

Chapter 3

Rationale for the Existence of Zoos

Ultimately, in this century, we have begun to realize that the way we display animals truly affects the way people view them and people speaking reverentially, and quietly before exhibits that were truly natural. Just as often standing before, old barren cages, I saw zoogoers yell, throw food and make fun of the animals inside. (Croke, 1997, p.93)

Today's zoos serve two basic functions: community resource and conservation entity (Hanna, 1996, p. 76).

Some individuals and groups view zoos and aquariums as prisons for animals. If we, as zookeepers, maintain our facilities with humanity and high standards, we needn't hang our heads and call ourselves wardens. We can instead look at our facilities with pride and see them as bridges between our visiting public and the wild they may never see. We can look our captive charges in the eye as we treat them with the respect due the highest-level ambassadors—ambassadors of the wild. (Hanna, 1996, p. 82)

Today, zoos, by their own definition, are conservation organizations and recognize themselves as places which are involved in the conservation of flora/fauna. However, the primary reasons cited by visitors for visiting a zoo are for the educational benefit of children and to see animals. Animals *can* and *do* interest visitors without the additional interpretation provided by institutions. As a specimen on display in a zoo, the animal becomes an “exhibit” and takes on the “mantle of history” and becomes part of the story that the zoo wants to tell. The animal specimen is part of the evidence for its species characteristics, just as a human artifact is evidence for aspects of human civilization. Furthermore, industrialization and urbanization are reducing students' direct interactions with nonurban nature. Due to the reduced contact people have with nonurban nature, interest in the variety of living things is perhaps becoming redirected toward human artifacts. As the world becomes more urbanized, our personal experiences with animals become more isolated, in many cases limited to domesticated pets and urban species. No matter how zoos choose to get their message to visitors, education is their most important conservation function.

Today, more than ever, zoos need to think harder [about] why they are there and what role they will fill in conservation, education, and research. Millions of dollars go to house artwork in museums, but there are more Rembrandts in the world than there are Siberian tigers. (Hutchins, 2003, p. 25)

As discussed in the second chapter, the functionality of zoos has evolved drastically since the 1820s, when the main focus was to display a vast collection of exotic animals for public enjoyment (Conway, 2003; Rabb, 2004). Zoos originally emerged as a place of scientific collections. The London Zoo is the predecessor of the modern zoo. This institution's founding body, the Zoological Society of London (ZSL), envisioned the zoo as a scientific collection for the advancement of zoology as well as comparative physiology of animals. In the beginning, the zoo was open only to members of the ZSL and their guests, but the financial demands of maintenance and upkeep influenced the opening of the zoo to a paying public. The business of the zoo would from then on be influenced by the zoo visitor, and the survival of zoos would be based upon the public's perception of the everyday role it plays in society.

Originally, most zoos were created as a place for recreation with an emphasis on biological literacy. The conservation of wildlife diversity and biological conservation education were not the most pressing issues to zoo founders. Indeed, the original pedagogical approach of zoos was to display animals in rows of enclosures so that people could see strange creatures and make comparative observations of the physical form of different species. As zoos developed during the 1960s, in addition to places of fun and family recreation, they saw themselves as having four functions: recreation, education, research, and conservation (Nichols, 1996). In the 1970s, as ecological concerns began to emerge, zoos could no longer justify themselves as primarily entertainment facilities and started to consider making conservation their central role (Hancocks, 2001). During the 1970s, zoo professionals began conservation programs, and the American Association of Zoos and Aquariums (AZA) maintained that conservation had become its highest priority (Hancocks, 2001; Reed, 1973). Today, due to the deteriorating link between humans and the nonurban natural world, zoos are coming under pressure to develop conservation plans and educate the public about the living world while maintaining financial stability. Therefore, zoos have evolved to include education as a priority along with conservation and research (Karkaria & Karkaria, 1998; Patrick, Matthews, Ayers, & Tunnicliffe, 2007a; Patrick, Matthews, Tunnicliffe, & Ayers, 2007b). Modern zoos work to bring biological conservation to the forefront of their educational programs and have the potential to shape public opinion, to encourage empathetic attitudes toward wildlife, and to educate the public about ecology, evolution, and wild organisms.

