Optimal Conditions for Captive Elephants: A Report by the Coalition for Captive Elephant Well-Being

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by

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Preface

The Coalition for Captive Elephant Well-Being is composed of zoo professionals, animal behavior experts, field, laboratory and academic scientists and legal specialists. We came together in recognition of an urgent need to articulate a comprehensive set of standards and best practices grounded in current scientific evidence. We also recognize the need to state clearly the value judgments informing such standards.

Open, intelligent and fruitful debate over the management of captive elephants can only be conducted with a clear articulation of the science and values that constitute a basis for definitions, protocols and standards being promoted. Worthwhile progress in captive elephant management depends on such a debate.

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This study is dedicated to Iain Douglas-Hamilton, Cynthia Moss, Joyce Poole, Ph.D., and Katy Payne. Their unsurpassed devotion to the well-being of elephants everywhere is a constant source of encouragement and hope.

Caveats

Minimal research measuring captive elephants' welfare and behavioral issues has been conducted in North America. Most of the studies cited here and in support of specific model Best Practices were conducted with laboratory animals. Where scientific evidence in various situations suggests a range of measurable results from no distress to acute distress and where there are no definitive elephant studies, we have chosen to rely on studies of other animals until scientific studies directly related to captive elephants demonstrate the absence of distress in the relevant situation.

It is outside the scope of the Coalition's mission to address the destructive impact of human activity on free-ranging elephant populations evident throughout most of Asia and Africa. Nevertheless, we are mindful of the daily hardship and danger free-ranging elephants' face. Their plight is often desperate—either due to degraded environments into which they are pushed or the lethal consequences of competing with humans for space and other resources. The existence of such desperate circumstances does not affect the accuracy of the scientific evidence underlying this document. If anything, their struggle in the wild makes the Coalition's quest to preserve their lives and history all the more urgent.

The Coalition takes no position on the value of exhibiting captive elephants. It is outside the scope of this paper.

We understand that theoretical and empirical research are distinct. We believe that both forms of literature are useful in determining the nature of optimal conditions of captivity for elephants. In this document, we examine and rely on the theoretical work of Paul Waldau, Heini Hediger, John Eisenberg and Debra Forthman. While they are certainly not the only contributors to this field, we believe their models and analytic approaches to thinking about captive wildlife in general and elephants in particular are helpful. Viewed together, their works offer a unifying framework into which to fit the important elements of husbandry and management of captive elephants. The scope and thoroughness of their thinking allows us to make reasonable judgments about optimal conditions where no evidence exists at the present time. Finally, their visions free us from the conventions of traditional industry practices.

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1. Introduction

As of September 2004, American Zoo and Aquarium Association (AZA) accredited institutions held 133 African elephants scattered throughout the country at member institutions in groups of unrelated individuals. Approximately 148 Asian elephants are held in similar circumstances at AZA zoos (Keele 2004). The most notable result of captive elephants' flagship status in zoos is the zoo community's commitment to breeding reproductively viable animals and to importing elephants from the wild. In short, there is reason to believe that elephants will be exhibited in zoos throughout North America for many years to come.

To date, no comprehensive evidence-based context for developing standards of care has been reported in the literature. In addition, current AZA elephant management standards are minimal; and, in the authors' opinion, are generally not supported by current scientific evidence.

This analytic framework is intended to provide a different vision—an evidence-based foundation for model best practices for use by the zoo industry, non-zoo institutions such as sanctuaries, and government agencies that license or otherwise oversee such institutions. This project is driven by two major assumptions: (1) captive elephants are most likely to flourish in an environment that provides conditions promoting species-appropriate behavior as revealed by the species' natural history; and (2) a training regime predicated on positive reinforcement and respect for the animal's autonomy is best suited to enhancing the lives of captive elephants and providing for their psychological well-being.

2. Scope

This document reviews and analyzes the present state of scientific knowledge of elephant behavior in the wild, identifies critical elements of an optimal captive environment that might encourage the expression of natural elephant behavior when welfare is a prime consideration.

The document also analyzes in detail one aspect of the captive elephant environment—the human-elephant relationship. The document describes three management systems in use: free contact, protected contact, and passive control. We identify the tools, techniques and consequences to animal welfare and keeper safety associated with each system. This section of the study also discusses the unique properties of positive reinforcement training to promote captive elephant welfare in contemporary American zoo facilities.

3. Assumptions

The Coalition's "Best Practices for Care and Well-Being of Captive Elephants" rests on four assumptions:

1. Captive elephants should be managed as unique individuals as well as members of their respective populations.

2. Captive environmental design, whether zoo exhibit, sanctuary or any other built environment that encloses and restrains elephants should emphasize the needs that an elephant "itself perceives to be important" (Mench and Kreger 1996, 13).

3. Zoos and sanctuaries should provide their captive elephants "optimal conditions" of confinement predicated on the critical elements of the species' natural history and elephants' key individual characteristics (Hancocks 1996; Coe 2003).

4. Captive elephant management best practices should incorporate training principles that maximize captive elephants' learning, autonomy and competence, minimize their experience of unnecessary pain or distress and maximize keeper safety.

4. Discussion

4.1 Assessing elephant welfare in zoos—an overview

Animal welfare is a function of a constellation of variables, "including behavior, health, reproduction, and longevity" (Laule 2003, 969). Zoos undoubtedly deliver timely and appropriate veterinary care. Still, captive elephants' reproductive success appears low when compared to elephants in the wild (Moss 1988; Taylor and Poole 1998; Olson and Wiese 2000; Wiese 2000; Rees 2003). Further, the longevity of zoo elephants is not better, even under the most favorable statistical assumptions, than that of free-ranging elephants (Wiese and Willis 2004). This is true even though zoo elephants are protected, for example, from the two main causes of early death in free-ranging African elephant populations: drought and human predation (Moss 1988).

Setting longevity and reproductive rates aside for the moment, the most significant distinction on a daily basis between the lives of free-ranging elephants and their cousins in captivity is the virtual absence of opportunity for zoo elephants to engage in the repertoire of natural behaviors—social, occupational, feeding and migratory—normal to their species (Clubb and Mason in press). As Desmond (1994, 19) suggested a decade ago, "*pursuit of enhanced animal welfare depends on assessing our efforts in terms* *of the animal's behavior."* In other words, the delivery of optimal care in captivity would be reflected in captive populations of elephants exhibiting a full range of natural behaviors.

Under Desmond's measure, zoos are not providing optimal welfare for the elephants in their care. The reality of zoo life for many elephants is one of confinement with one or two unrelated individuals in a "spatially limited" environment that is "sterile and unchanging, in comparison to the wild" (Laule 2003, 969). Virtually all captive elephants are denied natural family groups. It comes as no surprise that few zoo elephants in captivity are socially or reproductively competent when compared to their wild counterparts (Rees 2001).

4.2 Zoo management models

Seidensticker and Doherty (1996) provide a useful schema for thinking about animal welfare and management in zoos. They describe four approaches:

A. The "zoo exhibit" animal management model is summarized by the phrase, "Zoos are for people." This model encompasses today's zoos that, like their 19th century counterparts, display animals for close inspection by zoo visitors and use their animals in shows and for rides.

B. The "medical" management model emphasizes direct human technological intervention to help animals in captivity remain healthy. It focuses on fixing animals so that they can adjust to conditions of confinement rather than adjusting the conditions of confinement.

C. The "ethological" model is summarized as "Zoos are for wild animals that move and do things." This model is based on the notion that zoo animals should be managed so that their lives differ as little from those of their wild conspecifics as possible.

D. The "humane" animal management model assumes zoos are welfare states responsible for the care of individual animals from cradle to grave. This model is unconcerned with the zoo visitor and with animal species or populations as a whole. This model is sympathetic to many aspects of the "ethological" model, but not to any ethologically related practices that might be perceived as potentially injurious or stressful to individual animals. The humane animal management model dictates that animals can choose whether they want to be on exhibit or off, a choice that confounds exhibition strategies.

From a functional point of view, applied behavioral conditioning including positive reinforcement can serve the goals of any and all four approaches to animal management and welfare in zoos.

We believe a balance of the best features of the third and fourth approaches is most likely to result in a humane and effective management philosophy and the provision of optimal conditions of confinement (Forthman 1998). The third approach (the "ethological model") embraces the assumption that institutional recognition of the species' natural history and key characteristics of individuals is crucial to providing healthy, optimal conditions of confinement. Such recognition places responsibility squarely on all levels of zoo management to adjust conditions when reasonably possible to meet the animals' needs. The fourth approach (the "humane animal management model") puts the interest of the individual animal first and foremost. This premise is the first value informing humane animal welfare and animal management.[1] Accordingly, this value in the "humane" approach serves as the tiebreaker in those situations where competing interests dictate differing approaches and outcomes.[2]

4.3 Managing captive elephants as unique members of a population

AZA zoos manage their small populations of elephants from a species perspective (Hutchins, Smith and Allard 2003). The central goal of this top down approach is to enhance the species' health and reproductive vigor. This intention is put into practice through AZA's Elephant Management Standards (EMS), which mandate extensive and invasive veterinary procedures and protocols aimed at promoting zoos' ambitions to breed their elephants (AZA 2003).

Within the last year or two, AZA Species Survival Plan's (SSP) breeding recommendations frequently have required individual animals, almost always females, to move from institution to institution with little obvious regard to aspects of the individual's welfare[3] beyond its potential as a cycling female. Other movements of female elephants and the concomitant disruption of established relationships between bonded pairs have been justified on the ground that one of the animals will fulfill an important social role in its new group.[4] Frequently, such experience and knowledge is wholly absent from the animal's history because the elephant was separated from her natal herd in the wild as a young calf and spent her life as a member of a small, unnatural pair or group of unrelated, possibly socially incompetent individuals. An impoverished social background, common

1 The well-being of captives is a subject that will always be susceptible to the imposition of human values (Maple, McManamon and Stevens 1995)

2 We believe that zoos holding elephants have the responsibility to inform the public of the true costs and ongoing financial burden of providing their elephants' optimal conditions in captivity. This educational process may help the public and zoo administrators realistically assess their ability and willingness to undertake the expense, responsibility, and commitment necessary to exhibit elephants in optimal conditions.

