Chapter 27
Welfare of Captive Polar Bears and Their Value to In Situ Conservation Efforts

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Abstract Polar bears (*Ursus maritimus*) have always been one of the most popular animals in zoos. Though their charismatic nature has made them a good flagship species for the Arctic habitat, there has been very little examination of the co-relationship or need for collaboration between the in situ and ex situ polar bear worlds. In the 1990s, polar bear populations in North American and European zoos were declining, and many zoos were closing their polar bear exhibits (Meyerson 2006; Linke 2015; Poirier and Lanthier 1995). Though still popular with the public, animal well-being concerns and increasing governmental regulations made it evident that in order to appropriately house and exhibit this large and intelligent species, significant financial resources would need to be invested. Given that the wild population numbers had rebounded as a result of the cooperative regulations enacted by the five Polar Bear Nations (i.e., the Range States: USA, Canada, Union of Soviet Socialist Republics, Norway and Denmark/Greenland) (United Nations Environment Program Register of International Treaties 1973), which addressed issues such as illegal harvest and environmental toxins, the conservation threat for the species was relatively low, and zoos were choosing to use their limited financial resources to build exhibits for species that had a greater conservation need.

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27.1 Introduction

Polar bears (*Ursus maritimus*) have always been one of the most popular animals in zoos. Though their charismatic nature has made them a good flagship species for the Arctic habitat, there has been very little examination of the co-relationship or need for collaboration between the in situ and ex situ polar bear worlds. In the 1990s, polar bear populations in North American and European zoos were declining, and many zoos were closing their polar bear exhibits (Meyerson 2006; Linke 2015; Poirier and Lanthier 1995). Though still popular with the public, animal well-being concerns and increasing governmental regulations made it evident that in order to appropriately house and exhibit this large and intelligent species, significant financial resources would need to be invested. Given that the wild population numbers had rebounded as a result of the cooperative regulations enacted by the five Polar Bear Nations (i.e., the Range States: USA, Canada, Union of Soviet Socialist Republics, Norway and Denmark/Greenland) (United Nations Environment Program Register of International Treaties 1973), which addressed issues such as illegal harvest and environmental toxins, the conservation threat for the species was relatively low, and zoos were choosing to use their limited financial resources to build exhibits for species that had a greater conservation need.

That was until climate change. In the early 2000s, when the threat to polar bears due to the effects of climate change and a warming Arctic became obvious, the link between wild and ex situ bear populations became evident. Polar bears in zoos started to be seen having the potential to play a vital role, both as conservation education ambassadors and as an ex situ research population to help address in situ questions. The Association of Zoos and Aquariums (AZA) based in the United States, the Canada's Accredited Zoos and Aquariums (CAZA), and the European Association of Zoos and Aquaria (EAZA) shifted their focus toward more intensive scientific and cooperative management of polar bears in the 2000s in order to address the needs of decreasing ex situ populations, as well as the increasing demand to more effectively educate the public about the threats climate change posed to the species (Meyerson 2015; Szánthó 2014; Szánthó and Spencer 2015). The reality is that in order to save polar bears in the wild you need to save the sea ice, their hunting and denning platforms (e.g., see Chaps. 23 and 25). In order to save the ice, greenhouse gas emissions and carbon use must decrease. This can only been done through changes in human activities. The public appeal of polar bears makes them the perfect ambassador for the effects of climate change in the Arctic. Zoos offer the ability to educate a group of people that are already engaged with animals. This captivated audience can have profound effects on the climate change issue by both changing their own personal habits, as well as helping to create motivations to form environmental policy through political pressure (Fig. 27.1). With over 180 million visitors a year, greater than the number of people attending all major professional sporting events combined in the

Fig. 27.1 Bears in our care are true ambassadors for their wild counters. They can inspire visitors to make changes in their own carbon use that can have global effects, thereby helping save the habitat of the bears in the wild. *Image credit: Toledo Zoo*

USA, Association of Zoos and Aquariums (AZA) accredited institutions have great public reach, with a focus on connecting people and animals. Being a founding member of the Network for Ocean and Climate Change Interpretation, AZA and its members work to change public understanding of the impact of a warming planet (Swim and Fraser 2013). Similarly, the EAZA, partnering with NGO Polar Bears International and Arctic Action, launched a major public climate change education program with their Pole to Pole Campaign from 2013–2015.