Presently, zoos must justify their existence against a constant barrage of anticaptivity and animal rights groups, who dispute that any education is taking place and promote the idea that zoos exist purely as a form of entertainment at the expense of the organism's natural instincts. Some critics of zoos have gone so far as to compare the exhibits of animals to pornography and suggest there is a negative educational impact on zoo visitors (Acampora, 2005; Wagoner & Jensen, 2010). Acampora (1998) believes that zoos are not educationally beneficial because

... the public is largely indifferent to zoo education efforts (few stop even to look at, let alone read, explanatory placards); animals are viewed briefly and in rapid succession; people tend to concentrate on so-called babies and beggars—their cute countenances and

funny antics capture audience attention (Ludwig 1981). Of course, this sort of amusement is at the heart of what a zoo is (scientific ideologies of self-promotion notwithstanding). Consequently, and insidiously, what visits to the zoo instruct and reinforce over and over again is the subliminal message that nonhuman animals are here in order to entertain us humans. Even when, during our deluded moments of enlightenment, we insist that they are here rather to edify—even then their presence is still essentially assigned *to or for us*. Thus the phenomenological grammar of their appearance precludes the possibility of full otherness arising; this is what it means to put and keep a live body on display (a structural inauthenticity [sic] that remains despite the best intentions of humanitarian/ecologic pedagogy). (p.2)

The evolution of how a zoo defines itself is dependent on the public's perceptions of the zoo's contributions to society. The problem is that the day-to-day operations of the zoo go unnoticed, and citizens do not realize that the zoo's practices have an immeasurable and direct impact on the community and wildlife. Therefore, it is important to validate the existence of zoos through the programs they offer, their contributions to society, and the perceptions that the zoo-going public hold regarding these institutions. Zoos typically identify their own self-worth through their mission statement.

The [AZA] (2011a) defines the mission of zoos as striving to be global leaders in “animal care, wildlife conservation and science, conservation education, the guest experience, and community engagement.” Patrick, Matthews, Ayers & Tunnicliffe, (2007a) and Patrick, P., Matthews, C., Tunnicliffe & Ayers, (2007b) analyzed AZA-accredited zoos' mission statements and established that there are seven main themes in zoo mission statements: (1) *education*, (2) *conservation*, (3) *recreation*, (4) *facilities*, (5) *research*, (6) *administration*, and (7) *culture*. In addition to the seven themes found in mission statements, the literature identifies five main purposes of zoos: (1) exhibiting animals for the public (Mazur & Clark, 2001), (2) providing education (Clayton, Fraser, & Saunders, 2009; Ogden & Heimlich, 2009; Owen, Murphy, & Parsons, 2009; Price, Vining, & Saunders, 2009; Visscher, Snider, & Stoep, 2009), (3) conservation (Ballantyne, Packer, Hughes, & Dierking, 2007; Wagoner, Chessler, York, & Raynor, 2009), (4) research (Fernandez & Timberlake, 2008; Hutchins & Thompson, 2008; Kolbert, 1995; Rabb, 2004), and (5) providing recreational opportunities for visitors (Bostock, 1993; Chizar, Murphy, & Liff, 1990; Martin, 2000). There are overlaps in how zoos define themselves through their mission statements and how the literature defines the purposes of zoos. Even though modern zoos are placed in a unique position in which they can serve numerous functions, the average zoogoer does not understand the intricacies and *mélange* of their purposes (addressed in Chap. 4).

Education

Part of realizing the zoo's role in conservation is informing and involving the public in the conservation mission. Zoos are in a unique position to provide environmental education and biological conservation education to large numbers

of visitors. In 2007, 132 (96%) of the 137 AZA-accredited zoo mission statements include education as a predominant theme (Patrick, Matthews, Ayers, et al., 2007; Patrick, Matthews, Tunnicliffe, et al., 2007). However, no mission statements made a direct or specific reference to biological conservation education. Mission statements used the words conservation and education but not together. Therefore, a reference to education in the mission statement does not match the literature's specific call for biological conservation education. As early as 1989, the Zoological Society of Philadelphia stated that the modern zoo was failing to realize its potential for biological conservation education. Moreover, in 1994, Koebner stated that biological conservation education had become the first priority of accredited zoos and aquariums. The 1993 Conservation Organization Strategy (IUDZG/CBSG, 1993) developed specific goals for zoo conservation education: "(1) make it clear that nature conservation affects everyone, (2) increase public awareness of the connections between consumption and lifestyle and the survival of species and biological systems, and (3) inform the public about the threatened status of animals (p. 25)." However, zoo mission statements do not state they are specifically interested in conservation education. Zoo mission statements identify education as a general term, which could include knowledge of plants and animals, taxonomy, habitats, behavior, etc. Since 1994, the literature has focused specifically on biological conservation education (Clayton, Fraser, & Saunders, 2009; Ogden & Heimlich, 2009; Owen, Murphy, & Parsons, 2009; Price, Vining, & Saunders, 2009; Visscher, Snider, & Stoep, 2009) instead of the previously mentioned learning about plants and animals. Now, individual zoos need to specify biological conservation education as a mission and purpose, if biological conservation education is in fact their main goal.