3 For example, three elephants that had lived for thirty years with daily access to a multi-acre outdoors exhibit were transferred at respective ages of 54, 34 and 34 to another facility and expected to adapt to living conditions that included long, harsh winters and greatly reduced living space.

4 An African elephant that had lived and bonded with an Asian elephant over a decade or more was transferred 2000 miles to a zoo holding Africans. The elephant did not integrate successfully into her new social group and was eventually returned to the zoo of origin shortly before a state court was scheduled to address the propriety of the zoo's action in transferring the elephant from her longtime home.

to most AZA zoo elephants, does not equip them to discharge the complex reproductive or social roles their transfers are frequently intended to accomplish.

One of the consequences, then, of AZA's management of its elephants from a species perspective, is to minimize the welfare needs and history of its elephants as individuals (Hutchins, et al. 2003). This policy approach has produced an aging population of Asian and African elephants who cannot sustain their own small numbers (Olsen and Wiese 2000; Wiese 2000).

A different and potentially rewarding approach would be to view the welfare of individual elephants as the foundation for a flourishing population. As Jamieson pointed out in 1995, "[I] t is as misleading to speak of the welfare of a nonhuman species as it is to speak of the welfare of the human species. It is individual organisms that have welfares. As the philosopher Jeremy Bentham wrote nearly two centuries ago, the welfare of a community is simply the sum of the welfares of individuals" (Jamieson 1995).[5] Today, modern biologists proceed on the assumption that the primary unit of significance in ecology is *not* the species but, rather, *populations composed of unique individuals* (Mayr 1976).[6]

Thinking about AZA's elephants as individuals rather than collectively as a "herd" or as members of an elephant species more accurately describes zoo elephants' experiential reality and is more in keeping with modern principles of biology. Such an approach takes into account each elephant's unique genetic heritage and physical, mental, social and psychological history and is more likely to result in the animal's enhanced well-being. An approach focused on delivering optimal conditions of confinement as measured by the animal's behavior should gradually result in a healthy and flourishing population.

4.4 Waldau's approach--assessing captive elephant welfare in light of key individual characteristics and the species' natural history

Before addressing Hediger's concept of optimal conditions for captive wildlife and its application to elephants, we consider a different prism through which to discern both what captive elephants need and what a captive environment must provide. This is the prism of key individual characteristics.

Waldau (2002) postulates that elephants express specific attributes, such as intelligence and social complexity that may deserve moral consideration. Although the moral weight appropriately attributable, for example, to an

[5] Darwin recognized this principle, too, when he observed that natural selection operates on the level of individuals, not on the level of a species.

[6] A population is subject to mathematical and statistical analysis. It is also true that whatever is measured by such means may or may not be descriptive of or relevant to any given member of a small population (Mayr 1976). As Albert Einstein once remarked, "Not everything that can be counted matters, and not everything that matters can be counted."

elephant's intelligence is outside the scope of this project, it is useful to consider Waldau's approach as a means to describe the behavioral reality of individual animals. His approach compels consideration of each individual animal's reality and, simultaneously, provides a means to assess whether the animal is in an environment permitting it to experience its essence. So, we adopt this prism to the extent it compels caregivers to focus on the well-being of individual captive elephants and offers an approach by which to define well-being for individual elephants.

As adapted for our purposes, Waldau's approach asks the caregiver to determine what characteristics are important to individuals of the species or what characteristics of the individual empower it to enjoy the full range of normal behaviors and behavioral experiences its natural history suggests is its birthright. Put most simply, the question Waldau posits and we adopt, albeit in a different context and with a different purpose, is what makes an elephant an elephant?

As a general matter, we know from reports of elephant behavior in the wild and in captivity that they are complex individuals possessing distinct histories, personalities and interests (Moss 1988). More specifically, we know that they live in family groups in which they exhibit strong attachments, attachments sometimes lasting a lifetime (Moss 1988; Sukumar 2003). We know elephants are sentient creatures capable of suffering both physically and mentally (Moss 1988). And, finally, we know that elephants are physically vigorous creatures who possess the strength and endurance to transform forests into savannas and who move constantly through the large spaces of their home ranges (Poole 1997).

An important part of the answer to the question of what constitutes optimal conditions of confinement for elephants is answered by recognizing at least three key characteristics of individual elephants, irrespective of their species' membership. These characteristics are: (1) their cognitive ability or intelligence, (2) their social complexity, and (3) their physical vigor.

4.5 Applying Waldau's approach—defining elephants' key characteristics

Elephants are complex individuals with distinct social histories: "Each elephant is different from every other elephant, not only by virtue of its distinctive genes, but also because it has undergone unique experiences in life" (Sukumar 1994, 106). As Waldau points out, "apart from the fact that each elephant is an individual in the logical sense, each has a distinctive history in a social context populated by others with distinct histories" (2002, 78-79). Evidence collected over the past thirty years by field scientists uniformly supports the observation that elephants as individuals, exhibit significant cognitive abilities, social complexity and remarkable physical vigor (Eisenberg 1981; Moss 1988, Estes 1991; Sukumar 1994).

A humane captive environment must reflect an informed understanding of these key characteristics. As Mench and Kreger wrote, we must place emphasis on "designing zoo environments that meet the needs that the animal itself perceives to be important" (1996, 13).[7]

4.6. Cognitive ability

Elephants show a broad array of behaviors that behavioral scientists associate with intelligence. These include (1) noticeably different mental states or moods; (2) complex cognitive skills such as using mirrors to locate hidden objects (Vauclair 1996, 143): (3) play (Moss 1988, 106-07, 112; Shoshani and Eisenberg 1992, 134-136; Masson and McCarthy 1994, 148-149; and Fagen, 1981, 178-179); (4) boredom (Chadwick 1994, 18); (5) deception (Griffin 1992, 209); (6) tool use (Vauclair 1996, 53; Hart, Hart, McCoy and Sarath 2001) (7) knowledge of medicinal plants, e.g., to treat wounds and parasites (Douglas-Hamilton and Douglas-Hamilton 1975; Janzen 1978, 73-84; Moss 1988, 261; Payne 1998, 53; Engel 2002, 92-108); and (8) the possibility of self-awareness (Gallup 1983; Gergely 1994, 55; Poole 1998).

An elephant's large brain provides a host of advantages, including memory storage and the intellectual capacity for using complex acoustic communication. The acquisition and use of language has long been accepted by behavioral scientists as a mark of superior intelligence. Elephant species demonstrate a relatively large vocal repertoire and extensive communication networks (McComb, Moss, Baker and Sayialel 2000). The complex communication skills of elephants enable them to maintain a complex social system. Elephants exhibit skill and experience as they negotiate relationships with many different individuals they meet over their long lives (Poole 2004). For example, McComb's analysis of playback experiments with adult female African elephants suggests that they distinguish infrasonic contact calls of female family members and bond group members from those of females neither in their families nor bond groups. McComb further determined that they could discriminate between calls of family units further removed than bond group members, apparently on the basis of how frequently they encountered them. The researchers estimated that the elephants studied were familiar with the contact calls of 14 families in the population, or 100 adult females, in order to perform the discriminations observed (McComb, et al. 2000).

Elephants learn from experience and are able to pass their knowledge on to younger members of the family unit (Sukumar 2003). Recent research suggests that possession of enhanced auditory discrimination skills by the oldest member of a group influenced the social knowledge of the group as a whole (McComb,

[7] Emphasis in original.

Moss, Durant, Baker and Sayialel 2001). The capacity to learn and teach is another hallmark of intelligence recognized by humans.

Poole argues that elephants transmit knowledge, demonstrate complex emotions and possess a concept of self, a sense of humor and a concept of death (Poole 1998). Payne recently echoed a number of Poole's assertions, agreeing that elephant species develop and maintain multiple and many-layered social relationships over long periods of time and through changes in age, status and condition (Payne 2003, 507-510). Payne's report offers stunning evidence of individuality by noting "129 responses to the death of an elephant calf" by elephants present in a Dzanga Sangha forest clearing in the Central African Republic.

Intelligence, along with a well-developed system of communication making use of all senses—auditory, olfactory, tactile, visual and the ability to detect seismic signals (O'Connell, Hart and Arnason 1999)—enables elephants to maintain a broad network of relationships involving family, kin, friends, foes and strangers. Elephant intelligence and communication skills help them to find mates and consorts and to protect, soothe and rear their young.

Field research paints an increasingly complex portrait of animals who by conventional human measures are creatures whose intelligence is borne out by their ability to learn (Rensch 1957), to reason and to use tools; it is also exemplified by their possession of a prodigious memory, a sense of self and remarkable communication and social skills (Poole 1998; McComb et al. 2000; Payne 2003; Poole 2004).

4.7. Social complexity

Reproductive competence

It is generally accepted that the potential lifespan of elephants is around 50 to 70 years for Asian elephants and 80 years for African elephants (Walker 1975). In the absence of human predation and drought, wild African elephants can expect to live to a ripe old age (Moss 1988, 268). Such longevity has a number of interesting correlates of particular relevance to managing elephants in captivity.

Elephants are slow to reproduce, even under favorable environmental and social conditions in the wild (Moss 1988, 239). The slow rate of reproduction reflects the magnitude of resources required to rear a calf successfully. Like human offspring, elephant offspring require a long period of time to mature during which not only mothers invest considerable energy and attention, but also members of the entire family herd participate in helping young elephants learn skills they will need to become competent adults.