27.2 The Value of Ex Situ and In Situ Collaboration

With the increasingly apparent threat of climate change came new collaborative relationships between zoo professionals, nongovernmental organizations, and field scientists. Where once there was little interaction between the zoo community and

polar bear field biologists, the potential value of that partnership was realized and fostered by the NGO Polar Bears International, who had working relationships with both groups. In addition to the great public reach offered by zoos for climate education, there also was a realization that polar bears in human care could act as an ex situ research population to help answer in situ questions, using, noninvasive methods.

Doing research in remote locations in harsh environments with limited repeated access to individuals is extremely difficult and expensive. Through researchers employing normal husbandry practices and positive reinforcement training techniques, bears in zoos have participated in studies on energetics, sensory perception, reproduction, and emerging diseases (Rode et al. 2016; Ware et al. 2015). Polar bears in zoos are being trained to wear accelerometers and to walk treadmills in order to help quantify energetic expenditure rates, with results helping determine the effects of increasingly prolonged periods of swimming with declining sea ice (A. Pagano, US Geological Survey, personal communication). Sensory perception research in zoos has included olfaction studies, looking at olfactory communication in polar bears by pedal secretions (bears secrete signal scents which can be detected in footpad imprints by other bears) of relevance to their increasingly fragmented environment (Owen et al. 2015). Auditory studies have been carried out to determine noise disturbance parameters, especially in maternal denning areas, relevant as anthropogenic activities are able to increase as the Arctic warms. Assisted reproductive techniques such as artificial insemination and ova and sperm rescue are being applied to captive polar bear husbandry (Curry et al. 2014; Curry and Roth 2016). These techniques potentially have future applications for maintaining genetic diversity in the wild population if population fragmentation or genetic bottlenecks occur. Having bears in human care may also help to predict future issues with emerging diseases from a warming Arctic. Studies are currently looking at the upregulation of genes in response to environmental stressors (Bowen et al. 2015), as well as the potential threat of diseases such as West Nile Virus, which was the cause of death of a male polar bear in 2006 (Dutton et al. 2010, and research in progress).

Collaborations between the ex situ and in situ communities are not only providing information for use in in situ situations. While originally developed as a tool for field researchers to consistently describe the body condition of wild polar bears, "The Polar Bear Score Card: A Standardised Fatness Index," is now used by zoos as well (Polar Bears International 2015) (Fig. 27.2).

27.3 Improving Standards of Care of Captive Polar Bears

Even before the concern of climate change, zoo animal care professionals realized that if polar bears were going to continue to be exhibited, that standards of their care needed to be better defined and facilities would need to be designed to

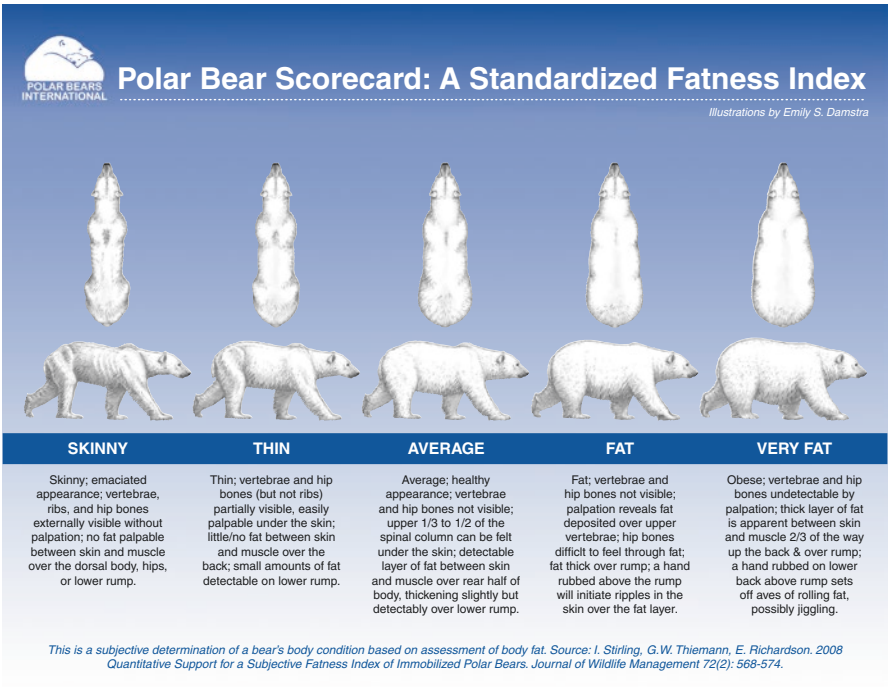

Fig. 27.2 "The Polar Bear Score Card: A Standardized Fatness Index," (Polar Bears International 2015). *Image credit: Polar Bears International*