Zoo mission statements may not define zoos as responsible for conservation education, but today's research literature specifically identifies conservation education as the prominent theme of zoos. A Google Scholar (<http://scholar.google.com>) search, inserting "zoo conservation education" as the search term, reveals that 5,500 documents are available on the topic since 2007. Therefore, zoo education research is shifting toward looking at zoos as sources of conservation education. The specific aim of biological conservation education is to develop lifelong knowledge and skills for conservation action. Biological conservation education recognizes the central role of people in all nature conservation efforts and is designed to people and their perceived roles in nature. Biological conservation education promotes the public education and awareness of the conservation of biodiversity by providing information about species and their natural habitats and working to develop a relationship between the public, wildlife, and wild habitats (AZA, 2011a; International Zoo Educators Association [IZEA], 2011; World Association of Zoos and Aquariums [WAZA], 2011). The zoos of the world have a unique role to play in the global efforts to make people conscious of the role of zoos in biological conservation (Carr, 2011; Hancocks, 2001; IUDZG/CBSG, 1993; IZEA, 2011; Sommer, 1972). Therefore, it is not only important that zoos formally define their role in education, but it is imperative that they define their role in biological conservation education.

The World Conservation Strategy (IUDZG/CBSG, 1993) defines conservation education in zoos as

... explaining the irreplaceable value of the entire biological system of our planet and all of its constituent components... conservation education in zoos can make it clear that nature conservation affects everyone, and that everyone needs to be concerned with it. They should play an active role in increasing the public and political awareness of the connections between consumption and lifestyle and the survival of species and biological systems. Conservation education includes informing the public about the threatened status of the species of zoo animals, and other animals which are taxonomically and/or geographically related. Conservation education in zoos can make it clear that nature conservation affects everyone, and that everyone needs to be concerned with it. (p. 25)

The International Zoo Educators Association states that biological conservation education is

... the process of influencing people's attitudes, emotions, knowledge, and behaviors about wildlife and wild places. This is done through the efforts of skilled educators and interpreters, who use a variety of techniques, methods, and assessments to reconnect people with the natural world. (IZEA, 2011)

Zoos give visitors the opportunity to see unique organisms, as well as a chance to learn more about familiar animals. During these close encounters, zoos have the attention of individuals, which gives them an opportunity, be it short, to emphasize their importance and the importance of conservation (Falk & Dierking, 2000; Tunnicliffe, 1995, 1996). Currently, conservation messages are shifting from endangerment and captive breeding to the importance of saving habitat (Mazur & Clark, 2001). As zoo programs continue to grow and improve, students and teachers remain a core audience served by classes, tours, outreach programs, and special curricular materials. Progress in conservation depends on reaching out to schools through educational opportunities and advancing public understanding of science issues and human roles in conservation.

Conservation

Conservation of endangered species and their habitats is a key role of zoos. Through their mission statements, zoos characterize their role in conservation as practice and/or advocacy (Patrick, Matthews, Ayers, et al., 2007a; Patrick, Matthews, Tunnicliffe, et al., 2007b). AZA defines zoos as conservation centers that are responsible for ecosystem health and species survival. To inform AZA of their conservation and research contributions, each AZA-accredited zoo submits data to the AZA Annual Report on Conservation and Science (ARCS) database. The ARCS database accounts for the \$90 million that zoos spend each year on conservation initiatives and tracks over 3,700 conservation projects (AZA, 2011b). The World Association for Zoos and Aquariums has branded over 185 projects as conservation endeavors. Fifty percent of these projects were directed at the conservation of mammals (Dick, 2010). Zoos' conservation programs are important because the

rate at which species are becoming extinct or threatened is occurring at a faster rate than at any time in Earth's recent history (Rogers, & Laffoley, 2011; Convention on Biological Diversity, 2010).

