

Association of Zoos and Aquariums
STANDARDS FOR ELEPHANT MANAGEMENT AND CARE
Adopted 21 March 2001, Updated 5 May 2003

The following standards apply to the husbandry and management of both African (*Loxodonta africana*) and Asian (*Elephas maximus*) elephants in AZA accredited institutions, AZA related facilities, and non-member participants in the AZA Elephant Species Survival Plan (SSP). The intelligence, strength, and social needs of these magnificent animals can pose many challenges for captive managers. Institutions desiring to hold elephants should therefore understand the substantial human, financial, and ethical commitments involved in appropriately maintaining these large and potentially dangerous species (Hutchins and Smith 1999). These standards have been developed to guide institutions that are planning and improving their elephant programs and are considered during the AZA accreditation process and non-member SSP participant evaluation. The AZA Board of Directors has instructed the Accreditation Commission to immediately require written verification from AZA member institutions holding elephants, certifying that they are meeting the required standards (BOD 3/25/03).

The AZA Board of Directors believes that the Association performs a valuable role in the cooperative development of standards for zoo and aquarium animal management and care, which are designed to advance the collective mission of AZA and its members. The development of these standards and the adoption of them through the AZA accreditation process is what sets AZA members apart from roadside animal attractions. The Board understands that there will be differences of opinion as to what constitutes appropriate standards. Standards evolve over time reflecting changes in knowledge, expertise, and public perception.

The AZA Board of Directors has asked the AZA Elephant SSP/TAG to begin formulating a draft vision for the future of elephant management in AZA accredited zoos. Because current standards are expected to change over time, it is recommended that members seeking to plan new elephant exhibits/care programs look to the vision, rather than the current standards, for guidance on where to go in the future.

Compliance with some minimum housing (specifically space, enclosure design, and elephant restraint device (ERD) requirements) must be implemented no later than five years from the issuance of these standards (1 May 2006). Institutions must have written implementation plans for compliance with these standards no later than three years from their issuance (1 May 2004). AZA accredited and related facilities must meet all other provisions described here within one year (1 May 2002) of the issuance of these standards, unless the Accreditation Commission approves a variance. Failure to meet basic AZA standards for elephant management and care will be noted during accreditation inspections. Current non-member participants in the SSP will be given the same time schedule for compliance, but new non-member participants must meet all new standards prior to approval.

Highlighted sections are recommendations or standards for which variances may be obtained.

Abiotic Environmental Variables

1.1. Temperature

1.1.1. Elephants must be kept outside on natural substrates as much as possible. Institutions should consider designing exhibits that allow elephants outdoor access twenty-four hours a day -- weather, health, and safety permitting. During daylight hours, elephants kept outdoors can tolerate moderate temperature extremes. Provisions must be made to protect animals from adverse weather, including intense sunlight, chilling rain, sleet, etc. Animals kept outdoors must be monitored frequently at temperatures below 40 degrees F (4.4 degrees C). Facilities may install outdoor heat sources to extend the amount of time the animals are able to remain outside.

1.1.2. While outdoors, all elephants must have access to shade during daylight hours in temperatures above 80 degrees F (27 degrees C) and when they are exposed to direct sunlight.

1.1.3. Indoor holding areas must be ventilated, and heated to a minimum temperature of at least 55 degrees F (12.8 degrees C) at all times of the year. One room must be capable of maintaining a temperature of at least 70 degrees F (21.1 degrees C) and be free of drafts, for accommodating sick or debilitated animals.

1.2. Humidity – There are no standards for humidity at this time. Information is limited, but this does not seem to be of major concern for elephant management.

1.3. Illumination

1.3.1. Natural daylight cycles are adequate for elephants, even in temperate regions. Indoor areas must be well illuminated during daylight hours, followed by a period of darkness. Fluorescent lighting provides a sufficient spectrum of illumination; skylights, in addition to interior lighting, are highly recommended. Ample interior lighting must be available, as it is especially important to maintain staff safety.

1.4. Space

1.4.1. Indoor space must provide adequate room for animals to move about and lie down without restriction. A minimum of 400 sq. ft (37.2 sq. m) is required for a single animal, approximately 800 sq. ft (74.3 sq. m) for two animals, and so on (AZA 1997). Because of their size and space requirements, bulls or cows with calves must have a minimum of at least 600 sq. ft (55.7 sq. m) (AZA 1997).