address an increasingly complex understanding of the bears' welfare needs. Rightly so, there was and is a concern about housing an intelligent, large mammal whose natural range can be across an area of hundreds of square miles. Zoo professionals have worked hard to define exhibit and behavioral husbandry needs to provide good welfare for polar bears in our care. EAZA polar bear experts have developed the Ursid Husbandry Guidelines and AZA polar bear specialists have produced the Polar Bear Animal Care manual. Features of new exhibits include more space, larger pools, soft substrate, the ability to get out of view of conspecifics, elevated viewing areas for the bears, and the ability to make changes to exhibit furnishings (UHG 2007, PB ACM 2009; Shepherdson 2013, Fig. 27.3).

Simple husbandry practices that include allowing the bears a choice of access to a small indoor area during zoo open hours has been found to decrease pacing in bears, apparently because they can exercise more control and are able to see activities behind outdoor enclosure doors and inside holding areas where the bears' caretakers are. For instance, "Gus," the male polar bear at Central Park Zoo (New York City, Wildlife Conservation Society), decreased his swim-pacing behavior from 80% of the time during daytime hours with the most basic "enriched conditions," to consistently less than 25% during the same hours when training was

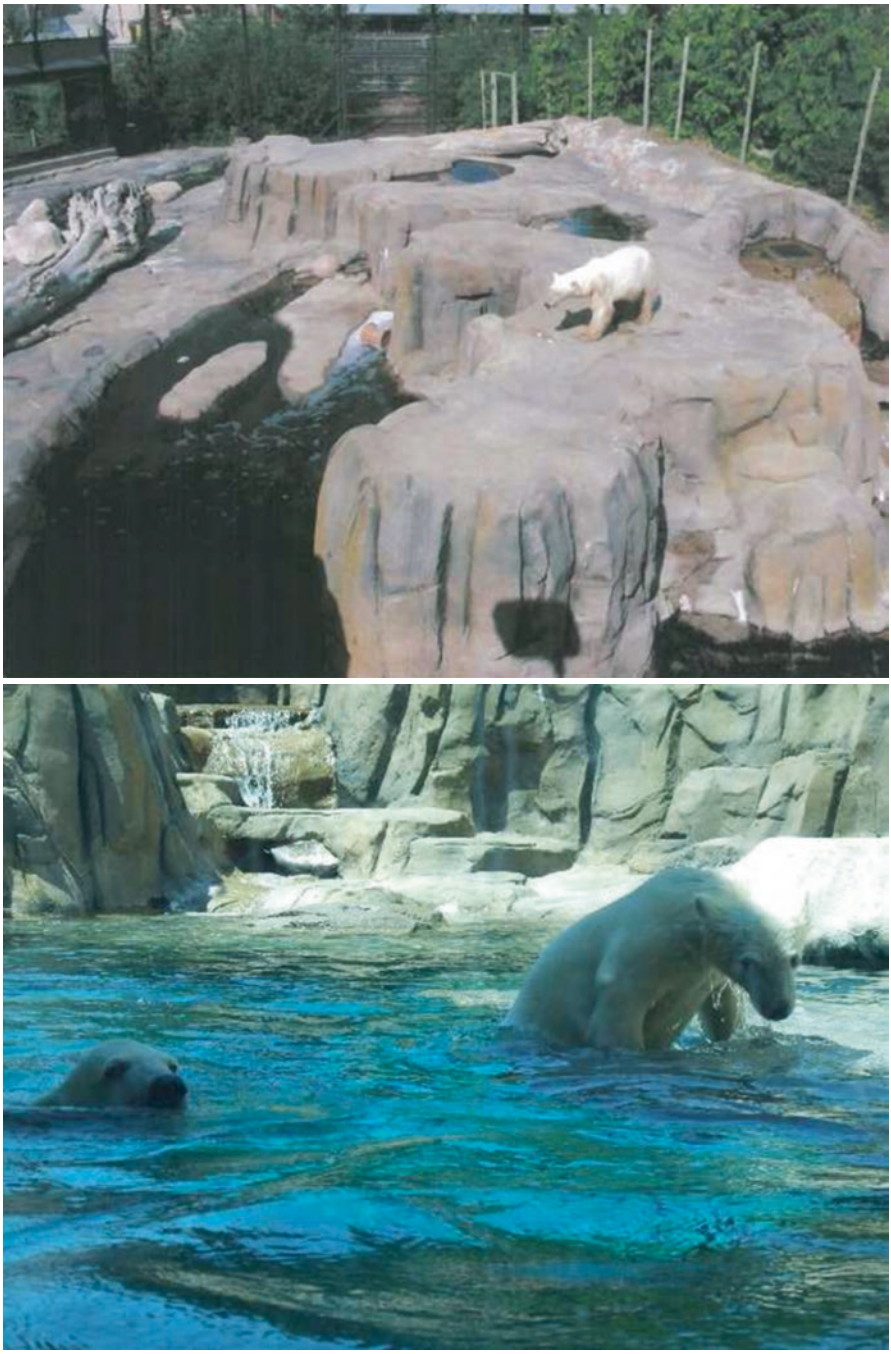

Fig. 27.3 The Toledo Zoo's new Polar Bear Exhibit, the Arctic Encounter opened in 2000. It's larger size and complexity, including varying topography, animal access to soft substrate and built in enrichment opportunities, allows the polar bears to exhibit a wider range of behaviors. *Image credits: Toledo Zoo*

Fig. 27.3 (continued)

increased and he was given continual access to an off-exhibit holding area. Additionally he chose to spend his time on-exhibit watching visitors and local birds (Moore, unpublished data 1996–2000). This kind of behavior change after receiving free choice as to whether they are in indoor holding or on-exhibit has been observed by other zoo scientists, including those at North Carolina, Chicago, and Toledo zoos (R. Meyerson, personal observation).