After its birth, a calf will be nursed and tended intensively by its mother for six months. A calf can suckle from its mother or "aunts" well into its second year. The weaning process is gradual, as the youngster feeds more and more independently over time (Estes 1991). Because Asian calves may also nurse from more than one female, Eisenberg (1981, 186) concludes that the presence of many lactating females in matriarchal herds "often ensures adequate nutrition for calves." Lee and Moss report that African elephant calves suckled until they were at least 4.5 years old (1986). Lee and Moss also report that cows with surviving male calves tend to have a longer inter-birth interval than cows with surviving daughters (1986).

Moss reports that the whole herd plays an active role in assisting with rearing the young. Moss observed that a young calf is rarely more than a few feet from its mother, and is often less than one foot away (1988, 162). Mother and calf are in almost constant physical contact. "Even at 9 years a calf may spend over half the time less than 5 m from its mother" (Estes 1999, 227).

Interactions between calves and other elephants were found to be frequent. They involved play, relaxed, friendly greetings or assistance from others when calves were threatened or distressed (Lee 1987). Juvenile and adolescent females in the herd comforted, assisted and protected calves. These allomothers tended to be family members but were not always siblings. Lee notes that siblings maintained close proximity to calves and that calf defense also routinely involved less closely related family members (1987). Lee concludes from her observations that the early establishment of close care-taking relationships within families may enhance the stability of the family through time (1987). Undoubtedly, such relationships support a calf's survival. The onset of puberty in females occurs at around 11 or 12 years of age with first calves born when females are about 13 years old (Moss 1988, 34). These first-time mothers receive strong support in rearing their young from the entire family.

Unlike most species, female elephants live long after the age of reproduction. Estes (1991, 261) concludes that their extraordinary post-reproductive lifespan reflects the crucial roles that "[l]eaderhip and experience play…in elephant social organization…."

"The family setting is thus indispensable for the normal growth and development of the young elephants…. Within the family, the calves are protected, nourished, nurtured, and taught the rules of living" (Sukumar 1994, 102). Females stay with their mothers throughout their lives. These family units are "the most stable across seasonal and temporal partitions" (Wittemyer, Douglas-Hamilton and Getz 2005).

Relying on research conducted by Poole, Moss reports that male African calves reach puberty between 10 and 15 years of age and leave the matriarchal herd anywhere between the ages of 10 to 19, with "the average age of independence at 14" (1988, 101). Still, young males tend to stay near cow/calf herds, tagging along the periphery with other young males. As they grow older, they gradually move in groups into "all bull" areas (Moss 1988, 112). Bulls typically come into musth at age 30 but compete successfully for females only when they are much older (Moss 1988, 112). Thus, males enjoy the society of many elephants including a wide range of core matriarchal groups on a regular basis, but do not exercise group leadership (Sukumar 1994, 92).

Eisenberg also wrote extensively about the impact of Asian elephants' social life on their reproductive competence. He observed "[t]he initiation of a young elephant into its social unit is a gradual process." He noted that until about four years of age, the social roles of males and females are virtually identical, "but they begin to diverge in the fifth year, and from then on we can speak of a separate male role and a series of female roles" (Eisenberg 1981, 184). Although a male may reach sexual maturity at 7 or 8 years of age, the average age of onset of puberty is 10 to 12 years. The young male begins to achieve adult stature and size at 17 years of age. Eisenberg refers to the years from 14 to 17 as a "sub-adult phase." During these years of maturation, a young male engages in contests with members of his own age-class (Eisenberg 1981, 184-185). In this way a dominance order is established among males who are familiar with each other because home ranges overlap. The contests rarely result in serious injury and seemed to Eisenberg to be limited to tests of strength. Younger males tend to follow and feed in the vicinity of older males. Eisenberg noted that older males with an established position in the populations' social hierarchy are generally semi-solitary for the better part of their lives.

These field observations of African and Asian elephants offer specific evidence that successful rearing of elephant young occurs over years in the context of a stable yet socially complex (multi-generational) herd. This review of the literature supports at least five key observations: (1) an elephant calf's maturation takes years; (2) calf rearing is the main work of the matriarchal herd; (3) the occasion of weaning is not a marker of the calf's physical independence, intellectual development or social competence; (4) after reaching adolescence, female and male elephants go on to lead significantly different lives, the full range of which take decades to unfold; and (5) the acquisition of social and reproductive competence by adult elephants, whether male or female, takes years.

Unique social skills of female elephants

Female elephants may enjoy one of the most extensive social network of any mammal studied other than human primates. It follows that understanding their social organization into multi-generational herds, bond groups and clans is of paramount importance.

The fundamental social unit is the cow-calf herd or family unit (Wittemyer et al. 2005). Moss (1988, 35) notes that the matriarchal herd is, "a tight-knit coordinated group" generally composed of a mother and her young with her grown daughters and their offspring. African and Asian female elephants remain with their natal herd throughout their lives (Eisenberg 1981; Moss 1988; Estes 1991; Sukumar 1994).

The typical matriarchal African herd size is 9-11 (Estes 1991, 260). The herd synchronizes its activities such as "feeding, or walking, or resting, or drinking or mud wallowing" (Moss 1988, 35) with the matriarch setting the activity, direction and rate of movement (Estes 1991, 260). The matriarch plays a crucial role in leading her herd and transmitting her experience to her family. Eisenberg wrote in a similar vein about female Asian elephants over twenty years ago:

> *The cow herd serves as a repository for traditional knowledge, including the routes to water holes during periods of drought, the routes to feeding grounds and so forth. Since the adult cows undoubtedly carry the memory of habitat utilization patterns, this is a form of living tradition (1981, 183).*

Female African elephants' profound expression of affiliation reaches outside the immediate family unit to related family members. Female elephants in the wild and in captivity have been repeatedly observed to engage in significant altruistic behavior, including allomothering. Estes (1991, 261) characterizes the degree of their expression of altruism as "remarkable." Captive elephants also demonstrate such helping behaviors (Schulte 2000).

Bonds between close relatives may be very strong and last a lifetime (Moss 1988). Subgroups of the same family, if reunited after a separation of only a few days, will greet each other with energy and excitement. Moss describes it this way: "The two sub-groups of the family will run together, rumbling, trumpeting, and screaming, raise their heads, click their tusks together, entwine their trunks, flap their ears, spin around and back into each other, urinate and defecate, and generally show great excitement. A greeting such as this will sometimes last as long as ten minutes" (1988, 128).

Female elephants not only express affiliation with other subgroups of related family members, for example subgroups led by adult siblings, but also nurture social ties extending to bond groups composed of associated family units and clans and unrelated bond groups sharing the same range (Wittemyer et al. 2005). When contact occurs with related bond groups, bonds are renewed, although less intensely than with close family members, through greeting ceremonies (Moss and Poole 1983). Over the course of their long lifespan and large home ranges, elephants come into contact with dozens of conspecifics and thus must acquire sufficient social skill to negotiate contacts successfully with acquaintances, strangers and even enemies.

The integrity of the elephant's natal unit and complexity of its larger social world are critical to its life history. The natal herd protects the young and creates "a social milieu in which the young elephant can mature and learn its role in adult life" (Eisenberg 1981, 183). Female elephants in particular are socially gregarious animals capable of transmitting experience and knowledge to each other and engaging in altruistic behavior calculated to enhance the other's survival. Female elephants' experience of and need for affiliation is profound (Moss 1988).[8]

4.8. Physical vigor

African and Asian elephants, all non-territorial herbivores, subsist in virtually any tropical and sub-tropical habitat providing adequate quantities of food and water. Elephants move through their home ranges throughout the year.

Sukumar (2003) reports that female Asian elephant home ranges of 34 sq. km to 800 sq. km have been measured. The home range of a male Asian elephant was measured as ranging from 200 sq. km to 235 sq. km (Sukumar 2003). Some home ranges appear to cover thousands of square kilometers (Sukumar 2003). Eisenberg observed that Asian males move in a consistent home range, visiting various feeding and watering locations on a periodic schedule.

Home ranges for African cow/calf herds may vary from 50 to hundreds of sq. km. African bull home ranges vary from 500 to 1500 sq. km (Shoshani 1997). Langman reports that African elephants travel 483-644 km during seasonal migrations (1995, 629). Elephants range over large distances on a daily basis, from 20 to 30 km, in order to exploit resources (Shoshani 1992).

Elephants' space requirements are driven in part by their size. Equally important is their natural history. They are intensely social, physically powerful animals built to roam large tracts of land searching for water, foraging for food and

[8] The details described in this section refer to savanna elephants. Less is known about forest elephants, a separate species.

minerals and exploring and investigating their physical environment. They also travel considerable distances in order to socialize with family, kin and conspecfics.

Elephants in the wild are typically on the move for 20 out of every 24 hours. Of those 20 hours of activity, 18 are usually devoted to foraging. Eisenberg (1981) observed that Asian elephants stay in a single area for no more than three days before moving on. Accordingly, both African and Asian elephants require access to varied and appropriate habitat permitting them to engage in significant foraging behavior.

Over time, elephants have evolved into creatures that can travel vast distances while expending relatively little energy (Langman, Roberts, Black, Maloiy, Heglund, Weber, Kram and 1995). They are huge, powerfully built animals that can transform a forest into a savannah. A successful captive environment, therefore, must provide them with sufficient space to fully exercise both their remarkable powers of endurance and strength.

At this time, AZA's EMS mandate 75 sq. meters of indoor space and 252 sq. meters of outdoor space for two elephants. These mandates are unaffected by the climatic location of the exhibit (AZA 2003).

In the wild, a modest elephant home range has been measured at 15 sq. km or 15,000,000 sq. meters. It follows that AZA's permitted barn space is about 200,000 times smaller than the smallest known space female African elephants have chosen for themselves. AZA's outdoor space is roughly 60,000 times smaller than the smallest known elephant home range. AZA elephants' frequent experience of arthritis, osteomyelitis and other chronic and sometimes fatal orthopedic disabilities is well known (Mikota, Sargent and Ranglack 1994; Csuti, Sargent and Beckert 2001; Fowler 2001; Roocroft and Oosterhuis 2001). The health history of captive elephants in North America suggests that traveling over significant space on a variety of substrates and terrain are important to maintaining foot health in Asian elephants and to ward off arthritis and related disabilities and diseases in all elephant species (Fowler 2001).