1.4.2. Outdoor yards must have at least 1,800 sq. ft (167.2 sq. m) for a single adult individual and an additional 900 sq. ft (83.6 sq. m) must be added for each additional animal (AZA 1997). If this space is the only location for exercise, then it is recommended that the space per elephant should be even greater.

** Note: Institutions can petition for a variance from the current minimum indoor or outdoor space standards. The applicant must explain why their facilities are adequate, even though they do not meet the minimum size standard. Accreditation inspectors will take a holistic approach to accreditation inspections, rather than focusing on specific size measurements. Context is particularly important. For example, it may not be a problem that the indoor space requirements are under the standard by a small amount if a zoo is located in a warmer climate and the animals

are outside most of the time. If, however, the zoo is located in a cooler climate and the animals are kept inside for many months during the winter, then the indoor space requirements must be met or, preferably, exceeded. Environmental enrichment programs should also be taken into consideration when evaluating space available.

- 1.4.3. Mature animals can reach a vertical height of 20 ft (6.1 m). Consideration of this must be given with regard to ceiling heights and fixtures (e.g., lights, heating units, plumbing, etc.) so that animals do not harm themselves or the facility.
- 1.4.4. All facilities must have the ability to separate and isolate animals to address behavioral concerns or allow veterinary procedures to occur (EMA 1999).
- 1.4.5. Outdoor yard surfaces must consist primarily of natural substrates (e.g., soil, sand, grass) that provide good drainage and have a cleanable, dry area for feeding (EMA 1999).
- 1.4.6. While outdoors, elephants must have access to sand or soil at all times for dust bathing (EMA 1999).
- 1.4.7. Rocks, tree stumps, or large sturdy objects must be provided in the exhibit so that the animals may use them for rubbing and scratching.
- 1.4.8. Elephant containment barriers must be in good condition and able to prevent elephant escapes. A wide variety of building materials can be used as long as they are able to withstand the animals' strength, contain the elephant in a specific space, and prohibit direct contact between elephants and the public.
- 1.4.9. Door and gate design is extremely important to ensure the safety of both elephants and keeper staff. Both doors and gates must be engineered to withstand extreme force. If mechanical opening devices, such as hydraulic or electrically powered drives are used, they must be able to be operated manually or with a backup generator in the case of a power failure.
- 1.4.10. Enclosures must be cleaned of excrement daily. Frequent daily manure removal is recommended and may be necessary for the maintenance of both sanitary and esthetic conditions (EMA 1999).
- 1.4.11. If the AZA Elephant SSP-managed population is to become sustainable, it is necessary to create housing for many more adult males (Wiese 2000, Wiese and Olson 2000). All institutions considering new construction for elephants should include holding space for adult males. Institutions modifying existing facilities should also make provisions for bull housing.
- 1.4.12. There are no standards on the visual, acoustic, and olfactory needs of elephants at this time.
- 1.4.13. There are no specific standards for the transportation of elephants at this time, but see Fowler (1995).

1.5. Water and Moats

- 1.5.1. While outdoors and weather permitting, elephants must have regular access to a water source, such as a pool, waterfall, misters/sprinklers, or wallow that provides enrichment and allows the animals to cool and/or bathe themselves.
- 1.5.2. Standing water in indoor floor areas can cause foot problems and become a breeding ground for bacteria. Floors must therefore be impervious to water, quick to dry, and sloped to a drain. Floor surfaces must be relatively smooth, but not

enough so that they become slippery when wet. Conversely, very rough surfaces may cause excessive wear or irritate footpads.

- 1.5.3. Dry moats can pose a substantial threat to elephants and their use must be limited with the ultimate goal that they are eventually phased out. Moats that are deep, narrow-sided, and hard-bottomed can be particularly dangerous. Although there should be no risk of animals falling or being pushed into the moat, written animal extraction protocols must be in place for any moat that is more than 3 ft (1 m) deep, less than 10 ft (3 m) wide, and/or hard-bottomed.

2. Biotic Variables

2.1. Food and Water

- 2.1.1. Elephants must have access to clean, fresh drinking water (EMA 1999). When water containers are used, drinking water must be cleaned and refreshed at least twice a day. Containers must also be cleaned daily.
- 2.1.2. Fresh browse and produce should be used as dietary supplements and enrichment for the animals.