The training and enrichment component of the overall husbandry program is just as important as facility design for facilitating good welfare for polar bears in human care. Enrichment programs that facilitate an increased range of behaviors, problem solving, and choice also promote a healthy bear. This can be done by changing objects in their exhibit or offering novel stimuli. Effective enrichment programs provide stimuli in varying ways. Most common is the manipulation of how food items are offered. Common methods include scatter feeds, freezing in ice blocks, hiding them, or presenting them in a puzzle box where manipulation of an object is needed to get to the food. Other types of enrichment include auditory and olfactory stimulation, playing vocalizations, and offering different scents, spices or fur, and feces of other bears or species. Effective enrichment also promotes increased activity through the manipulation of objects. This can be provided both through exhibit design such as providing logs to claw, or mulch to dig through, or the provision of novel items such as 55 gallon plastic barrels, browse, PVC pipes, cardboard boxes, thick balls, and floating items. While enrichment is an important component of any polar bear husbandry program, novel items may also offer a safety risk, and for this reason good programs have an approval process that involves both animal and veterinary care staff.

Training polar bears for husbandry practices (e.g., shifting on and off exhibit) has been common, and recently zoos' training programs have been improved to include the ability to offer better veterinary care through enhanced husbandry training that has veterinary care goals. Behaviors, such as an "open mouth" for tooth exams, presenting appendages for injections, presenting feet for foot soaks, and most recently voluntary offering of feet for blood draws, allow for better care of polar bears; voluntary blood draws and other voluntary participation also facilitate the bears' participation in research that can increase our understanding and conservation of the species. In addition to these benefits, since polar bears are worked with only in protected contact where staff does not directly share space with them, this training participation is voluntary, and the time spent with the keepers can be seen as strengthening the keeper and bear bond (e.g., Fig. 27.4).

