Melting Under Pressure

THE REAL SCOOP ON CLIMATE WARMING AND POLAR BEARS

By Ian Stirling and
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Credit: G. Thiemann

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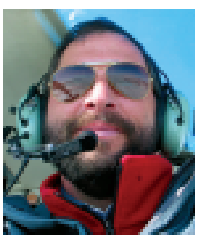

Courtesy of Andrew Derocher

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Recent press coverage about the long-term survival of polar bears and the loss of sea ice in the Arctic due to climate warming has been substantial. In response to a petition from the Center for Biological Diversity and other organizations, the U.S. Fish and Wildlife Service proposed in January 2007 to list polar bears as threatened because of the possibility that "all or a significant proportion of the total population will become endangered in the foreseeable future" (defined for the purpose of the assessment as 45 years). Habitat loss of sea ice is the central justification for the proposed listing. In response, contrarian articles continue to appear in the popular press, questioning climate warming in general and, more specifically, denying the potential negative effects on polar bears. Such articles generally exhibit a poor understanding of polar bear ecology and selectively use information out of context, which results in public confusion about the real threat to polar bears due to loss of sea ice.

Further confusion was introduced in Nunavut, Canada, when local ecological knowledge reported sightings of more polar bears around certain settlements in recent years. This was interpreted as evidence that the populations were increasing, which led to allowable harvest levels being increased, despite scientific evidence that the populations were declining in two areas and a lack of current population data for a third population (Stirling and Parkinson 2006). Polar bears have home ranges that often exceed 200,000 km2 (Garner et al. 1991; Mauritzen et al. 2001) and roam far beyond the purvey of hunters based on or near the coast; therefore, it is simply not possible to develop a population perspective from anecdotal observations of polar bears. Further, regional observations may also be affected by factors difficult to measure locally, such as large-scale shifts in the distribution and abundance of prey species or of sea ice.

Polar bears are the largest of the terrestrial carnivores and males are roughly twice the mass of females. Females first breed at four to six years of age, usually have two cubs born in snow dens on land (although some are born in dens on the sea ice), and cubs stay with their mothers for two and a half years before weaning; therefore females cannot breed more often than every three years. Both sexes can live 20 to 25 years or more and, over most of their range, their primary prey is ringed seals and bearded seals. Polar bears are uniquely adapted to thrive on sea ice and are dependent on it as a platform for hunting seals, seasonal movements, summer refuge, traveling to ice or terrestrial refuge areas, finding mates, and breeding.

Assessing the Facts

Superficially, polar bears might appear secure. They are widely distributed throughout the ice-covered seas of the circumpolar Arctic, especially in their preferred habitat, the annual ice over the biologically productive waters of the continental shelf where ringed seals are most abundant. They still inhabit the majority of their original habitat and their worldwide abundance, in 19 subpopulations, is estimated at 20,000 to 25,000 (IUCN/SSC Polar Bear Specialist Group 2006). Historically, the conservation of polar bears, as well as other arctic marine species, has assumed the arctic marine ecosystem to be relatively stable and ecologically predictable over the long term (MacDonald et al. 2003). Thus, until recently, once estimates of population size and demographic parameters were made for a subpopulation and estimates of sustainable harvest were made, it was assumed that little other than harvest monitoring was required until another population estimate could be made. In Nunavut, the jurisdiction with the largest harvest of polar bears worldwide, most populations have not been monitored long enough to assess a trend in numbers, let alone possible effects of climate change. Further, because the inventory cycle for population assessment in Nunavut is every 15 years, most populations lack two estimates made sufficiently far apart to allow determination of whether they are increasing, decreasing, or staying the same. Additional concerns arise from using model projections to estimate future population trends in relation to harvesting, based on short-term mark-recapture studies, because they cannot account for unknown but likely fluctuations in environmental conditions.