2.2. Group Composition

- 2.2.1. The minimum age offspring must remain with their mothers is three years. Some flexibility is necessary in cases of maternal rejection and when infants cannot be reestablished in their social group.
- 2.2.2. Institutions must have the ability to manage social compatibility as well as dominance and aggression among an elephant group (EMA 1999).
- 2.2.3. Institutions must have the ability to manage introductions and separations of a new female to a herd and, if the institution is a breeding facility, females to males for breeding, newborn calf to its mother, and calf and mother to the herd.
- 2.2.4. Institutions must provide an opportunity for each elephant to exercise and interact socially with other elephants (Taylor and Poole 1998, EMA 1999).
- 2.2.5. Adult males (six years and above) may be housed alone, but not in complete isolation (opportunities for tactile, olfactory, visual, and/or auditory interaction with other elephants must be provided) (Rasmussen et al. 1982).
- 2.2.6. A behavioral profile must be maintained for each individual elephant and updated annually.
- 2.2.7. All holding institutions must have a written environmental enrichment plan for their elephants and show evidence of implementation (Shepherdson et al. 1998, EMA, 1999, Shepherdson 1999).
- 2.2.8. Staff must be aware of each animal's social compatibility and the dominance hierarchies of the herd (EMA 1999).

2.3. Group Size

- 2.3.1. Zoos should make every effort to maintain elephants in social groupings. It is inappropriate to keep highly social female elephants singly (see Sukumar 1992, Taylor and Poole 1998, EMA 1999). Institutions should strive to hold no less than three female elephants wherever possible. All new exhibits and major renovations must have the capacity to hold three or more female elephants.

****Note:** It is understood that obtaining additional elephants for zoo exhibits can be difficult at this time. Temporary variances will therefore be considered regarding group size requirements. Institutions that do not currently meet the group size standard should demonstrate that they have requested assistance from the SSP in obtaining additional animals.

It is recognized that some socially aberrant adult females currently exist and these elephants can be managed singly if the institution has made every effort to introduce them to a social group and the SSP agrees that the anti-social behavior is not correctable.

2.4. Human-animal Interactions – A minimum of two qualified elephant keepers must be present during any contact with elephants. A qualified keeper is a person the institution acknowledges as a trained, responsible individual, capable of and specifically experienced in the training and care of elephants.

2.5. Introductions – There are no specific standards for elephant introductions at this time, but see Lindburg and Robinson (1986) and Krantz (1996).

3. Health and Nutrition

3.1. Diet

3.1.1. High quality and nutritionally correct food must be provided in sufficient quantities to maintain animal health and appropriate weight (EMA 1999). Hay and grain should be formulated to provide a complete diet as recommended by the Elephant SSP Nutrition Advisor.

3.1.2. There are no specific standards for elephant nutrition at this time, but see Dierenfeld (1995), Oftedahl et al. (1996) and Ullrey et al (1997).

3.2. Medical Management

3.2.1. A veterinarian with experience in large mammal medicine must be on call at all times to deal with routine elephant health evaluation and treatment and medical emergencies.

3.2.2. Each elephant must be given a thorough annual physical examination (Mikota et al. 1994).

3.2.3. All elephants must be visually inspected on a daily basis (EMA 1999). A general assessment must be made and any unusual activities should be recorded in the daily log at each inspection. Specifically, reports should include observations such as condition of urine and feces, eating and drinking patterns, administration of medications (if any), and general condition and behavior.

3.2.4. A veterinarian or trained veterinary technician must perform fecal examinations to look for parasites and other problems at least twice a year (Samuel et al. 2001). Results should be recorded.

3.2.5. All elephants must be trained to permit a complete body daily exam (include feet, eyes, ears, open mouth and tongue, teeth, and tusks) for any sign of abnormalities. Results should be recorded.

3.2.6. All elephants' body weight must be assessed and recorded at least twice a year (EMA 1999) through actual weighing or through the use of standardized body

measurement tables, photographs, or similar, previously validated techniques (e.g., Nirmalan and Sreekumar 1990).