4.9. Optimal conditions of captivity – Hediger's perspective on the captive environment and Eisenberg's model of mammalian life strategies

We do not assume that the only acceptable conditions of captivity are ones closely replicating the complexity and scale of the wild. We do assume, however, that captive environmental options and opportunities must mimic conditions in the wild sufficiently to permit elephants to engage in the full repertoire of natural behaviors. The idea of employing knowledge of natural life histories in design and management of zoo animals is not new, but its application is still novel more often than not.

More than fifty years ago Swiss zoo director Heini Hediger called for the development of zoo environments that provided for the behavioral, psychological and physiological needs of captive animals based upon the species' natural history (1950, 1955).

Subsequently, Eisenberg prepared detailed reports on studies of captive and wild mammals and developed a theoretical model based on life history strategies, which he described in his book, *The Mammalian Radiations* (1981). The ecological variables in Eisenberg's model offer a cogent means for assessing primary design considerations to match a zoo environment with a wild animal's needs. He and zoo scientist Devra Kleiman had promoted the necessity of behavioral studies in zoo animal management (1977).

Following Eisenberg's work (1981), zoo curators John Seidensticker and James Doherty asserted that the usefulness of behavioral studies in zoo exhibit design "cannot be overemphasized" and that significant exhibit improvements could not be achieved without reference to natural history of the species in the wild (1996).

In 1998, Debra Forthman offered a detailed proposal for a zoo environment for ungulates predicated on the work of Hediger (1950, 1955) and Eisenberg (1981).

4.10. Delivering optimal conditions of captivity – Forthman's Proposal

Consistent with Hediger's philosophy of providing the best care for captive animals by addressing an array of fundamental needs, Forthman (1998) embraces the ideal that zoos provide optimal conditions of confinement informed by the animal's natural history assessed in terms of discrete ecological variables, including the physical, social an occupational variables identified by Eisenberg (1981). We embrace this ideal as well

Forthman asserts and we agree that the central goal of animal management standards is "to provide optimal conditions in every aspect of our care of confined animals" (Forthman 1998, 237; Forthman, McManamon, Levi and Bruner 1995). Forthman's proposal sets forth a comprehensive approach by which to describe and analyze the constituent variables of captivity and to identify and assess the quality of care being delivered.

Forthman refined and applied Eisenberg's model to define and describe components of optimal care for ungulates in captivity. Her proposal provides a general discussion and analysis of each variable with respect to ungulates as a grand order. This section summarizes her main points and describes research about behavioral and ecological variables first identified by Eisenberg and their meaning for captive elephants.

4.11. Definitions

Physical variables: These factors include geographic range, body size and life history strategy.

Sensory variables: These factors include visual, auditory, tactile and olfactory environmental stimuli.

Occupational variables: These factors fall into two broad categories: activity cycle and habitat use.

Feeding variables: Forthman identifies two significant feeding variables that cross both occupational categories: foraging strategy and diet.

Social variables: This ecological category has the longest list of critical elements, including social structure, reproductive behavior and vulnerability of the species' young.

4.12. Physical variables

Geographic Range

The term geographic range encompasses, in gross terms, the geographic limits over which an entire species carries out its natural life cycle (Eisenberg 1981). Geographic range encompasses the complete range of habitats to which a species is adapted (Eisenberg 1981). For example, "savanna" elephants are found in temperate woodland, savanna, riverine forest, bush, desert, etc.

Forthman argues that geographic range is important precisely because its implications are "frequently ignored" by the zoo community (Forthman 1998, 238). She recognizes that the ability of humans to provide for captive animals is constrained, at best.

For example, stress is commonly caused by the failure of captive conditions to provide the subject animals with the environmental options necessary to permit them to exercise evolved thermoregulatory strategies: "When thermoregulation begins to constrain other species-specific activities, the animal is both deprived and distressed" (Forthman 1998, 238). This problem is thrown into sharp relief in her discussion of body size.

Body Size

Forthman points out that body size is closely related to home range size. The larger the mammal is, the larger the home range typically is. Principles of allometry indicate that very large animals (and elephants are the largest extant land mammals) will be sensitive to heat stress. Forthman asserts that thermal assessments are "critical" to exhibit design for species at either end of the size spectrum. Langman reports that elephants are obligatory heterotherms, meaning that they store heat in their body tissues when temperatures exceed 23C (74F). Langman cautions that elephants must be allowed to "dump" excess heat they store above 23 C (74 F) into the atmosphere and that an inability to release excess heat could result in chronic low-level stress (Sampson 1999).[9]

Forthman recommends that exhibit materials should approximate the thermal characteristics of natural matter. She also recommends that species-appropriate water or mud features as well as multiple opportunities for shelter be provided. Forthman defines shelter as structures that go "beyond simple shelter from the sun in those climates in which the heat index (a measure of "apparent temperature" that takes into account relative humidity) may be very high." One rule of thumb suggested is creating multiple areas in each exhibit that provide four thermoregulatory options: sun and wind, shade and wind, sun with no wind and shade with no wind.

Consideration of temperature and humidity are important, especially for large mammals at risk of hyperthermia (Forthman et al. 1995). For example, shelter from direct sun in shade may be insufficient to offer an effective thermoregulatory option if the heat index in the shaded area is higher than in direct sun due to poor air circulation or higher relative humidity. Accordingly, shade alone is not a sufficient thermoregulatory option for large mammals that need to reduce their thermal loads (Langman 1985, 1990).

Langman's field research on thermoregulation indicates that in the wild, each species uses behavioral options to maintain a balance between heat gain and loss (Langman 1996). Langman reports that evaporation only accounts for twenty to thirty percent of total heat loss; behavioral thermoregulation is the most important strategy for most species. Langman observes that captive enclosures rarely provide a species with a range of behavioral choices as large or diverse as those in the wild. Recognizing that ambient conditions in an exhibit during the summer months may exceed the upper critical temperatures for a species (in this case, sea lions), Langman (1996) suggests an alternate indoor habitat, air-conditioned to temperatures below the published upper critical temperature.

[9] "From a veterinary perspective, chronic or intermittent stress is undesirable because it has potential harmful impact on all aspects of animal health" (Baer 1998, 279). Chronic or intermittent stress has been associated with impaired reproduction (Moberg 1985), increased susceptibility to disease (Landi, Drieder, Lang and Bullock 1982; Kelly, 1985), gastric ulcers, cardiovascular pathology and alterations in basal metabolism (Klasig, 1985).

Life History Strategy

Body size relates to life history strategy. Longevity is positively correlated with body size. Ungulates are herbivores and generally live longer than species of the same size utilizing a different diet (Eisenberg 1981). Forthman asserts that these observations imply that "providing optimal captive environments and care for many ungulates is a long-term proposition" (1998, 239). Further, she points out that because most large ungulates have small litter sizes, the death of even one offspring is significant to the animal's reproductive fitness (Eisenberg 1981) and relevant to an ambition to propagate captive species.

Forthman's review concludes that facilities for ungulates must be designed to accommodate individuals throughout their lives. While maintaining fundamental features that contribute to the ungulates' sense of security in a familiar home range, temporal variation of enrichment objects is important to approximate the temporal environmental complexity of their natural environment. Furthermore, she recognizes that "relatively stable social groups should be maintained over time to best approximate field conditions for most social species, including continuity of care taking staff" (1998, 239). Forthman observes that managers should, among other things, provide refuges to protect immature or low-status animals from aggression and environmental extremes.

4.13. Physical variables and elephants

Elephants' need for space is not only driven by their body size but also by their key characteristics as highly social, physically vigorous individuals. Elephants' need for space is also a function of the species' natural history playing out in a warm climate over large tracts of land. See additional discussion of the topic in 4.8. Physical vigor.

Langman's (1990, 1996, 2003) and Rees's (2002) research suggests that exhibits must provide elephants with environmental options that allow them to regulate their body temperature effectively. For example, elephants located in zoos in the lower tier of American states must be provided access to water features or outside corrals at night so that they can shed excess heat absorbed during the day.

As stated previously, body size and longevity are positively correlated. It is not surprising, therefore, to consider that Asian elephants have a lifespan roughly 50 to 70 years and Africans a lifespan of 80 years (Walker 1975). Accounting for this potential places a heavy burden on zoos to develop appropriate lifespan planning (Maple 2003). Such planning would address, at a minimum, the needs of aging, sick, disabled and generally more needy elephants (Maple 2003). It is incumbent on zoos exhibiting elephants to develop and maintain technical expertise in the diagnosis and delivery of geriatric care, to provide remedial environmental options both indoors and outdoors to protect vulnerable animals, and to provide for the welfare of zoo elephants by retiring them to appropriate facilities when their resident institution cannot address or ameliorate their health condition (e.g., arthritis, chronic foot disease or other significant disability) or can no longer effectively and humanely exhibit them.

4.14. Sensory variables

Elephants have formidable senses of hearing and smell. Elephants also have an acute tactile sense, a sense important for social communication. Because captive mammals' perception may not always be the same as that of the humans who design their facilities, "sensory over-stimulation, or the masking of species-specific cues by irrelevant or distressful ones, must be considered as a potential and often subtle source of distress" (Forthman 1998, 240).

Vision

Light or illumination is a critical environmental variable to consider when designing captive mammal facilities. Few studies have attempted to quantify the deleterious effects of improper lighting—whether too much or too little—and the effect on species held indoors for long periods (e.g., Helfman 1981).