Inuit and scientists agree that climate warming is having a significant negative impact on sea ice in the Arctic. In a 2006 study, Josefino Comiso, a senior research scientist at NASA's Goddard Space Flight Center, reported low ice extents in the Arctic during winter and other seasons in 2005 and 2006. Overall, the winter ice anomalies correlated well with both surface temperature anomalies and wind circulation patterns, and because historical satellite data indicated a positive trend in winter temperatures and a negative trend in the length of ice growth period, Comiso concluded it is likely that the winter ice cover will continue to retreat in the near future. In a recent review of long-term trends in ice cover and causative mechanisms, Serreze et al. (2007) also reported negative linear trends in arctic sea ice extent in the polar basin from 1979 to 2006. The trends were negative in every month and most dramatic in September, with a decline of 8.6 ± 2.9 percent per decade. The authors wrote, "Given the agreement between models and observations, a transition to a seasonally ice-free Arctic Ocean as the system warms seems increasingly certain (p. 1536)" and "Although the large scatter between individual model simulations leads to much uncertainty as to when a seasonally ice-free Arctic Ocean might be realized, this transition to a new Arctic state may be rapid once the ice thins to a more vulnerable state (p. 1533)." If these projections are correct, such a significant loss in the total ice habitat will have profound negative effects on polar bears.

In several polar bear populations in the Hudson Bay-Foxe Basin and Eastern Arctic areas of Canada, the ice melts completely in summer, forcing all bears in those populations to spend several months on shore until freeze-up in autumn (Stirling and Parkinson 2006). Toward the southern extent of polar bear range, in Western Hudson Bay, polar bears feed extensively on the sea ice during spring and early summer before the ice melts. Then, all bears in the population fast while on shore for at least four months until the sea ice refreezes and the bears can resume hunting. Pregnant females fast for eight months, during which time they give birth to cubs weighing approximately 0.6 kg and nurse them up to 10 to 12 kg when they leave their maternity dens and return to the sea ice to hunt seals again. Gagnon and

Courtesy of Ian Stirling

Andrew Derocher and Ian Stirling study the population dynamics, behavior, and biology of populations of polar bears in the Western Hudson Bay.

Gough (2005) reported that in Western Hudson Bay, between 1971 and 2003, the mean annual temperatures increased at most weather stations with trends varying from a minimum of 0.5°C per decade at Churchill to 0.8°C per decade at Chesterfield Inlet. Further south in James Bay, the temperature has warmed at about 1°C per decade. Skinner et al. (1998) reported that during April through June, the temperature near Churchill and over the adjacent offshore ice had warmed at a rate of 0.3 to 0.5°C per decade from 1950 to 1990. Comiso (2006) reported a similar warming trend from data collected from 1981 to 2005. Apparently in response to this well documented warming pattern, breakup of the sea ice in Western Hudson Bay now occurs about three weeks earlier on average than it did only 30 years ago. (Stirling et al. 1999, Stirling et al. 2004, Gagnon and Gough 2005, and Stirling and Parkinson 2006).

Polar bears are large animals and they got that way by eating seals, not berries.

Signs of Decline

The trend toward progressively earlier breakup of the sea ice has had significant effects on the polar bears of Western Hudson Bay. The most important time for polar bears to feed on ringed seals is from late spring to breakup, when newly weaned ringed seal pups, up to 50 percent fat by wet weight and still naïve to predators, are abundant. Thus, over the last 30 years, the polar bears in Western Hudson Bay have been forced to abandon hunting seals on the sea ice at the most important time of year and begin their fast on land following breakup at progressively earlier dates. There is a significant negative relationship between the date of breakup and the condition of both adult male polar bears and adult females accompanied by dependent young (Stirling et al. 1999). Also, as a consequence of steadily declining conditions, the average mass of lone (and suspected pregnant) adult female polar bears has declined from approximately 290 kg in 1980 to about 230 kg in 2004 (Stirling and Parkinson 2006). Derocher et al. (1992) reported that no female weighing less than 189 kg in the fall was recorded with cubs the following year, suggesting that polar bear females below that mass will no longer reproduce. More recently, Regehr et al. (2007) (In Final Review) demonstrated that the decline in survival of cubs and subadults was significantly correlated to breakup date, i.e., the earlier the breakup, the poorer the survival. The progressively earlier breakup brought on by climate warming, in combination with the failure to adjust a harvest rate that was no longer sustainable, caused the population to decline from about 1,200 animals in 1987 to 935 in 2004. A similar pattern of earlier breakup of sea ice is now evident in southern Hudson Bay (Gagnon and Gough 2005), and a corresponding decline in the condition of polar bears of different age and sex classes between mid-1980s and the mid-2000s has been reported (Obbard et al. 2006). A decline in population size will likely follow, if it has not already started.