- 3.2.7. For management purposes, all elephants must be trained to accept injections, oral medications, insertion of ear or leg vein catheters, treatment of wounds, enemas, and urogenital examinations (Mikota et al. 1994, EMA 1999).
- 3.2.8. All elephants must be trained to accept regular collection of blood, urine, feces, saliva, semen, skin biopsy, and temporal gland secretion (Brown 1998, EMA 1999). Biological specimens should be stored according to the SSP Veterinary Advisor's guidelines on biomaterials collection.
- 3.2.9. All elephants' skin must be thoroughly inspected on a daily basis and cared for as needed through bathing, removal of dead skin, and treatment of dry skin or other skin problems (Mikota et al. 1994, EMA 1999).
- 3.2.10. Each elephant facility must have a written protocol for routine foot care and show evidence of its implementation (Mikota et al. 1994, Csuti et al. 2001). This protocol must include daily cleaning and inspection of each elephant's feet.
- 3.2.11. Baseline foot radiographs or thermographs of all adult elephants must be taken and kept on file. In some facilities, it may be appropriate to annually monitor selected elephants (i.e., those that have a history of chronic foot problems) (Csuti et al. 2001).
- 3.2.12. A written daily exercise program for each individual animal must be designed and followed (Taylor and Poole 1998). The program should be developed in consultation with the elephant manager, elephant handlers, and the staff veterinarian(s).
- 3.2.13. When forming new herds, Asian and African elephants should not be placed together in the same enclosure. Herpes viruses endemic to one species can be fatal in the other (Richman et al. 1996, 1999). In addition, there is concern that behavioral differences between the two species may lead to problems with dominance and aggression (Hutchins and Smith 1999).
- 3.2.14. Institutions must adhere to USDA APHIS requirements for testing and treatment of tuberculosis (USDA APHIS 2000, Mikota et al. 2000).

4. Reproduction

- 4.1. Each male and female elephant of reproductive age (8 to 35 years) must have an initial reproductive assessment and follow-up assessments on a regular basis by transrectal ultrasound to verify reproductive status and assess overall reproductive health (Hermes et al. 2000, Hildebrandt et al. 2000 a,b). Exceptions include elephants with known reproductive problems, actively breeding animals, or those with documented medical/behavioral conditions that preclude them from breeding.
- 4.2 Each male and female elephant of reproductive age (8 to 35 years) must have hormone (progesterone or testosterone) values assessed through weekly (or bi-weekly) collection of blood samples (Brown 1998, 2000). Exceptions are elephants with known reproductive problems or those with documented medical/behavioral conditions that preclude them from breeding.

5. Behavior management

5.1. Training

5.1.1. Electrical devices designed for use on livestock, such as commercially manufactured electric prods and shocking collars/belts, are prohibited as routine training tools or for handling animals during exhibition. Electric prods are permissible only as an emergency safety device; however, their use is restricted to situations in which keepers feel the imminent need to defend themselves against elephant attacks, or to protect an elephant from possible injury (see Schanberger et al. 2001).

5.1.2. Elephant training terminology and descriptions of specific behaviors are outlined in the *AZA Schools for Zoo and Aquarium Personnel Principles of Elephant Management (PEM) Course Notebook* (AZA Board of Regent's 2001). Trained behaviors should allow the elephant staff access to the animal in order to accomplish all necessary animal care and management procedures and permit inter-institutional consistency. The PEM-recommended list of commands and their corresponding behaviors are ones that every elephant and elephant keeper must know so that basic husbandry and veterinary practices can be accomplished. Behaviors should be reinforced so that all elephants attain close to 100% compliance upon request of the elephant staff (Sevenich et al. 1998).

Appropriate elephant training may employ several training aids or “tools” (see PEM Course notebook for a list and description of some elephant training tools and procedures). The goal of a good trainer is to be able to reduce the amount of time any particular training aid is used (Roocroft and Zoll 1994).

The AZA considers the following training tools/techniques to be inappropriate for use at member institutions:

- a. Insertion of any implement into any bodily orifice, unless directed by a veterinarian specifically in connection with training for a medical or reproductive procedure.
- b. Striking an elephant with anything more substantial than an ankus (a traditional training tool used by elephant trainers)
- c. Striking an elephant with any sharp object, including the hook of an ankus (Fowler 1995).
- d. Striking an elephant on or around any sensitive area, such as the eyes, mouth, ears, or genital region.
- e. No tools used in training should be applied repeatedly and with such force that they cause any physical harm to an animal (i.e., breaking of the skin, bleeding, bruising, etc.).
- f. Withholding or reducing an animal's daily-recommended amount of food and or water.
- g. Withholding veterinary care for any reason.