Audition

Audition serves many critical functions for elephants (Payne 1998). Forthman (1998, 240-241) states, "Certain conditions associated with confinement may subject ungulates to auditory distress, either chronic or acute, predictable or random" (Hanson et al. 1976; Peterson 1980; Gamble 1982; de Boer, Slangen and van der Gugten 1988; de Boer, van der Gugten and Slangen 1989; Thomas, Kastelein and Awbrey 1990; Gold and Ogden 1991). Elephants' range of auditory sensitivity differs markedly from humans. Accordingly, they may "particularly suffer auditory distress" (Forthman, 1998, 241).

Sound, like light, is a critical environmental variable. Like light, the deleterious effects of sound on captive mammals can be pervasive and profound (Peterson 1980; Stoskopf 1983; Krause 1989). The absence of published data on the influence of sound stimuli within zoos on elephants is not evidence of the absence of such influence. Deleterious physiological and behavioral effects of loud noise are well documented (Peterson 1980; Thomas et al. 1990). Frequency of sound also profoundly influences the psychoneuro-endocrine and immune system of animals (Forthman et al. 1995).

Forthman's research suggests that decibel level and frequency of noise, particularly in the elephants' holding areas, must be kept at a minimum. See additional discussion of audition in 4.6. Cognitive ability and 4.7. Social complexity.

Olfaction

Necessary cleaning and disinfecting of exhibits and holding areas can deprive captive mammals of olfactory stimuli, including urine, feces and glandular secretions, even though such stimuli “function in spatial orientation and social communication” (Forthman 1998, 241).

4.15 Sensory variables and elephants

Many holding areas for elephants are constructed of acoustically reflective concrete. This is another reason arguing in favor of the pragmatic advantage of holding elephants in a climate to which they are suited. While the provision of veterinary care and husbandry might require holding areas, a suitable climate would minimize the amount of time an elephant would spend in such areas.

Given the critical importance of sound as an environmental variable and the broad use of auditory signals to communicate, zoo elephants’ access year round to quiet space outdoors as well as indoors may be important (Peterson 1980; Stoskopf 1983; Krause 1989; Forthman et al. 1995; Forthman 1998).

Similarly, the preservation of olfactory stimuli could be enhanced to the extent that elephants are exhibited in climates similar to those in which they have evolved. This would result in less time spent confined to sanitized holding areas. Further, to the extent that spacious exhibits more appropriate to the size of elephants and their home ranges are constructed, rotation of pastures could reduce the necessity for constant removal of solid waste.

Research reported in the August 2004 issue of *Chemistry and Biology* discusses pheromone transport in Asian elephants (Lazar, Rasmussen, Greenwood, Bang and Prestwich 2004). The investigation reported that female Asian elephants communicate their readiness to mate by excreting a sex pheromone in their urine. Males detecting the pheromone touch the pheromone-loaded urine with their trunk tip and then place some of the urine in their mouths, for analysis in the vomeronasal organ, after which mating typically ensues (Lazar et al. 2004). Given the importance of supporting the dwindling number of Asian elephants in captivity, exhibit construction and social groupings of individuals should take advantage of this information about the important role that olfactory stimulation plays in Asian elephants’ reproductive strategy.

4.16. Occupational variables

Activity cycle

Observations of ungulates and elephants suggest that they are polycyclic (Eisenberg 1981; Moss 1983). This activity pattern results from the interaction of feeding, thermoregulatory behavior and, to a lesser extent for elephants, anti-predator strategies (Eisenberg 1981; Moss 1983). We agree with Forthman's suggestion that the provision of optimal care requires work shifts and sufficient security precautions to permit animals to remain on exhibit for the majority of the time, except when caretakers bring the animals in twice daily for individual monitoring and dietary supplements. As Forthman indicates, "this routine would permit more normal activity patterns and might also reduce the incidence of behavioral stereotypes associated with confinement, social restriction, and scheduled feeding times …" (1998, 241).

Habitat use

Habitat use is inextricably bound to feeding strategy. It is well known that African elephants tend to exploit relatively open habitat while Asian elephants are usually found in more heavily wooded environments (Moss 1988; Sukumar 1994). Forthman observes that most large herbivorous mammals are nevertheless confined by zoos to "monotonous exhibits in which the animals are managed on compacted dirt, perhaps enhanced with a mud wallow and small patches of hardy or heavily protected vegetation" (Forthman 1998, 242). Her pointed observations are especially relevant to many zoo elephant exhibits.

Forthman recommends an aggressive redesign of exhibits holding large ungulates: " It is imperative to provide access for trucks, cranes and other heavy equipment necessary to install and replace large exhibit furnishings, including entire trees, as well as to till compacted substrates, add gravel and replant or reseed. Plans for adequate irrigation and careful selection of the hardiest grasses and herbs are also extremely important in the maintenance of vegetation. Surface area, terrain, and substrate are additional considerations in designing and maintaining habitats that will elicit species-typical behaviors" (1998, 242).

4.17. Occupational variables and elephants

Elephants in the wild occupy approximately 18 hours of their day browsing or grazing. They move almost continuously while feeding. The remainder of their day is largely given over to socializing, water or dust bathing, or wallowing in mud. They rest for approximately 4 hours a day (Moss, 1988; Eisenberg 1981).

Given the manner and duration of activity of elephants in the wild, options must be available to captive elephants permitting them to maintain a normal activity pattern. Options basic to elephant occupational variables would include room to roam on a variety of substrates, with a variation in topography, and access to appropriate plant material or large and free provision of cut fresh browse (branches) for species specific foraging. Other basic occupational options suggested by elephants' natural history include daily access to dust, water and mud of sufficient volume to permit totally submerged bathing and all-body wallowing.

4.18. Feeding variables

Foraging strategy and diet

How an animal forages influences more than its diet. Foraging strategy influences "ranging patterns, activity budgets, and social organization" (Forthman 1998, 242). Grazers typically spend more time foraging than browsers (Eisenberg 1981).

Elephants are adapted in the wild to range over large areas and to forage for a considerable part of any 24-hour period. Arbitrary feeding schedules cause ungulates, "to suffer from the dissociation of appetitive and consummatory behaviors." Such dissociation can result in stereotypic patterns of ingestion (e.g. fence licking seen in giraffes) and locomotion such as weaving and pacing. Adequate amounts, distribution and availability of appropriate plant material beginning at an early age can prevent these problems from developing.

Forthman aptly observes that diet selection by ungulates requires learning. Ungulates must learn to select from a vast number of plants, selecting those parts that are most nutritious and avoiding those that contain harmful amounts of toxins. Visual, olfactory and gustatory cues, together with time and experience, all play a role in the ungulate's process of learning to select an appropriate diet. The arbitrary provision of processed food, pristine hay, and fresh fruits and vegetables in a monotonous exhibit or holding area does not permit the animal to engage the full range of its abilities and behavioral repertoire.

4.19. Feeding variables and elephants

Elephants represent "the ultimate adaptation for feeding upon coarse plant materials" (Eisenberg 1981, 183). An elephant's teeth are highly adapted for grinding down tough grasses, sedges and bark. Because it is adapted for feeding on plant materials with relatively low nutrient content, "[f]eeding may occupy from 70 to 80 percent of an elephant's waking hours, and in the process of selective feeding it may consume 250 to 400 pounds of wet forage in an average twenty-four-hour period" (Eisenberg 1981, 183). Elephants feed night and day. While Asian elephants take in a significant amount of grasses, especially for females and young animals "branch-feeding in the forest occupies 30 to 50 percent of their feeding time" (Eisenberg 1981, 184).

Foraging and diet are key elements of an elephant's occupation cycles (Eisenberg 1981; Moss 1983; Sukumar 2003). Yet little is understood about how and why elephants forage as they do. For example, recent field research indicates that termite mound soils, which contain higher concentrations of calcium, magnesium, potassium, sodium and phosphorus, support plants and trees subject to more intense feeding by African elephants than plant material from the surrounding area (Holdo and McDowell 2004). Earlier research suggests that elephants ingest termite mound soils, possibly as a mineral supplement to their diet (Ruggiero and Fay 1994). Accordingly, termite mounds may play an important role in determining food availability, dietary mineral intake and spatial feeding patterns by elephants, as well as ranging perhaps, as termites are altitude-limited.

Still, we know that elephants spend more time foraging and feeding than any other activity (Owen-Smith 1988). The absence of appropriate opportunity to engage in foraging and feeding can result in stress to the animal. When a species has evolved to perform a linked set of responses, in this case forage and then feed, they adapt "with difficulty to disruptions in that linkage" (Forthman, et al. 1995). When a normal consummatory response is delayed or prevented, maladaptive behaviors, like pacing and swaying, are performed. Animals exhibit these maladaptive behaviors to reduce potentially damaging physiological stress responses (Brett and Levine 1979).

In most zoos, elephants lack control over access to appropriate food sources. Accordingly, it is incumbent on those keeping captive elephants to deliver a species-appropriate diet in a way that permits species-specific foraging strategies, that addresses the full range of their dietary needs, and avoids creating new health and behavioral problems. The provision of ample volumes of browse material (branches) is critical.

4.20. Social variables

Appropriate social groupings can lead to dramatically improved propagation of the species (Clubb and Mason in press). The principal problem associated with confining large, socially gregarious animals like elephants is the inability of most zoos to provide appropriate space for a socially viable sized group. Forthman contends that one solution to this problem is obvious: "If insufficient space is available for an appropriate herd, the species should be excluded from the collection" (Forthman 1998, 244).

Reproductive behavior and social context

Given the powerful role of social relationships to the health of individual elephants, it is imperative that captive female elephants intended for breeding be given the social context in which to undertake the task of delivering and raising a calf. Elephant reproduction[10] must also take into account the probability of surplus males. Formation of single-sex groups, like bachelor herds, can be appropriate in facilities with adequate space (Forthman 1998).

Vulnerability of young

Vulnerability of young in confined settings usually results from disease or intra-species aggression and relates to management of space and group composition. Age at weaning and emigration from the herd "must be considered and planned in advance as well. It may be optimal to maintain a stable female group in an exhibit over time and to exchange breeding males" (Forthman 1998, 246).