Zoological institutions are continuing to evolve into centers of wildlife conservation (Rabb & Saunders, 2005). Human population growth has led to the loss of habitat, habitat fragmentation, overhunting, climate change, and invasive species producing unnatural environmental stresses on wild populations (Bertram, 2004). The extinction of a single plant or animal has an unmeasurable effect on the surrounding ecosystem and represents not only the loss of a plant or animal but also the loss of millions of years of genetic evolution and adaptation (Cameron et al., 2011; Fonseca, 2009). In order to combat the loss of genetic variability, many zoos have frozen zoos, in which they freeze plant seeds and/or animal tissue. Plant-frozen zoos have been established by the Millennium Seed Bank Kew Gardens (UK) and the Missouri Botanical Garden (USA). Animal-frozen zoos were first established at the San Diego Zoo in the 1970s (Linington, 2000). In 2004, the Frozen Ark Project was established and invited zoos to be active participants. The Frozen Ark Project saves animal tissue with the goal of saving "the genetic material of threatened animals species and, where possible, their viable cells before they become extinct" (Clarke, 2009, p. 222). Each 1 cm² tissue contains thousands of cells and holds the entire genome of the animal. By sampling and preserving DNA, viable somatic cell cultures, and gametes in cryogenic labs, the Frozen Ark Project offers researchers the ability to develop new *in vitro* and *ex situ* techniques which can save some species from complete extinction, especially those which are difficult to breed in captivity (Clarke). These vast databases can lead to a better understanding of the interplay of cytogenetics and infectious disease and play a more crucial role in bio-surveillance. With the recent outbreaks of West Nile virus, SARS, and monkeypox, researchers have turned to zoos' frozen collections for genetic samples and tissue.

All AZA-accredited zoos are required to have a conservation plan in their mission statement, and the goal of each institution should be to have a "measurable impact on wildlife conservation" (AZA, 2011b). However, setting zoos' goals and policies for conservation action is increasingly a scientific, monetary, and political endeavor with numerous factors influencing the selection of ecosystem species (Leader-Williams et al., 2007). Some AZA-accredited zoos do participate in restoration programs. People believe that zoos are saving large numbers of mammalian species, when in reality, much of the conservation that occurs is the sustainability of small populations of animals. The conservation of these small numbers is safeguarding the species against extinction with the prospect of reintroducing them into the wild. Additionally, many of these species are used to raise funds and public awareness of environmental issues such as deforestation and habitat destruction (Bertram, 2004; Turley, 1999).

There are several examples of the conservation work zoos do with small, localized populations. One such example is the California Condor. In 1952, the San Diego Zoo established a captive breeding program to increase the wild populations.

In the 1980s, growing concern of high mortality rates for the California Condor led to a massive effort to rescue this majestic animal from sure extinction as a result of lead poisoning from ingesting bullets lodged in carcasses. By 1987, only 27 individuals remained, but breeding efforts saw an exponential growth of captive populations, and by 1992, reintroduction efforts began. By 1999, 88 birds had been released in 16 separate attempts (Meretsky, Snyder, Beissinger, Clendenen, & Wiley, 2000). Currently, the Los Angeles Zoo, the San Diego Wild Animal Park, the Portland Zoo, and the World Center for Birds of Prey in Idaho have very successful captive breeding programs. There are around 370 living California Condors with about 180 living in the wild, but the threats of lead poisoning and habitat destruction are still difficult barriers in the wild populations. Other US reintroduction programs include the black-footed ferret at the Cheyenne Mountain Zoo and the Smithsonian National Zoo, the Karner blue butterfly at the Toledo Zoo, and the desert antelope and the Mexican wolf also at the Smithsonian (AZA, 2011c; Smithsonian National Zoological Park [SNZP], 2011; Sweet, 2006).