If properly executed training procedures are ineffective in eliminating aggressive or inappropriate behavior in a given animal, institutions should consider other alternatives, including transfer to a facility with more experienced staff or a different management system. Protracted and repeated use of corporal discipline in training is of serious ethical concern and AZA considers abusive training practices to be unacceptable. Further, elephants that are untrained, unexercised, or unable to complete minimum behavioral requirements may be considered neglected and thereby abused.

- 5.2. Management Systems – Different elephant management systems have both advantages and disadvantages (Desmond and Laulie 1991, Doyle 1993, Preist et al. 1998, Schmid 1998). AZA standards for elephant management recognize that a diversity of approaches exist, but encourage members to continue to experiment with the goal of maximizing elephant health and reproduction and minimizing risk of injury to keeper staff (Lenhardt 1991, 2001, Chapple and Ridgway 2001). System definitions have been defined in the PEM Course and are as follows:

Free Contact – The direct handling of an elephant when the keeper and elephant share the same unrestricted space. Neither the use of chains nor the posture of the elephant alters this definition.

Protected Contact – Handling of an elephant when the keeper and the elephant do not share the same unrestricted space. Typically in this system the keeper has contact with the elephant through a protective barrier of some type while the elephant is not spatially confined and is free to leave the work area at will. This includes confined contact, where the handling of an elephant through a protective barrier where the elephant is spatially confined, as in an Elephant Restraint Device (ERD).

- 5.3. Management Protocols – Each AZA member institution and related facility that holds elephants must have a written elephant management policy. This policy must be consistent with AZA standards for elephant management and care, and must, at minimum, include a description of the institution's:
- a. Elephant management program's missions and goals (EMA 1999).
 - b. Elephant management policies, including guidelines for handling, training, and translocation (EMA 1999).
 - c. Plan to separate animals from each other, safely manage elephants that are aggressive toward other elephants, safely move elephants from one location to another, and safely manage elephants that are aggressive toward humans (EMA 1999).
 - d. Staff management policies, including guidelines for keeper safety (EMA 1999).
 - e. Individual elephant profiles and incident reports for all cases in which elephants show aggression toward keepers or the public, regardless if any injury actually resulted.
 - f. Emergency response protocol. Institutions should be able to demonstrate readiness to respond to an emergency situation, such as an elephant escape or keeper injury (EMA 1999).

5.4. Safety

- 5.4.1. All elephant-holding institutions must undertake at least a semi-annual elephant facility and program safety assessment, identify safety needs, and fully implement any corrective measures. Each facility shall establish a safety assessment team. The team may include elephant staff, management staff, animal health care staff, and experts in the area of risk management and safety. Each facility should establish the make-up of the team based on its own needs and resources. A written record must be kept for each inspection and that record be reviewed and its recommendations acted upon.
- 5.4.2. In the interest of public safety, AZA strongly discourages visitor-elephant interactions, outside of the primary enclosure. AZA strongly discourages the practice of walking elephants in public areas during public hours (BOD 3/25/03).
- 5.4.3. In the interest of safety, AZA strongly encourages members to discontinue public elephant rides (BOD 3/21/00).

5.5. Restraint

- 5.5.1. Chaining is acceptable as a method of temporary restraint (Fowler 1995). However, elephants must not be subjected to prolonged chaining (for the majority of a 24-hour period) unless necessary for veterinary treatment or transport. Institutions that regularly use chains for some portion of a day must alternate the chained foot on a daily basis. All new construction and major renovations must be constructed in a manner that minimizes or eliminates the need for chaining (Schmid 1995, Gruber et al. 2000).