The renewed prediction of continued climate warming from the Intergovernmental Panel on Climate Change (IPCC) in January 2007 indicates that the long-term negative changes to the sea ice will continue to be unidirectional in the foreseeable future. However, the effects of climate warming on sea ice and polar bears will vary in timing and rate of change in different regions. For example, in Hudson Bay/Foxe Basin and the Eastern Canadian Arctic (Baffin Bay and Davis Strait region), the sea ice melts completely each summer. Bears survive the summer using their stored fat with opportunistic augmentation by scavenging, feeding on vegetation, and sometimes hunting other marine mammals. Polar bears, however, obtain the vast majority of their annual energy intake by hunting seals from the sea ice surface. Thus, suggestions that today's polar bear populations will be able to obtain replacement energy sources are fanciful: Polar bears on land in Western Hudson Bay are in

Credit: Russell A. Mittermeier

Polar bears now spend more time on the shore as their sea ice habitat melts.

a hibernation-like physiological state of fasting (Ramsay and Stirling 1988). Since their most important feeding period is from mid-April until breakup, bears in these populations are likely to be affected before other areas by progressively earlier breakup caused by climate warming. In comparison, in the Beaufort and Chukchi seas (part of the polar basin), ice is breaking up earlier and freezing later, although some multi-year ice remains throughout the summer, up to a few hundred kilometers offshore over the deep polar basin and near the north-western islands of the Canadian Arctic Archipelago (Serreze et al. 2007). Climate-related effects on populations of polar bears in the Canadian Arctic Archipelago have not yet been identified, but Nunavut does not maintain a research program that would be capable of detecting such change. Claims by some that climate warming has increased the size of the subpopulation in Davis Strait, Canada, are unsupported by data. An ongoing mark-recapture study indicates that the population of polar bears there is larger than previously thought. However, polar bears are probably more abundant in Davis Strait because of the combined effects of a large increase in the harp seal population and the conservative harvest level, which has been in place for decades (Stirling and Parkinson 2006). Yet neither possible factor that could stimulate an increase in numbers is related to climate warming.

At this point, it is uncertain how the documented and predicted patterns of seasonal ice reduction and permanent loss will affect all the different populations of polar bears or their distribution and movements. The pathways through which polar bears in different ecological circumstances are, or will be, affected are only partly understood and should be investigated through multi-disciplinary research. However, if the climate continues to warm and negatively affect the duration, extent, and thickness of arctic sea ice as predicted, it will ultimately have a negative effect on all populations.

Media Mix-ups

Against this extensive backdrop of long-term studies that document the negative effects of continued climate warming on sea ice and polar bears, and projections by the IPCC that those trends will continue, the press continues to cite minority contrarian opinions as if they have equal credibility. One oft repeated example is, "Of the 13 [polar bear populations] in Canada, 11 are either stable or increasing in size" (e.g., *Edmonton Journal*, 31 December 2006, among other publications). In fact, at the 2005 meeting of the IUCN

Credit: iStockPhoto/JohnPitcher

Recent research indicates that melting sea ice has seriously affected the reproductive ability and survival of polar bears.

Polar Bear Specialists Group in Seattle, scientists and managers from the five Arctic nations with polar bears unanimously agreed to a status report that concluded that of the 13 populations within Canada, or shared with Greenland, two were severely depleted from previous overharvesting and were being managed for recovery, five were declining, and the rest were recorded as stable, except for one which was reported as increasing based on a computer projection model using extrapolated demographic data.