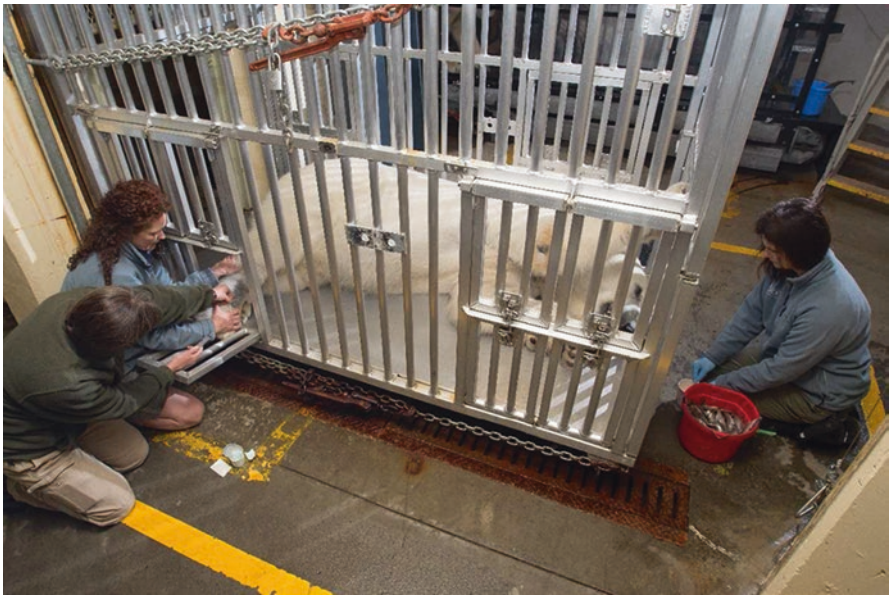

Fig. 27.4 This polar bear at the Oregon Zoo is being rewarded with fish snacks as staff perform a voluntary blood draw from the top of his rear foot. This type of cooperative training allows the veterinary staff to assess the bears' health without having to immobilize them, as well as enabling participation in research projects requiring multiple samples of small amounts of blood. *Image credit: Michael Durham/Oregon Zoo*

27.4 Positive Outcomes on Health and Well-Being of Captive Bears

With a better understanding of polar bear needs and behaviors, and better husbandry and veterinary techniques, positive effects on vital measures (mortality, fecundity, and longevity) are starting to be seen. Regional and international studbook databases have been used for decades to pool institutional records for all cooperatively managed bears—from the time of birth or import until death—and these studbooks can provide data on vital rates (fecundity, mortality) as well as cause of death. Studbook data from the European and American zoo associations' polar bear populations show mortality rates of the most vulnerable first age class (0–1 year old) decreasing in recent decades (from an average of 62% for females and 63% for males from 1970 to 1999 to 46 for females and 51% for males from

2000 to 2015) (Linke 2015). Causes of death recorded in the AZA regional studbook indicate there has been a significant reduction in intraspecific aggression (Meyerson 2015). From 1970 to 1999, injury from exhibit mates was the third most common cause of death (after euthanasia and unknown/other) of the 221 deaths recorded in the studbook for animals older than 1 year. However, in recent years (2000–2015), following the shift to more formal cooperative management as a Species Survival Plan, there were no deaths due to conspecific injuries, aggression, or self-inflicted injuries, and the number of deaths attributed to infection has decreased considerably (from 15% of deaths to 5%). Data from both North American and European accredited zoos indicate that animals are now living to older ages, with the mean age at death significantly higher in both regions in the more recent time period of modern management (during 2000–2015, on average 3.1 ± 0.61SD years older for AZA and on average 8.0 ± 0.57SD years older for EAZA) compared to prior management period (1970–1999) (Fig. 27.5). One of the driving factors of this increase is that proportionally fewer individuals died at younger ages during the more recent time period (Fig. 27.6).

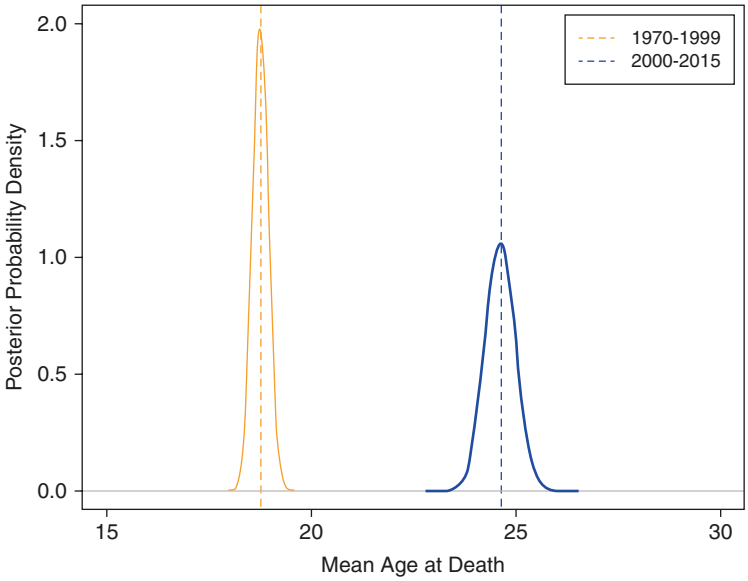

Fig. 27.5 A comparison of the mean age at death of polar bears in European and American zoos combined, between two time periods: 1970–1999 and 2000–2015. The expected ages at death are 18.8 (95% credible interval = 18.4–19.2) and 24.6 (23.9–25.4) years for the earlier and more recent time period, respectively (ages at death were modeled as a Poisson distributed variable in a Bayesian statistical model with non-informative priors. The dashed lines show the average age at death for each time period, and the curved lines show the range of likely ages or the posterior probability density of the model estimates)