One of the main tenets of zoo mission statements is the involvement of zoo staff and researchers in zoo wildlife conservation programs. However, zoos need to involve the public in their conservation and reintroduction programs to make them more successful. For example, the Durrell Wildlife Conservation Trust runs the Toadwatch campaign. The Toadwatch campaign asks people in the community to report when and where they see the Jersey toad (*Bufo bufo*), known locally as crapaud. Since 2005, the trust has recorded over 300 separate sightings and determined that the Jersey toad population is declining in natural ponds and increasing in garden ponds. In addition to reporting their Jersey toad sightings, volunteers participate in the Toads on Roads campaign. On wet, warm winter nights, volunteers pick up toads, weigh and measure them, and carry them across busy roads (Durrell Wildlife Conservation Trust, 2011). Zoos are also working with local farmers and local community environmental watch programs to develop conservation programs. For example, the Wildlife Conservation Society (WCS) is working with Indonesian farmers in southern Sumatra to develop a peaceful coexistence with local elephants (<http://www.wcsip.org/>). Moreover, the WCS has worked with the local community and conservation groups to bring back the Bronx River in New York. The Bronx River was heavily polluted but is now home to native fish species that have since returned.

The work at the Durrell Wildlife Conservation Trust proves that citizen scientists are an important resource in gathering large amounts of data over a vast area and *citizen conservationists* are an essential part of ensuring the survival of a species. *Citizen conservationists* are individuals who are inspired to take action in caring for natural resources, maintaining local wildlife habitats, and participating in local environmental conservation efforts. It is now the role of the zoo to figure out how their work in conservation and their animal displays can be a bridge between people and conservation action, inspiring individuals to become *citizen conservationist*.

Recreation or Entertainment

Even though zoos tout conservation and biological conservation education as their main goals and promote a conservation image, 69% of AZA-accredited zoo mission statements state that the zoo is for recreation (Patrick, Matthews, Ayers, et al., 2007a; Patrick, Matthews, Tunnicliffe, et al., 2007b). Moreover, public perceptions persist that zoos are places of entertainment rather than institutions of scholarly, scientific, or conservation pursuits (Bitgood, 1988; Frost, 2010; Kellert & Dunlap, 1989). Even though 60% of US zoo visitors state that zoos are places for education (Lessow, 1990), few people visit zoos with the declared aim to be educated. People generally visit zoos to be entertained (Martin, 2000). Zoos in developed countries compete with other attractions for the leisure time of visitors, while zoos in less-developed countries are one of the few available places for recreation. Even when adults recognize the educational importance of zoos, they do not visit the zoo intending to learn, but they encourage their children to do so (Lessow, 1990). As far back as 1885, the prospectus of the Zoological Society of London suggested that “vulgar admiration” was not the objective of their animal collection (Jordan & Ormrod, 1978). However, despite the educational and scientific aspirations of the learned society, the zoological garden became a place for a leisure visit.

Balancing the role of conservation advocate, educator, and recreational promoter is a major issue facing zoos (Tribe, 2004). However, when zoo specialists say that “you should use your selling experiences to advocate your mission (Holst, 2010)” and that zoo websites are “places to increase revenue (Israel, 2011)” and “the website’s number one job is commerce not conservation education (Israel, 2011),” then the mission is entertainment not conservation. In the past, zoos have relied solely on live animals to draw visitors to the zoo. Today, the mission is selling an experience that the zoo hopes will bring people to the end goal of recognizing the importance of the zoo. In the past, zoos have utilized animal shows, 3D IMAX adventures, traveling art shows, informational carts, overnight camps, Halloween celebrations, and the announcement of babies on display to entertain people and increase visitorship. In today’s digital world, these ploys are not enough. To address the need for more entertainment experiences, zoos provide enrichment activities for the visitor as well as for the animals. The Ocean Park zoo of Hong Kong and the Chessington World of Adventures in England combine animal exhibits with entertaining, rollercoaster rides. Visitors are provided with the opportunity to get their photo taken with an elephant, wash an elephant, participate in ropes courses, ride on zip lines, and ride in swan boats (Ellis, 2010; Garner, 2010; Holst, 2010). The John Ball Zoo recently added ropes courses to get 12–13-year-olds to visit the zoo. Holst stated that since the ropes courses were added, sales in the gift shop had increased, and zoo visitors stayed 20 minutes longer, thus increasing the zoos opportunity to deliver their biological conservation message to visitors. Providing zoo visitors with entertainment for an additional 20 minutes does not translate to more time to teach them the conservation message of the zoo, but 20 minutes of involvement in a conservation-related project does.