****Note: If AZA policies on chaining require new construction, rather than procedural changes, then institutions will have five years to comply with this requirement. Plans must be in place within three years and institutions must apply for a variance from the AZA Accreditation Commission.**

- 5.5.2. All elephant holding facilities should install an Elephant Restraint Device (ERD) (Schmidt et al. 1991). However, all bull-holding facilities, as well as those that manage elephants in protected contact, must have an ERD. Use of the ERD should not be weather dependent.
- 5.5.3. Each elephant must be trained to enter and stay in the ERD, if one is available, for husbandry, veterinary, reproductive assessment, and other procedures to occur in a safe and efficient manner (Schmidt 1991).
- 5.5.4. If a facility does not have an ERD, staff must demonstrate a method of restraint that allows necessary husbandry, veterinary, and reproductive procedures to occur in a safe and efficient manner (Fowler 1995).

6. Staff Organization and Training

- 6.1. Each institution must have one person, designated as the elephant manager. This individual is responsible for (1) staff training; (2) developing and maintaining the program; and (3) communicating with others about the elephant program. The elephant manager must also demonstrate knowledge about all emergency protocols and continually improve elephant management techniques as the industry standards evolve.

- 6.2. All elephant managers must attend the AZA Principles of Elephant Management Course (BOD 3/25/03), preferably within 18 months following acceptance/promotion to the position. In addition, every elephant keeper is encouraged to attend this course. The BOD directs the Board of Regents to develop a mechanism for the PEM graduates to remain current in best practices in elephant management (BOD 3/25/03).
- 6.3. The BOD instructs the Board of Regents to hold best practices workshops on elephant management systems and transitioning from one management system to another (BOD 3/25/03).

7. Conservation, Education, and Research

7.1. Education Programs

- 7.1.1. Every institution should institute a program to educate zoo visitors about elephant and elephant conservation issues (EMA 1999, Smith and Hutchins 2000). Assistance is available from the Elephant SSP Education Advisor
- 7.1.2. Every institution should have up-to-date educational graphics and/or information about elephants on display to the public.

7.2. Conservation and Research Activities

- 7.2.1. AZA zoos that currently exhibit or desire to exhibit elephants should make every effort to maintain elephants in their collections so that they can contribute to conservation through public education, scientific research, and the support of field conservation. Elephants are an important flagship species and the cornerstone of many members' African and Asian exhibit areas. (BOD 3/21/00)
- 7.2.2. Every institution should contribute in some way to elephant research activities (Keele and Dimeo-Ediger 1997, EMA 1999, Smith and Hutchins 2000). Involvement in one or more of the following disciplines is strongly recommended: behavior, cognition, reproduction, communication, enrichment, health (disease/pathology, nutrition), and education.
- 7.2.3. Every institution should contribute in some way to *in situ* conservation of elephants and their habitats (EMA 1999, Smith and Hutchins 2000).
- 7.2.4. AZA members are strongly encouraged to provide financial, personnel, logistical, and other support for priority research and conservation initiatives listed in the AZA Elephant SSP/TAG Action Plan (Wiese and Hutchins 1994).

8. Cooperative Management (BOD 3/21/00)

8.1. SSP Participation

- 8.1.1. SSP participants should be given highest priority in elephant dispositions, whether through breeding or importation.
- 8.1.2. AZA institutions should cooperate among themselves to pursue self-sustainability with their elephant populations. Since self-sustainable elephant populations are not possible currently within AZA, then cooperation with outside organizations should be considered on a case-by-case basis.
- 8.1.3. AZA zoos may provide elephants or their gametes to approved non-members on a case-by-case basis.

8.2. Importation

8.2.1. All elephant imports must be approved within the AZA Elephant SSP/TAG. Periodic importation may be used as a way to maintain population viability in the North American Elephant SSP/TAG population. The SSP/TAG and participating institutions will employ a combination of breeding and importation with the goal of eventually creating a self-sustaining population. When acquiring elephants for the SSP/TAG, first consider captive animals in substandard conditions in North America, then captive animals outside the U.S., then wild animals surplus to the needs of the managed population or those to be captured or killed because of human-animal conflicts (especially those that are going to be killed).

8.2.2. An effort should be made to assess the potential for cooperating with sister organizations, such as the European Association of Zoos and Aquariums (EAZA).

Documentation

AZA Regents. 2001. *AZA Schools for Zoo and Aquarium Personnel: Principles of Elephant Management*. American Zoo and Aquarium Association, Silver Spring, MD.

Brown, J. (1998) The need for routine elephant blood draws. *Animal Keeper's Forum* 25: 357-359.