Research demonstrates "the persistent influences of early environmental experience on neural organization" (e.g. Rosenzweig and Bennett 1978). It follows, therefore, that exhibits, indoor enclosures, and outdoor enclosures and corrals must be designed to accommodate the several distinct developmental stages and special vulnerability of elephant youngsters. Exhibit designs and staff skills facilitating the provision of a natural, complex and varied "captive environment are probably key in production of behaviorally flexible, fit, and competent animals" (Forthman et al. 1995, 395).

4.21. Social variables and elephants

Social role of the herd

Although Forthman did not single out the role of the herd as a social variable, we believe that the social organization of elephants into cow/calf and bull herds is of paramount importance. Even a cursory review of the three elephant species' natural history furnishes ample evidence that the cow/calf herd is as important an influence on an elephant's life history strategy as social nurturing is to humans (Wittemyer et al. 2005). Recognition of the importance of sustaining a stable social group to approximate field conditions of the species in the wild has special resonance for elephants (Rees 2001). In the opinion of Ian Whyte, Senior Scientist, Large Herbivores, Kruger National Park, "…it would be inhumane to remove juveniles from their

[10] There is a growing body of veterinary literature on captive elephant breeding. Those issues are outside the scope of this paper.

families at any time or for any reason. Elephants have very strong social bonds. Daughters stay with their mothers for as long as they are both alive, even after the daughter has achieved sexual maturity and has young of her own. I believe that to knowingly separate juveniles from their mothers is inhumane" (2003). See further discussion of this topic in 4.7. Social complexity.

Reproductive health and the herd

Forthman's observation that social roles powerfully influence the reproductive health of individuals and the herd is particularly relevant to elephants. Raising an elephant calf requires an enormous investment of energy and attention from the mother. Observations in the field indicate many members of the herd contribute energy and attention as well.

Successful elephant breeding and rearing in the wild occurs in the context of a stable, multi-generational herd. It is, therefore, incumbent upon zoos with breeding ambitions to provide their elephants with a viable social herd in which to undertake the task of delivering and raising young (Rees 2001). Given the unchallenged importance of the cow/calf herd to a female elephant's life strategy (Wittemyer et al. 2005), zoos must provide their captive female elephants a stable social group of sufficient size and social complexity to furnish the rich and life-long relationships reflected in their species' natural history. See additional discussion of this topic in 4.7. Social complexity.

4.22. The human-elephant relationship

Captive elephants represent a considerable investment by any zoo holding them. Not only do zoos invest significant amounts of capital, but also they must commit large numbers of specially trained staff to their care over many years. This section addresses the three main management systems used today in North American zoos and sanctuaries: free contact, protected contact and passive contact.

4.23. Definitions

Free contact

Free contact, as practiced in AZA zoos, is a system for managing elephants that uses a combination of negative reinforcement, positive reinforcement and physical punishment or threat of physical punishment. Directing the position and movement of the elephant is achieved through the use of an ankus or hook (Olson 2004). Cooperation on the part of the elephant is compulsory (AZA Regents 2001). The ankus is also used to strike the elephant when physical punishment is deemed necessary and appropriate (Olson 2004). In free contact, the trainer or zookeeper shares the same physical space with the elephant. Trainers function from within the elephant social hierarchy by establishing and maintaining a position of social dominance (Koontz and Roush 1996).

Protected contact

Protected contact, as originally conceived and implemented by its architects, Gail Laule and Tim Desmond, is a system for managing elephants that uses positive reinforcement training as the primary method to modify behavior and relies on the trainer developing a non-authoritarian rapport with the elephant and the elephant's voluntary cooperation.[11] Directing the positioning and movement of the elephant is achieved primarily through the use of targets. Keeper safety is achieved by positioning elephant and keeper relative to each other and to a barrier that typically separates human and animal spaces. Trainers function outside the elephant social hierarchy and do not attempt to establish a position of social dominance. Protected contact does not utilize physical punishment.[12]

Passive control

Passive control is practiced at The Elephant Sanctuary in Hohenwald, Tennessee. The Sanctuary defines passive control as "a scientific and compassionate approach to the care and management of elephants. … Passive control incorporates facility design along with positive reinforcement to encourage an elephant to respond. No ankus or weapon is ever used. Negative reinforcement and punishment are not allowed. "

4.24. Free contact-selected topics

Keeper safety

Dominance-based free contact is a common approach in many North American zoos and all circuses. The tradition postulates that trainers or keepers best control captive elephants by assuming the position of most dominant member of the herd through the use of force (Koontz and Roush 1996; Leach 2001). Free contact keepers employing dominance management techniques are frequently subject to attack, injury

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11 An animal's control over its own behavior is particularly significant because research on stress indicates that the ability to exercise control over an environment, even if the stress stimulus cannot be removed, greatly reduces the degree of stress experienced by the animal (Seligman and Binik 1977; Foster-Turley and Markowitz 1982; Markowitz and Line 1989; and Laule and Desmond 1998).

12 The use of electric wires as part of a containment system is not a training tool of protected contact.

and death. Since 1990, AZA free contact programs have reported 25 serious keeper injuries, 5 of which resulted in keeper death. The complexity and intransigence of keeper's risk of injury or fatality using dominance-based management "is a serious issue" (Chappel and Ridgeway 2001).[13] Olson observed that working with elephants in free contact "compromises the safety of the handler to a greater degree" (Olson 2004, 19).

Chaining

Chaining is the most common form of restraint in free contact programs. It is frequently used to restrain elephants overnight, and to deliver routine husbandry and corporal punishment. As recently as 1999, chaining was used to restrain elephants at night in a majority of zoos (Brockett, Stoinski, Black, Markowitz and Maple 1999). Survey results indicated that elephants were chained in a row for as many as 16 hours a night.

Today, the AZA permits member institutions to chain elephants up to 12 hours out of every 24. Overnight chaining is not discouraged (AZA 2003).

Research conducted at Zoo Atlanta by Brockett et al. (1999) reveals that overnight chaining is linked to diminished welfare. The authors observe that chaining limited the animals' activity, prevented natural socializing among them, promoted stereotypical behavior and promoted aggression towards keepers.

Brockett et al. identify social and health advantages to the unchained elephants they observed:

- The elephants were able to exercise and regulate their body temperatures by alternating between indoor and outdoor enclosures;

  They were able to "make choices" about activities and social partners;

- They remained fully active and engaged "in a full behavioral repertoire during the evening hours."

Finally, Brockett et al. conclude that none of the risks the traditional elephant management community predicted, including injuries among unchained elephants or inadequate feeding or sleeping time, were observed. The authors recognized that, "*Indicators of declining health, such as foot problems, arthritis, and colic, appear to decrease when animals are not chained*"[14] (Brockett et al. 1999, 102). Brockett et al., went on to explain: "The natural history, psychological health, and physical health factors mentioned herein establish an argument against the use of chaining, an idea that is

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13 Four keepers employed in traditional, dominance-based free contact elephant programs in the United Kingdom and AZA zoos died between October 2000 and November 2002. Three keepers in AZA zoos were seriously injured between December 2002 and June 2004. A bull calf in free contact killed a keeper in Vienna in February 2005.

14 Emphasis added.

supported by the successful maintenance of groups of unchained elephants by many zoos" (1999, 102).

"Unchaining elephants has been identified as a factor promoting an improved relationship between trainer and elephant" (Lehnhardt 1984). A study in 2000 showed that displays of stereotypic behavior like swaying by circus elephants fell 59% when the elephants were penned rather than chained (Gruber, Friend, Gardner, Packard, Beaver and Bushong 2000). Kinzley observed that stereotypic behavior of swaying is a direct result of long term chaining, usually overnight chaining that typically limits elephants' side-to-side movement (pers. comm.).

Physical punishment

Physical punishment is intended to reduce the occurrence of a behavior (Skinner 1965). Physical or corporal punishment is a technique of free contact.

Corporal punishment is a training approach for human children and animals with well-documented limits. Physical punishment is a questionable technique for reducing undesirable behavior in children because the application of physical punishment is linked with aggression, hostility and delinquency (Hoffman, 1970; Loeber and Stouthamer-Loeber, 1996; Lytton, 1996).

Evidence suggests that physical punishment may not promote learning. While a child is more likely to comply with demands immediately after being punished, he or she will not learn the desired behavior (Gershoff 1997). Punishment is not more effective than other methods of behavior modification (Roberts and Powers 1990).

Behaviorists studying non-human animals have drawn similar conclusions. Punishment of animals is linked to a variety of "very undesirable side effects," such as aggression, including lethal aggression, against other animals or the trainer (Chance 1994, 272). Punishment is not more effective than positive reinforcement in training dogs (Hiby, Rooney and Bradshaw 2004). Dogs trained with punishment exhibited increased problematic behaviors associated with compromised welfare and a state of increased anxiety (Hiby et al. 2004).

It has been well known for a quarter century that, "Another undesirable side effect of punishment is that agents who use punishment are reinforced for punishing" (Kazdin 1975, 162). Such reinforcement can lead to a tendency for physical punishment "to get out of control. The use of corporal punishment in schools has resulted in broken bones, ruptured blood vessels, hematomas, muscle and nerve damage, whiplash, spinal injuries, and even death (Gurske 1992)" (Chance 1994, 274).

AZA elephants may be subject to physical or corporal punishment (AZA 2003). Defenders of physical punishment within AZA claim that it is justified because elephants in the wild discipline subordinate members of the herd with physical punishment and aggression.

Reports from the field offer contradictory evidence. Poole reports that African elephants do not "discipline their young," nor is discipline "natural in elephant society [and] therefore something that an elephant can understand." Poole states (2001, 5): "I have no idea how this myth was started, but I have never seen calves 'disciplined.' Protected, comforted, cooed over, reassured, and rescued, yes, but punished, no. Elephants are raised in an incredibly positive and loving environment. If a younger elephant, or in fact anyone in the family, has wronged another in some way, much comment and discussion follows. Sounds of the wronged individual being comforted are mixed with voices of reconciliation."