Another regularly repeated statement is that climate warming may be good for polar bears and that they will just adapt somehow and switch to terrestrial diets, including berries. It is possible that in the short term, the sea ice habitat of polar bears in the heavy ice of the farthest northern areas of Canada and Greenland, over the continental shelf, may improve temporarily as the climate continues to warm. However, as the patterns of ice loss mirror those in more southerly areas, the bears will ultimately be negatively affected as well. Similarly, even if there is little ice remaining, some

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polar bears may be able to augment their diets and survive for variable periods of time by scavenging, preying periodically on larger marine mammals such as walruses, and eating vegetation as available. However, research has shown that the large size of coastal Alaskan brown bears cannot be attained solely by eating berries (Welch et al. 1997) and, further, that large body mass is closely related to the amount of animal matter in the diet (Hilderbrand et al. 1999). It is particularly telling that the smallest black bears and brown bears in the world are found in the Arctic tundra near the coast of northern Labrador and the Beaufort Sea, respectively, because terrestrial food resources at high latitudes are meager. Polar bears are large animals and they got that way by eating seals, not berries. Their survival in anything like the large numbers present today is dependent on large and accessible seal populations and vast areas of ice from which to hunt.

Dire Reality

Using both field observations of hunting behavior and size-specific metabolic requirements, Stirling and Øritsland (1995) estimated that, on average, a polar bear requires 45 ringed seals (or ringed seal equivalents) per year to survive (larger bears would require more and smaller bears less). Hunting of harp seals, bearded seals, and walruses would reduce the number of ringed seals needed but the message is clear that large numbers of polar bears require enormous numbers of ringed seals or equivalents (most species of which also require ice for pupping and molting). In crude numbers, 20,000 polar bears would require about 900,000 ringed seals (or ringed seal equivalents) each year, the majority of which would be pups. Although the total population size of ringed seals is unknown, estimates range between 5 and 7 million, making them one of the most abundant seal species in the world. Like polar bears, however, they are highly evolved to live and breed in association with sea ice so that their reproductive success and total population size will almost certainly decline as the sea ice disappears.

In the long term, the loss of an iconic species such as the polar bear is but a symbol of much larger and hugely significant changes that will occur in many ecosystems throughout the world if the climate continues to warm and especially if, as projected by the IPCC, such warming is largely a consequence of excess anthropogenic productivity of greenhouse gases. For polar bears, habitat loss is the most critical single concern. The symptoms of climate warming on polar bears are becoming clearer. Highly specialized species are particularly vulnerable to extinction if their environment changes, and polar bears fit that prescription. If the population of the planet is truly concerned about the fate of this species, we need to collectively reduce greenhouse gas production significantly and quickly. ■

The Power of Conservation Photography
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be purchased is the empathy and sense of urgency necessary to create awe-inspiring images that move people to take actions to ensure that the wild world persists.

So, although the similarities between traditional nature photography and conservation photography are many, the most outstanding difference lies in the fact that the latter is born out of purpose. From the early achievements of Ansel Adams in capturing the imagination of the American public with his well-crafted images of wild America, to the brilliantly executed images made by National Geographic's "Nick" Nichols during the epic trek made by Dr. Michael Fay across the Congo (which has recently led to the creation of an entirely new protected area system in Gabon), conservation photography has a well-established, yet seldom recognized record.

In traditional nature photography the subject is defined by aesthetics; in conservation photography the subject must also be defined by conservation priorities. Beyond documenting nature, conservation photography answers to the mission of protecting nature. This is a discipline limited by specific places and issues and its purpose is to elicit concerns and emotions that affect human behavior. We need to advocate for shooting the whole scene and not just the select pieces that we, the architects of the image, choose to show the public.

As conservation challenges continue to grow around us, the need for the kinds of images that touch people's hearts and change people's minds is also growing. Photographers of great conviction have already traced the path for us. It is our job to show the way to the legions of new photographers who are not yet a part of the conservation movement. ■