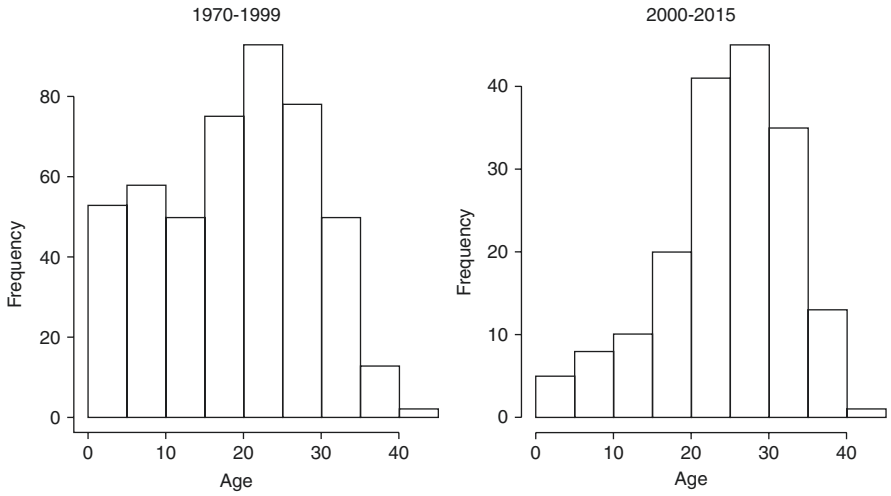

Fig. 27.6 Distribution of the ages at death for polar bears in European and American zoos during two time periods ($N = 472$ in 1970–1999, $N = 178$ in 2000–2016). In the more recent time period (2000–2015), proportionally fewer individuals died at younger ages and the median age at death is higher (20.0 for 1970–1999, 25.5 for 2000–2016)

27.5 Opportunities for Future Collaboration

Zoos work cooperatively through EAZA's European Endangered Species Programme (EEP) and AZA's Species Survival Plan (SSP) program to help to ensure that individual polar bears have appropriate facilities in which to live as both cubs and adults and that the populations remain genetically diverse and demographically stable (Ballou and Lacy 1995; Ballou et al. 2010). Governments also recognize the special requirements of the species and have enacted regulations to protect their welfare as well. As examples, in the United States, polar bears have their own regulations under the Animal Welfare Act (USDA 2013), and in Manitoba, Canada, captive polar bear management is regulated by the Polar Bear Protection Act (2002, 2008, and 2013). In 2012, the province also established the Leatherdale International Polar Bear Conservation Centre at the Assiniboine Park Zoo in Winnipeg. This center was established to transition orphaned polar bear cubs rescued in the province, for eventual placement in approved facilities. The center also contributes to understanding of the conservation of polar bears through its education and research programs.

In addition to having the skills to offer better welfare for the bears in our care, zoo professionals can offer additional skills that can directly help wild bears. With knowledge accumulated over time on how to house and handle polar bears, zoo professionals offer a large contingent of people experienced in working with live bears who can respond to environmental disasters like oil spills. Caring for the

animals where they naturally occur allows them to remain there after their rehabilitation. For those whose care requires them to be removed from their native habitat, zoos offer a place for rescue. Collaborations like this have already occurred with input from the zoo community when the USFWS Polar Bear Oil Spill Response Plan was updated in 2015 (USFWS 2015). Additionally, AZA has an active Oil Spill Response program, working both to assist with animal care and partner with government and native communities (see http://aza.org/oilspill/).

27.6 Conclusions

The long-term sustainability of polar bear populations in the wild depends on the reversal of the effects of climate change, and accredited zoo facilities can help with the global conservation efforts of polar bears. These facilities can directly contribute education programs that seek to change public behaviors through effective education and interpretation—and these processes can affect hundreds of millions of visitors on-site and virtually. In addition, zoological facilities can continue to conduct ex situ basic biological and behavioral research with in situ applications, in developing assisted reproductive techniques in case of population bottlenecks, in researching emerging diseases and mitigation of disease and parasite effects, in executing contingency plans for the rescue of orphaned and compromised bears, and in understanding and responding to human-bear conflict and mitigating negative human-bear behaviors. The very real plight of the polar bear and the planet from the threat of climate change has facilitated partnerships between governments, zoos, researchers, nongovernmental organizations, and more recently with native communities. In order to save the bears, there is a need to continue to think outside the box on how to deal with these challenging and threatening issues.

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