Facilities

Facilities have been addressed in 54% of AZA mission statements. Patrick, Matthews, Ayers, et al. (2007) and Patrick, Matthews, Tunnicliffe, et al. (2007) have found that the term most prominently used when describing the zoo's facilities is exhibits. The educational importance and influence of exhibits are discussed in Chap. 5; therefore, exhibits are not discussed in detail in this chapter. At present, zoos are changing their approach to exhibit design and their facilities. Hands-on laboratories, interactive technology, computer simulations, teleconferencing centers, discovery rooms, and immersion exhibits are now an integral part of what zoos have to offer. Classrooms are being built around themes such as habitats, biogeography, and educational expeditions. Zoos are taking into account their own learning objectives and that of national and state educational standards. Zoos are developing zoo schools in cooperation with their local school system. The idea of education for all visitors is apparent in their more recent pursuits to build libraries and teaching resource centers (Carr, 2011).

In addition to exhibiting animals, the institution's facilities must be maintained. The everyday maintenance of the zoo, including animal care, is a sensitive matter that requires knowledge and skill. The average visitor may think that animal care means that the animals are clean, properly fed, and have adequate space, but there are many facets of animal care. Superior health, husbandry, and welfare of zoo collections are of paramount importance to any AZA – (AZA, 2011b) and European Association of Zoos and Aquaria (EAZA, 2011a) – accredited institution. The priority of the zoo is not merely feeding the animals. Animal diet is an important aspect of maintaining healthy, breeding animals. EAZA (2011b) states that:

Providing a good diet, which fulfills as many aspects of natural feeding ecology as possible, is an essential consideration in the welfare of zoo animals. As a basic foundation of animal management, nutrition is also integral to longevity, disease prevention, growth and reproduction. Proper feeding management incorporates husbandry skills and applied nutritional sciences.

During the 1960s, many zoos employed the services of licensed veterinarians to monitor the health and breeding of captive animals (Puan & Zakaria, 2007). The AZA recommends that all accredited institutions employ an on-site veterinarian. However, in some cases, zoos do not have the financial support to employ a full-time veterinarian. Therefore, all zoos are required to have a part-time veterinarian that inspects the collection twice a month and is able to respond quickly in case of emergencies. In other words, zoos must have a veterinarian available 24 hours a day. Additionally, zoos participate in year-round pest control, test for pathogens that could potentially ravage their collections, and use preventative measures such as quarantining newly arrived and sick animals (AZA, 2011c).

Research

AZA (2011b) states that

A commitment to scientific research, both basic and applied, is a trademark of the modern zoological park and aquarium. An AZA accredited institution must have a demonstrated commitment to scientific research that is in proportion to the size and scope of its facilities, staff and animal collections (p. 14).

Even though research is considered essential by zoological institutions (Benirschke, 1987) and 37% of AZA-accredited zoos include research as a mandate in their missions (Patrick, Matthews, Ayers, et al., 2007; Patrick, Matthews, Tunnicliffe, et al., 2007), historically, zoos have not been regarded as elite research institutions. Previously, zoos have worked with each other to share animal collections and study behavior of captive animals. The *in situ* and *ex situ* research conducted by zoos has traditionally been considered isolated from universities and research institutions (Turley, 1999). Today, however, zoological institutions are becoming more engaged in collaborative studies with major research institutions. Moreover, the EAZA states that one of their main objectives is “to promote the potential conservation value of zoo and aquarium research among authorities, universities, and conservation bodies (EAZA, 2011c).” Zoos are involved in animal research programs at universities and in research concerning infectious diseases (McNamara, 2007; Turley, 1999).

Zoological institutions’ *in situ* scientific research has driven the standards of animal husbandry and behavior and has produced visible results. Animals in zoos provide valuable data concerning the behavior of both captive and wild-living populations (Barbosa, 2009; Watters, Margulis, & Atsalis, 2009). Since the 1980s, much of the research conducted in zoos has involved the psychological health of captive animals. Monitoring the animals’ daily behaviors plays a significant role in the assessment of animal well-being. The psychological health of captive animals can have drastic consequences on its physiological health. To address the psychological, social, nutritional, and physical health of the animal collection and the public’s view of zoos, modern zoos aim to display animals in what are deemed naturalistic environments. Traditional cages are no longer considered healthy for the animals and the visitor.