Negative reinforcement

Negative reinforcement increases the chance of a behavior recurring by the removal of an aversive or unpleasant stimulus; it is also known as escape or avoidance training (Pryor 1985). For example, when a keeper cues an elephant under its leg with an ankus, the elephant learns to lift its foot up promptly to avoid the aversive stimulus of the ankus.

Properly applied, negative reinforcement is brief and informative, permitting an adaptive response that terminates the aversive stimulus. Like punishment, however, "many people use too much negative reinforcement" (Pryor 1985, 119). Pryor (1985) notes that overuse of negative reinforcement results in anxiety, fear and/or distress in the subject.

The foundation of free contact training in zoos is negative reinforcement. Positive reinforcement is typically applied only after the application of the aversive stimulus that is used in the initial stages of training behaviors (Olson 2004).

Similarities between physical punishment and negative reinforcement

Punishment and negative reinforcement are distinct techniques to influence behavior. However, both techniques create similar risks to the welfare of the animal in training:

- Both involve a trainer inflicting pain or discomfort on the animal;
- Both approaches are inconsistent with a respectful and trusting relationship between the trainer and the animal; and
- Both techniques are subject to abuse, either in frequency or intensity.

Chaining, physical punishment, negative reinforcement and stress

Corporal punishment and negative reinforcement are, by their very terms, external stressors intended to modify an animal's behavior. Because physical punishment is sometimes delivered when the elephant is chained or otherwise restrained, the elephant is without options and simultaneously experiencing pain over which it has no control. The absence of options is itself a source of stress (Seligman 1975).

The intentional infliction of pain in circumstances of acute stress is undesirable because acute distress is related to destructive consequences like increased aggression and dysfunctional behavior. Intermittent or chronic stress, a level of stress likely associated with negative reinforcement "is undesirable because it has a potential harmful impact on all aspects of animal health" (Baer 1998, 279). Chronic or intermittent stress has been associated with impaired reproduction (Moberg 1985b), increased susceptibility to disease (Landi et al. 1982) and gastric ulcers, cardiovascular pathology and alterations in basal metabolism (Klasig 1985).

4.25. Protected contact—selected topics

Keeper safety

In 1989, Laule and Desmond developed a concept document for a new system of managing elephants called protected contact. The system is designed to address two fundamental objectives: increase keeper safety and enhance elephant welfare. Protected contact is predicated on positive reinforcement and the ability to gain the willing cooperation of the elephant in husbandry and veterinary procedures (Desmond and Laule 1991). Physical punishment and the routine use of negative reinforcement is prohibited. Development of the system took place in two phases at the San Diego Wild Animal Park. Phase 1 in 1989 involved Asian and African bulls and Phase 2 in 1991 included the bulls and the addition of one Asian and one African cow.

The system has been in use in AZA zoos since 1992, with initial focus on bulls and aggressive females quickly evolving into the conversion of entire elephant programs. AZA reports that 60% of its zoos now use protected contact. Protected contact programs have reported 0 deaths and 1 serious injury since its inception.

Positive reinforcement and animal learning

B.F. Skinner defines reinforcement as "any stimulus the presentation of which strengthens the behavior upon which it is made contingent" (1965). More recently, Pryor wrote, "Positive reinforcement is anything which, occurring in conjunction with an act, tends to increase the probability that the act will occur again" (1985, 23).[15] Positive reinforcement works to increase the chance of a behavior recurring by presenting the animal with something it wants, a desirable stimulus, in conjunction with a correct behavioral response (Whittaker, personal comm.). For example, the elephant moves from point A to point B and is given an apple; the chance of the elephant performing that movement again is increased.

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[15]Pryor next wrote, "Memorize that statement. It is the secret of good training" (1985, 23).

Methodical, scientific use of positive reinforcement based on knowledge of the animal can be much more effective than the use of instrumental negative reinforcement or punishment in gaining the cooperation of animals. Evidence in support of this proposition comes from research on learning theory as applied both to humans and as applied to other animals.

The Academy of Pediatrics Consensus Conference on Corporal Punishment (1996) states essential elements for new learning include a positive learning environment and a consistent strategy. Children's need for a positive learning environment is based on social learning theory (Patterson, 1975). This theory suggests children thrive better when adults take an interest in what they are doing, praise good behavior, allow choices and are aware of children's developmental needs and emotional reactions to stress. Conversely, frequent reprimands, inconsistent responses to undesired behavior, and a lack of recognition of the child's developmental and emotional needs lead to antisocial behavior.

Animal behaviorists report similar conclusions about animal training. Animals "worked with negative reinforcement will not enjoy the experience and will only work at the level necessary to avoid the negative reinforcement" (Martin 1996, 141). Martin reports that the use of positive reinforcement results in an elephant looking forward to the training session and becoming "more creative in how to earn the reward" (Ibid.141).

An animal free of anxiety or fear of training is more likely to cooperate and try new behaviors, making the training session a potent source of enrichment for the captive animal: "To a real trainer, the idiosyncratic and unexpected responses any subject can give are the most interesting and potentially the most fruitful events in the training process" (Pryor 1985, 15).

Positive reinforcement in zoos—practical results

Positive reinforcement has been used to facilitate medical procedures at the Calgary Zoo involving a male elephant's infected digit (Honeyman, Cooper and Black.1998). Staff skilled in protected contact and appropriate use of conditioning principles gained the cooperation of the elephant in numerous medical procedures, including

- Flushing, debriding, packing, antibiotic infusion, soaking,
- Two surgeries, and
- Wearing a protective boot.
- "Time outs" were effective when the elephant stopped responding to commands in a desirable manner.

Laule and Whittaker (1998) report that comprehensive use of positive reinforcement has revolutionized care of captive animals in some AZA institutions. The benefits of using positive reinforcement included providing the animals the opportunity to comply rather than responding to force; and providing staff greater accessibility and increased opportunity for delivering preventative medicine to the animals.

Abadie (1997) reports that positive reinforcement was used with success at Houston Zoological Gardens to permit a variety of veterinary and husbandry procedures on the elephants in its care:

- Thailand, a 33-year-old bull was trained to accept routine trimming and deep trimming into abscessed areas of a foot as well as daily foot soaks;
- Methai, a 29-year-old cow, was trained to allow staff to radiograph her rear legs and accurately diagnose and treat her arthritis;
- Kiba, a 5-year-old bull calf, was trained to cooperate with an ultra-sound exam while leaning into a training wall; and
- Positive reinforcement training was used to gain the cooperation of Indu, a 32-year-old cow, for dental surgery.

Examples of the successful use of positive reinforcement involving captive wild mammals other than elephants are common:

- Bonobos have been trained to accept husbandry and medical procedures (Loehe, 1995).
- A sea lion was saved from euthanasia when trained to accept post-operative treatment of her cancerous lower mandible (Laule and Whittaker 1998).
- Positive reinforcement has been used to train primates at the Memphis Zoo (Philipp, 1997),
- To desensitize giraffes to a chute and hippopotamuses to medical and diagnostic procedures at Busch Gardens, Tampa, Florida, (Dumonceaux, Burton, Ball and Demuth 1998), and
- To treat a bonobo who engaged in chronic, severe, self-mutilating behavior at Milwaukee Zoo (Wallace, Bell, Prosen and Clyde 1998).

Laule and Whittaker (1998) report creative uses of positive training to successfully condition captive wild mammals. Positive reinforcement permitted staff to:

- Collect saliva samples on dental gauze from gorillas
- Train free-ranging hoof stock to accept yearly vaccinations
- Milk a female rhinoceros to supplement the diet of a hand-raised calf
- Perform a vaginal swab on a female warthog
- Train female drill baboons to accept tube insertion for artificial insemination

- Collect blood from rhinos, pygmy hippos, giant anteaters and tapirs
- Hold giant anteaters on target while taking body measurements

Laule and Whittaker (1998, 387) conclude that positive training provides “the means to develop and implement an effective program of preventative medicine.”

4.26 Passive control—selected topics

Keeper safety

One facility in the United States, The Elephant Sanctuary, in Hohenwald, Tennessee, describes its method of elephant management as “passive control” Blais (2000, 2001) and Buckley (2001). Certain Sanctuary staff members manage their resident elephants while sharing the same physical space with the animal. The Sanctuary reported no serious keeper injuries or deaths since the facility came into being in 1995 until the death of a senior keeper in 2006. The keeper was killed by Winkie, an Asian elephant taken from her family at the age of six-months and exhibited for 35 years in a Wisconsin zoo utilizing free contact management. [16]

Space, autonomy, and positive reinforcement

Passive control is defined as a non-dominant approach to the management of elephants that utilizes positive reinforcement exclusively (Blais 2000, 2001; Buckley 2001). “Passive control management utilizes barn and yard facilities, keepers' knowledge of the individual elephant, recognition of species-specific behavior and the principles of operant conditioning to encourage an elephant to cooperate. Negative reinforcement and punishment are never used in passive control management” (Blais 2001).

Blais (2000) states a number of factors that are critical to making passive control a viable system for elephant management. Blais observes that access to large, diverse, and useable space helps to reduce social tension and relieve boredom. The Elephant Sanctuary operates on 2700 acres. It is divided into three habitats: a 2200 acre habitat for a herd of Asian elephants, a 200-acre habitat for a second herd of Asian elephants previously exposed to TB, and a 300-acre habitat for African elephants.

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[16] Gay Bradshaw, Allan Schore, Janine Brown, et al., (2005) theorize that traumatic disruption of early social attachment processes by forcible separation of calves from their mothers can result in the affected animal expressing hyper-aggression, impaired immunity responses and increased vulnerability to disease throughout its life. Brain science suggests that trauma caused by disrupting normal attachment processes in elephant infants affects neural functions in the infants’ developing brain.

