*) Conservation Management Plan, Draft. U.S. Fish and Wildlife, Region 7, Anchorage, Alaska. 59 pp. 21. Pacifici M et al., 2013. Generation length for mammals. *Nature Conservation* 5: 87-94. 22. Derocher A et al., 1992. Pregnancy rates and serum progesterone levels of polar bears in western Hudson Bay. *Canadian Journal of Zoology* 70(3): 561-566. 23. Peacock E et al., 2015. Implications of the Circumpolar Genetic Structure of Polar Bears for Their Conservation in a Rapidly Warming Arctic. *PLoS ONE* 10(1): e112021. 24. Overpeck, J et al., 2005. Arctic system on trajectory to new, seasonally ice-free state. *Eos Trans. AGU* 86(34): 309-313. 25. Stocker T et al., 2013. Technical Summary. In: *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. 26. http://wwf.panda.org/what_we_do/where_we_work/arctic/last_ice_area/ 27. Durner G et al., 2009. Predicting 21st-century polar bear habitat distribution from global climate models. *Ecol. Monog.* 79: 25-58. 28. Mawdsley J et al., 2009. A review of climate-change adaptation strategies for wildlife management and biodiversity conservation. *Conservation Biology* 23(5): 1080-1089. © 2015 WWF. All rights reserved by World Wildlife Fund, Inc. 10-15

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