Zoological institutions have concluded that *in situ* behavior may not mimic the behaviors normally seen in the organism’s natural environment. For example, zoological institutions have found that breeding success is not a determinant of an animal’s mental health. Some domestic animals breed readily in captive environments and in close proximity to humans. This might explain why these animals were selected for domestication. Domestic dogs will breed even in cramped and unsanitary conditions, such as breeding farms and puppy mills. A number of wild animals living in captivity also follow this breeding pattern, including certain species of monkeys, anteaters, and birds. The previously named organisms have been documented reproducing in small cages and under stressful stimuli. Conversely, some animals such as the giant panda, mountain gorilla, and rhinoceros

have difficulty breeding in captivity and require assistance from zoo personnel. The welfare of the organism is a priority (Wickins-Drazilova, 2006), but breeding is paramount from a conservation standpoint. In fact, the *in situ* research at zoological institutions has made great advances in animal husbandry. As a result of the research conducted, zoos have reduced the need to capture wild animals to maintain their collections and are striving to release animals back into their natural environment (AZA, 2011d). The genetic exchange programs zoos have developed help maintain the genetic diversity of the collection (Bertram, 2004; Bostock, 1993; Watters et al., 2009; Wickins-Drazilova, 2006).

Even though zoological institutions have established that there is a relationship between long life and overall health (Bostock, 1993), the animals that live in zoos, on average, enjoy a longer lifespan than most captive animals. This is a result of being kept in a controlled environment with access to routine expert veterinary care. Zoo animals receive superior medical care and may play a key role in public health. Exotic animals are highly susceptible to foreign pathogens. Therefore, they are monitored daily through observations and blood tests. The results of the test can alert the animal management team and the public health organization of possible epidemics. For example, in 1999, wild crows began dying at an alarming rate, and epidemiologists were scrambling to find the cause, and exotic birds began to die at the Bronx Zoo. When the zoo-owned birds began to die, the zoo's veterinarian rushed to uncover the underlying cause in fear that other collections might become infected. The zoo uncovered the link between mass avian deaths and human disease when they determined that the West Nile virus was responsible for the birds' deaths. Even though zoos had played a vital role in the detection of the disease common in Africa and the Middle East, the results were not immediately released to the public. In 1999, zoos were not seen as a viable research institution and were considered disconnected from the mainstream public health (McNamara, 2007).

When animals are kept in captivity, they may exhibit undesirable and unnatural behaviors such as pacing, head swaying, and staring (Bostock, 1993; Wickins-Drazilova, 2006). The monitoring programs at zoos identify the circumstances in which stereotypic behaviors exist. As zoos have evolved so has their management of captive animals. They have been active in pursuing optimal care for the organisms and designing zoo exhibits. *In situ* research in zoological institutions provides a wealth of knowledge in captive breeding, behaviors, and effective environmental stimuli.

Animal husbandry, behavioral monitoring, and epidemiology are not the only scientific endeavors that take place within zoo collections. Contemporary research is concerning itself with climate change and global warming and the effects these have on captive and wild animals. As geologists have uncovered the geological patterns of long-term climate change, they have revealed periods of glaciation and extreme drought. Geologists believe glaciation and drought, in particular regions of the world, may have lead to megafaunal extinctions. Taking these geological patterns into consideration, zoological institutions are paying closer attention to the changes in the health of their animal collections and wild populations as they relate to environmental health. Although zoo animals live in controlled environments, they

may offer some insight into parasitic infections and zoonotic diseases (Barbosa, 2009). As the climate warms, infections and diseases may become more prevalent. The Wildlife Conservation Society has found an increase of fly larva infecting baby birds in Argentina due to an increasingly muggy climate. The parasitic maggots burrow into the skin of nesting chicks and can kill the baby birds or cause abnormal growth (WCS, 2010).

The science of global warming and climatology is a relatively new research frontier for zoos. Because zoos have 150 years of meteorological, climatological, and geographical data (Barbosa, 2009), they are well positioned to be research leaders in climate change and its effects. We term this new science *bio-climatogeography*. Bio-climatogeography uses the meteorological data gathered by zoos and their geographical locations to determine how ecosystems, plants, and animals will react to global climate change and climatic patterns. Research into understanding the role zoos play in the critical issues of conservation is only beginning.

Culture and Society

Zoos are cultural institutions (Wharton, 2011). Throughout the historical development of zoos, they have been a part of society and have matured into important institutions that reflect current cultural and societal changes (Ballantyne et al., 2007; Fraser & Wharton, 2007; Hoage & Deiss, 1996; Marino, Lilienfeld, Malamud, Nobis, & Broglio, 2010). Zoos' architectural and exhibit designs reflect the past and present cultural impacts and subsequently project cultural perspectives to zoo visitors (Tarlow, 2001).