Brown, J. 2000. Reproductive endocrine monitoring of elephants: An essential tool for assisting captive management. *Zoo Biology* 19: 347-367.

Chapple, C. and Ridgway, D. 2001. Elephant handling and an analysis of the risks. *Journal of the Elephant Manager's Association* 11: 163-165.

Csuti, B., Sargent, E.L., and Bechert, U.S., eds. 2001. *The Elephant's Foot: Prevention and Care of Foot Conditions in Captive Asian and African Elephants*. Iowa State University Press, Ames, IA.

Desmond, T. & G. Laule. 1991. Protected contact: Elephant handling. Pp. 84-91 in *Proceedings of the 12th International Elephant Workshop*. Burnet Park Zoo, Syracuse, NY.

Dierenfeld, E. 1995. Nutrition and feeding. *Journal of the Elephant Manager's Association* 6: 32-39.

Doyle, C. 1993. Protected/confined contact as a supplement in a free contact system. Pp. 30-32 in *Proceedings of the 14th Annual Elephant Managers Conference*. Marine World Africa USA, Vallejo, CA.

EMA 1999. The EMA standard guidelines for elephant management. *Journal of the Elephant Manager's Association* 10: 203-204.

Fowler, M.E. 1995. *Restraint and Handling of Wild and Domestic Animals*. Second Edition. Iowa State University Press, Ames, IA.

Gruber, T.M., Friend, T.H., Packard, J.M., Beaver, B., and Bushong, D. 2000. Variation in stereotypic behavior related to restraint in circus elephants. *Zoo Biology* 19: 209-221.

Hermes, R., Olson, D., Goritz, F., Brown, J.L., Schmitt, D.L., Hagan, D., Peterson, J.S., Fritsch, G., and Hildebrandt, T.B. 2000. Ultrasonography of the estrous cycle in female African elephants (*Loxotana africana*). *Zoo Biology* 19: 369-382.

Hildebrandt, T.B., Goritz, F., Pratt, N., Brown, J.L., Montali, R., Schmidt, D.L., Fritsch, G. and Hermes, R. 2000a. Ultrasonography of the urogenital tract in elephants (*Loxotana africana* and *Elaphas maximus*): An important tool for assessing female reproductive function. *Zoo Biology* 19: 321-332.

Hildebrandt, T.B., Hermes, R., Pratt, N.C., Fritsch, G., Blottner, S., Schmidt, D.L., Ratanakorn, P., Brown, J.L., Reitschel, W. and Goritz, F. 2000b. Ultrasonography of the urogenital tract in elephants (*Loxotana africana* and *Elaphas maximus*): An important tool for assessing male reproductive function. *Zoo Biology* 19: 333-345.

Hutchins, M. and B.R. Smith. 1999. *AZA Elephant Planning Initiative: On the Future of Elephants in North American Zoos*. American Zoo and Aquarium Association, Silver Spring, MD.

Keele, M. and N. Dimeo-Ediger. 1997. *AZA Elephant Masterplan 1997-2002*. Oregon Zoo, Portland, OR.

Krantz, K. 1996. Introduction, socialization and crate training. Pp. 78-87 in Kleiman, D.G., Allen, M., Thompson, K.V., and Lumpkin, S., eds. *Wild Mammals in Captivity*. Smithsonian Institution Press, Washington, DC.

Lenhardt, J. 1991. Elephant handling: A problem of risk management and resource allocation. *AAZPA Annual Conference Proceedings*: 569-575.

Lenhardt, J. 2001. Response. *Journal of the Elephant Manager's Association* 11: 165-166.

Lindburg, D.G. and Robinson, P. 1986. Animal introductions: Some suggestions for easing the trauma. *Animal Keeper's Forum* 13: 8-11.

Mikota, S.K., Larson, R.S. and Montali, R. 2000. Tuberculosis in elephants in North America. *Zoo Biology*: 393-403.

Mikota, S.K., Sargent, E., and Ramglack, G.S. 1994. *Medical Management of the Elephant*. Indria Publishing House, West Bloomfield, MI.

Oftedahl, O., Baer, D.J., and Allen, M.E. 1996. The feeding and nutrition of herbivores. Pp. 129-138 in Kleiman, D.G., Allen, M., Thompson, K.V., and Lumpkin, S., eds. *Wild Mammals in Captivity*. Smithsonian Institution Press, Washington, DC.