He further states that large space results in improved physical conditioning and healthy feet, reduction in the need for intensive medical management often associated with zoo elephants housed in small spaces on unnatural, hard substrates. Blais explains that access to large spaces helps reduce social tension because subordinate elephants do not feel trapped or intimidated by a more dominant animal. Avoiding confrontation reduces stress that can cause an elephant to become fearful and agitated, states of arousal often associated with the aggression towards other elephants and keepers.

Blais explains that passive control is reliant upon meeting elephants' basic needs for social companionship, space, food, water and shelter met without conditions placed upon their behavior. Food, water, shelter, space and social companionship are never withheld in passive control. This approach is premised on the assumption that "…without threat of being deprived or forced to do something against their will, they are cooperative and calm" (Blais 2000).

Passive control posits that the elephants must have freedom of choice about whom they spend time, what they eat, when and where they do so, and when and where they sleep. Blais reports that elephants at The Elephant Sanctuary have unlimited access to a wide range of vegetation and habitat and free access to a large, heated barn, so they control when they come inside and how long they stay. Promoting the elephants' autonomy is premised on the assumption that "…when such decisions are made by the elephants, they form strong bonds with one another and their keepers" (Blais, 2000). Authors of this mode of management recognize that the most challenging component of this approach is allowing the elephants to operate in their own time, and to determine their own schedule for all activities.

We conclude that passive control appears to be a highly positive method of managing elephants, with elements that are inherently designed to increase captive elephant welfare as the cornerstones of the approach. However, we cannot determine whether to recommend passive control as a method of management to zoos since no American zoos currently provide their elephants the large, diverse, usable space or autonomy of choice that passive control requires.

5. Analysis

At the beginning of this report, we announced our assumption that captive environments, whether in a zoo or sanctuary, should emphasize the needs that an elephant "itself perceives to be important" (Mench and Kreger 1996, 13). This assumption, in turn, rested on an even more basic premise: sufficient scientific evidence and knowledge exist permitting us to identify those needs. As this report makes clear, sufficient scientific study and observation is available to allow us to identify with reasonable confidence certain key individual characteristics shared by all elephants irrespective of their species' membership—sophisticated cognitive ability, social complexity and physical vigor. Sufficient evidence exists to permit our identification of the critical elements of their natural history, including the social role played by the cow/calf herd, the powerful bonds between herd members, the critical role played by the herd in the reproductive health of its members, elephants' daily movement through huge spaces for feeding, resource exploitation, exploration and social networking (Sukumar 2003), and their use of 70 to 80 percent of their time foraging and browsing.

This scientific knowledge paints a detailed picture of the cognitive, social, occupational, feeding and sensory world of elephants. As the scientific literature discloses, the complexity and scale of their lives are staggering.

So long as human institutions, like zoos and sanctuaries, hold elephants captive, these institutions must consider whether they are capable of making the commitment of resources necessary to meet the requirements suggested by the species' natural history and individual elephant's key characteristics. Zoos and other institutions undertaking this responsibility must meet the challenge of providing environmental and social options that promote a population of healthy individuals engaged in the full panoply of species-specific behaviors. We believe that providing such environmental and social options to captive elephants requires a new vision of captivity, one requiring a change in kind rather than a change in degree of present captive practices.

One of the most important changes required is abandonment of negative reinforcement and physical punishment to train and manage captive elephants. This determination rests on two foundations. The evidence shows that effective management and training of elephants can be achieved without resort to use of negative reinforcement or physical punishment. Both negative reinforcement and physical punishment are intended to cause varying degrees of pain. While we recognize that the infliction of pain is not necessarily unethical (e.g., to perform a reasonable and necessary veterinary procedure) civilized humans everywhere agree that inflicting *unnecessary* pain is unethical and wholly indefensible.

Over the past 30 years abundant scientific knowledge has been gained in laboratory and clinical settings on animal behavior, animal learning, stress and distress. The evidence reported here strongly suggests that animals, including elephants, can be effectively trained and managed without resort to the infliction of pain or the incitement of fear and distress. Training methods predicated on positive reinforcement are effective, whether addressing husbandry, medical or behavioral issues.

Knowledgeable and appropriate application of positive reinforcement conditioning principles works, whether applied to people, hippos, anteaters, non-human primates or elephants. Staff trained in these principles can deliver life-saving medical care and teach new and complex behaviors to captive mammals while simultaneously enhancing husbandry and enrichment. Animals trained with positive reinforcement experience little or no pain or suffering during the learning process.[17]

The application of positive conditioning principles also results in important collateral benefits for both staff and animals. The training benefits staff by permitting flexibility in scheduling, promoting safe working conditions, lessening the animals' stress related to husbandry and veterinary care, and contributing to a more cooperative relationship between staff and animal (see e.g., Loehe 1995).

Positive reinforcement and, for example, principles of protected contact promote the animal's control over its environment and eliminate the threat of negative reinforcement or punishment if the "wrong" behavior is exhibited. If, for example, the elephant does not understand a behavior being taught in free contact, whether it lacks preparedness[18] for learning the particular behavior or the necessary sensory repertoire, it may suffer punishment or other aversive stimuli. Under principles of protected contact, for example, the burden instead falls on the trainer to develop an approach that takes advantage of the knowledge, personality, preparedness and sensory repertoire the elephant brings to the task. The single acceptable form of punishment in protected contact is "time outs," in which the trainer leaves the session for a brief period (Whittaker, pers. comm.).

Physical punishment is defended within the zoo community because elephants in the wild use physical punishment and aggression to control subordinate members of the herd. We reject this position for two reasons: (1) it is disputed by Poole's published observations from the wild; and (2) we have scientific evidence demonstrating that positive reinforcement is an effective tool to train and control the behavior of captive elephants. Because we know that positive, effective tools exist, resort by human caregivers to the infliction of pain or distress is unnecessary and, therefore, unethical.

As was earlier noted in this document, the use of physical punishment, deprivation (Leach 2001) and routine negative reinforcement to train captive elephants compromises keeper safety. These training techniques increase the likelihood of aggression by the elephant towards other elephants with which it is kept. These training techniques also increase the likelihood of aggression by the elephant towards its trainer. The long history of keeper death and injury rates in free contact is urgent

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[17] Used moderately and appropriately, a time out is an acceptable form of punishment in elephant training and management. A time out is distinct from physical punishment in form, duration and impact on the animal. It is not a form of food deprivation and inflicts no pain or physical discomfort on the animal (Laule, pers. comm.).

[18] Certain animal learning is limited by an animal's state of "preparedness" (Seligman, 1970). Seligman suggests that genetic predispositions make an animal prepared, contra-prepared, or unprepared to learn particular things. A second limitation on animal learning involves the limits of the individual animal's sensory repertoire. Obviously animals can only respond to sensory stimuli that they can perceive.

and irrefutable testimony about the aggression and dysfunctional behavior of elephants managed through physical and psychological dominance.

The cessation of AZA's endorsement of the use of routine negative reinforcement and physical punishment is particularly important. AZA wields significant influence as an authoritative voice in captive management of wildlife. Powerful historic[19] and clinical evidence shows the tendency of humans to obediently inflict pain, including excessive pain, when directed to by an authority.[20] In light of AZA's special status as an authority in the field of wildlife management, it bears a special responsibility to exercise its power in a scientifically and ethically defensible manner.

Educating the public about the intrinsic value of elephants in our natural world and the importance of their well-being in captivity is incompatible with holding elephants in sub-optimal conditions or managing them through dominance. We believe that the public perceives an ethical difference between using a management system predicated on human dominance, routine chaining and the infliction of pain and a system predicated on positive reinforcement and the voluntary cooperation of the animal.

6. Conclusion

In light of the evidence available on the issues identified, we conclude that protected contact that employs positive reinforcement and eschews negative reinforcement and physical punishment while allowing a protective barrier between animal and trainer is best suited to maximize animal learning and promote animal and staff safety. We further conclude that protected contact management that is devoid of physical discipline, and reliant upon positive reinforcement is the bedrock of ethical, effective and humane treatment and training of captive elephants in existing North American zoo facilities.

We recommend, therefore, that the following conditions are necessary to create an optimal captive environment that promotes elephant welfare and contributes to their conservation:

- ❖ Spacious quarters that permit foraging, exploration and exercise, year-round access to the outdoors, year-round access to live vegetation, membership in a social group of conspecifics and freedom to exercise reasonable autonomy.
- ❖ Freedom from overnight and other extended periods of chaining.
- ❖ Life-long protection of the natal bond between mothers and female calves, in the absence of extraordinary cause.

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[19] "When you think of the long and gloomy history of man, you will find more hideous crimes have been committed in the name of obedience than have ever been committed in the name of rebellion. If you doubt that, read William Shirer's `*Rise and Fall of the Third Reich*'" (Snow 1961).

[20] See Milgram 1963. "Behavioral Study of Obedience." *Journal of Abnormal and Social Psychology*: 67 (4), 371-378.

- Freedom from dominance-based behavior management, including physical punishment or threat of physical punishment, isolation or deprivation.

A detailed statement of best practices employing and amplifying each of these four essential principles can be found in the Coalition's "Best Practices for Captive Elephant Well-Being." The Coalition's Best Practices detail our present understanding of the optimal conditions, tools and techniques necessary for captive elephants to flourish in our midst. Our Best Practices rely on living elephants' natural history, their key characteristics, and the wealth of available scientific knowledge on animal behavior. The Coalition's Best Practices present a coherent, science-based vision for humane captivity designed to minimize captive elephants' experience of distress and to maximize their experience of autonomy and a full range of their natural behavior. We believe that to the extent that elephant holding institutions commit themselves to these Best Practices, they will simultaneously expand scientific knowledge and promote the welfare and conservation of captive elephants.

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