Society has and will probably continue to view zoological collections as centers of recreation. However, zoos perceive themselves as providing society with an enriching connection to conservation, biology, and organisms. Although the mission statements of zoos emphasize conservation, education, and research, zoos appear to be devoted to providing an enjoyable experience in a fun atmosphere. Now, zoos' goals need to focus on devising a plan that utilizes enjoyable, entertaining experiences to encourage informal education as the zoo increases much-needed revenue. Zoos need to utilize their marketing strategies and present information regarding their scientific activities. The style in which they choose to publicize their scientific and conservation endeavors must be interesting and entertaining. For example, the North Carolina Zoological Park produces ZooFilez with a local television news station. ZooFilez provides viewers with an opportunity to learn about organisms and the zoo's conservation efforts. According to a survey of 270 high school students living in the same county as the North Carolina Zoological Park, 90 students were aware of ZooFilez and stated their knowledge of zoos was gleaned from ZooFilez (Patrick & Tunnicliffe, 2009). Zoos can fulfill their commitments to conservation and research as well as deliver quality conservation education.

The Future

Globalization and other environmental factors have led to a not-so-promising future. The relationship between human impact and habitat sustainability may not be easily conveyed through a simple visit to the zoo, but zoos must continue to communicate their message. Zoos hold the key to shaping the future relationship between society and nature. Most zoos have a limited capacity and are not able to manage large areas of natural habitats. However, all zoos assume five roles as the executor of the relationship between society and nature.

First, zoos take on the role of the “model citizen” by conveying a conservation message. They advocate for a sensible, sustainable use of natural resources and promote less wasteful, green-building alternatives. Many zoological institutions are developing organizational plans that include the use of solar, wind, and thermal power in their daily operations. Additionally, they are growing food for the animals, composting, and using recycled materials in their exhibit design. Second, zoos are maintaining a viable and genetically diverse collection. Zoos are managed under the premise that wildlife conservation is of foremost importance. As zoological institutions have become more active in field studies (i.e., dallaszoo.com/conservation/cs3_current), their research findings are being applied to larger conservation efforts. Moreover, the conservation research that takes place *in situ* and *ex situ* is important in saving small fragmented wild populations. Third, zoos directly influence the attitudes and behaviors of the community in relation to the conservation of plants, animals, and habitats. Due to their urban locations within heavily populated cities, zoos have a unique geographic placement within the community. The urban location of zoos provides them with a unique opportunity to influence government policy. Fourth, the zoo is a conservation mentor. Through mentoring efforts, future generations of scientists and citizens will be more aware of the benefits of long-term conservation (Rabb, 2004). As conservation mentors, zoos must lead the public to become citizen conservationist. Fifth, zoos are a place for people to learn basic facts about organisms and their behavior.

This is a technological era in which electronics rule our daily lives, and their use has become second nature. Information is available at the click of a button, but nothing can replace the mental health that interacting within nature provides (Louv, 2006). Even though most organisms in zoos are exotics, they do represent organisms in a simulated natural setting. Viewing animals in a naturalistic, though simulated, setting provides a sensory response that two-dimensional representations cannot duplicate (Broad & Smith, 2004; Rabb, 2004). Although it is difficult to measure the impact of a single zoo visit on an individual’s behavior, zoos frequently ask visitors to participate in surveys that gauge the efficacy of the biological conservation message. Zoo visitors, even if it is their first visit, have preexisting knowledge of zoos (Patrick, 2010, 2011). A zoo visit may be the only interaction that a person living in an urban setting has with wildlife. Children are out of touch with nature, and their knowledge of organisms and biological conservation may be

based on media, books, and formal classroom education (Falk et al., 2007; Patrick & Tunnicliffe, 2011; Rabb & Saunders, 2005). The number of zoo visitors each year looks promising. Each year, AZA-accredited institutions tout approximately 140 million visits. However, this statistic does not take into account repeat visitors who have a deeply rooted curiosity of organisms and biological conservation. How can zoos encourage people who are not interested in research, conservation, education, or the use of organisms for entertainment to visit? How can teachers utilize zoos as places for student research and education? Zoos and educators should capitalize on the human need to experience the diversity of the natural world and the knowledge people have of zoos.

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