Samuel, W.M., Pybus, M.J., and Kocan, A.A. 2001. *Parasitic Diseases of Wild Mammals*. Second Edition. Iowa State University Press, Ames, IA.

Sreekumar, K.P. and Nirmalan, G. 1990. Estimation of body weight in Indian elephants (*Elaphus maximus indicus*). *Veterinary Research Communication* 14: 5-17.

Priest, G., Antrim, J. Gilbert, J. and Hare, V. 1998. Managing multiple elephants using protected contact at San Diego's Wild Animal Park. *Soundings* 23 (1): 20-24.

Rasmussen, L.E.L., Schmidt, M.J., Henneous, R., Groves, D., Daves, G.D. Jr. 1982. Asian bull elephants: Flehman-like responses to extractable components in female elephant estrus urine. *Science* 217: 159-162.

Richman, L.K., R.J. Montali, R.C. Cambre, J.M. Lehnhardt, Kennedy, S.K. Potgieter, L. 1996. Endothelial inclusion body disease: A newly recognized fatal herpes-like infection in Asian elephants. *Proceedings of the American Association of Zoo Veterinarians' Annual Conference*: 483-485.

Richman, L.K., R.J. Montali, R.L. Gerber, M.A. Kennedy, J. Lenhardt, T. Hildebrandt, D. Schmitt, D. Hardy, D.J. Alecendor & G.S. Hayward. 1999. Novel endotheliotropic herpesviruses fatal for Asian and African elephants. *Science* 283: 1-5.

Roocroft, A. and Zoll, A.T. 1994. *Managing Elephants: An Introduction to Their Training and Management*. Fever Tree Press, Ramona, CA.

Schanberger, A. et al. 2001. Discussion on chaining, electricity continues. *Journal of the Elephant Management Association* 11: 160-161.

Schmid, J. 1995. Keeping circus elephants temporarily in paddocks-The effects on their behaviour. *Animal Welfare* 4: 87-101.

Schmid, J. 1998. Hands off, hands on: Some aspects of keeping elephants. *International Zoo News* 45: 476-486.

Schmidt, M.J., Henneous, R.L., Haight, J.D., Rutkowski, C., and Sanford, J. 1991. *The Elephant Restraint Chute Owner's Manual*. Washington Park Zoo, Portland, OR.

Sevenich, M., Upchurch, B., and Mellen, J. 1998. The science of animal management: Evaluating the effects of training and enrichment on elephant behavior. *Journal of the Elephant Manager's Association* 9: 201-205.

Shepherdson, D.J. 1999. Environmental enrichment for elephants: Current status and future directions. *Journal of the Elephant Manager's Association* 10: 69-77.

Shepherdson, D.J., Mellen, J.D., and Hutchins, M. eds. 1998. *Second Nature: Environmental Enrichment for Captive Animals*. Smithsonian Institution Press, Washington, D. C.

Smith, B. and Hutchins, M. 2000. The value of captive breeding programmes to field conservation: Elephants as an example. *Pachyderm* 28: 101-109.

Sukumar, R. 1992. *The Asian Elephant: Ecology and Management*. Cambridge University Press, Cambridge, U.K.

Taylor, V.J. and Poole, T.B. 1998. Captive breeding and infant mortality in Asian elephants: A comparison between twenty western zoos and three eastern elephant centers. *Zoo Biology* 17: 311-332.

Ullrey, D.E., Crissey, S.D., and Hintz, H.F. 1997. Elephants: Nutrition and dietary husbandry. Fact sheet #004. *AZA Nutrition Advisory Group Handbook*. American Zoo and Aquarium Association, Bethesda, MD.

USDA APHIS. 2000. *Guidelines for the Control of Tuberculosis in Elephants*. United States Department of Agriculture, Washington, DC.

Wiese, R.J. 2000. Asian elephants are not self-sustaining in North America. *Zoo Biology* 19: 299-309.

Wiese, R.J. and Hutchins, M. 1994. *Species Survival Plans: Strategies for Wildlife Conservation*. American Zoo and Aquarium Association, Bethesda, MD.

Wiese, R.J. and Olson, D. 2000. State of the North American African elephant population and projections for the future. *Zoo Biology* 19: 311-320.