



**EASTERN
MASSASAUGA
RATTLESNAKE
(*Sistrurus catenatus
catenatus*)
CARE MANUAL**

CREATED BY
**EASTERN MASSASAUGA RATTLESNAKE
SPECIES SURVIVAL PLAN®**
IN ASSOCIATION WITH
AZA SNAKE TAXON ADVISORY GROUP

Eastern Massasauga Rattlesnake (*Sistrurus catenatus catenatus*) Care Manual

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Authors and Significant contributors:

Andrew M. Lentini, PhD, Toronto Zoo

Joanne Earnhardt, PhD, Lincoln Park Zoo, Former AZA Eastern Massasauga SSP Coordinator

Reviewers:

Mike Maslanka, Smithsonian National Zoo

Randy Junge, Columbus Zoo and Aquarium

Jeff Jundt, Detroit Zoo

Mike Redmer, US Fish and Wildlife Service

Bob Johnson, Toronto Zoo

Fred Antonio, Orianna Society

AZA Staff Editors:

Deborah Colbert, PhD, Vice President, Animal Conservation

Candice Dorsey, PhD, Director, Animal Programs & Science

Maya Seaman, MS, Animal Care Manual Editor

Cover Photo Credits:

K. Ardill

Disclaimer: This manual presents a compilation of knowledge provided by recognized animal experts based on the current science, practice, and technology of animal management. The manual assembles basic requirements, best practices, and animal care recommendations to maximize capacity for excellence in animal care and welfare. The manual should be considered a work in progress, since practices continue to evolve through advances in scientific knowledge. The use of information within this manual should be in accordance with all local, state, and federal laws and regulations concerning the care of animals. While some government laws and regulations may be referenced in this manual, these are not all-inclusive nor is this manual intended to serve as an evaluation tool for those agencies. The recommendations included are not meant to be exclusive management approaches, diets, medical treatments, or procedures, and may require adaptation to meet the specific needs of individual animals and particular circumstances in each institution. Commercial entities and media identified are not necessarily endorsed by AZA. The statements presented throughout the body of the manual do not represent AZA standards of care unless specifically identified as such in clearly marked sidebar boxes.

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Introduction

Preamble

AZA accreditation standards, relevant to the topics discussed in this manual, are highlighted in boxes such as this throughout the document (Appendix A).

AZA accreditation standards are continuously being raised or added. Staff from AZA-accredited institutions are required to know and comply with all AZA accreditation standards, including those most recently listed on the AZA website (<http://www.aza.org>) which might not be included in this manual.

Taxonomic Classification

Table 1. Taxonomic classification for eastern massasauga rattlesnake

Classification	Taxonomy
Kingdom	Animalia
Phylum	Chordata
Class	Sauropsida
Order	Squamata
Suborder	Serpentes
Family	Viperidae

Genus, Species, and Status

Table 2. Genus, species, and status information for eastern massasauga rattlesnake

Genus	Species	Common Name	USA Status	IUCN Status	AZA Status
<i>Sistrurus</i>	<i>catenatus</i>	Eastern Massasauga Rattlesnake	--	--	SSP

General Information

The information contained within this Animal Care Manual (ACM) provides a compilation of animal care and management knowledge that has been gained from recognized species experts, including AZA Taxon Advisory Groups (TAGs), Species Survival Plan® Programs (SSPs), Studbook Programs, biologists, veterinarians, nutritionists, reproduction physiologists, behaviorists and researchers. They are based on the most current science, practices, and technologies used in animal care and management and are valuable resources that enhance animal welfare by providing information about the basic requirements needed and best practices known for caring for *ex situ* Eastern massasauga rattlesnake populations. This ACM is considered a living document that is updated as new information becomes available and at a minimum of every five years.

Information presented is intended solely for the education and training of zoo and aquarium personnel at AZA-accredited institutions. Recommendations included in the ACM are not exclusive management approaches, diets, medical treatments, or procedures, and may require adaptation to meet the specific needs of individual animals and particular circumstances in each institution. Statements presented throughout the body of the manuals do not represent specific AZA accreditation standards of care unless specifically identified as such in clearly marked sidebar boxes. AZA-accredited institutions which care for Eastern massasauga rattlesnake must comply with all relevant local, state, and federal wildlife laws and regulations; AZA accreditation standards that are more stringent than these laws and regulations must be met (AZA Accreditation Standard 1.1.1).

AZA Accreditation Standard

(1.1.1) The institution must comply with all relevant local, state, and federal wildlife laws and regulations. It is understood that, in some cases, AZA accreditation standards are more stringent than existing laws and regulations. In these cases the AZA standard must be met.

The ultimate goal of this ACM is to facilitate excellent eastern massasauga rattlesnake management and care, which will ensure superior eastern massasauga rattlesnake welfare at AZA-accredited institutions. Ultimately, success in our eastern massasauga rattlesnake management and care will allow

AZA-accredited institutions to contribute to Eastern massasauga rattlesnake conservation, and ensure that eastern massasauga rattlesnakes are in our future for generations to come.

The eastern massasauga rattlesnake is a small stout rattlesnake (47.2–76 cm) that is found in Ontario, New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, Iowa and Missouri (Conant & Collins, 1991). The typical pattern of the massasauga consists of dark brown blotches on the back and three rows of alternating blotches on the side over a grey background.

The massasauga is a member of the pit viper subfamily, the Crotalinae (Family Viperidae). The pit vipers are venomous snakes that possess paired heat sensing facial pits located slightly below, and between the eye and the nostril (Klauber, 1956). Neural signals from the spatial arrangement of infrared receptors in the pit organs are integrated with visual information in the brain's tectum, suggesting that the pit organs are infrared imaging devices rather than simple thermal receptors. The pit organs are exceptionally sensitive and respond to thermal radiation and allow the snake to detect thermal differences between an object and its surroundings of 0.003–0.005 °C (32 °F) (Bullock & Diecke, 1956). Facial pits are used to aid in prey acquisition and may also play a role in defensive behavior and in thermoregulatory behavior (Krochmal & Bakken, 2003).

Rattle: The characteristic rattle is composed of interlocking rings of keratin (*stratum corneum*) at the end of the tail. Each time the snake sheds its skin, a new segment is added to the rattle. Specialized tail muscles vibrate the rattle at a rate of 20–100 Hz thus producing the distinctive buzzing sound from 2–20 kHz (Klauber, 1956; Fenton & Licht, 1990). The primary function of the rattle is defensive. Klauber (1956) documented a multi-layered pattern of behavior when a rattlesnake is disturbed. He described how a snake remains silent; relying on crypsis to remain undetected even when a potential threat is only a short distance away. Once the rattlesnake has been disturbed, it will begin to rattle. If the disturbance continues, the snake will try to retreat. If the disturbance or perceived threat is imminent and retreat is not possible, it will change its posture and adopt the characteristic S-shape that readies it for a strike. This escalating pattern of behavioral response to a threat illustrates that rattlesnakes are shy snakes and prefer to remain motionless and undetected in order to avoid harm.

Status: The massasauga is considered a species at risk of extinction and is listed as Endangered, Threatened, or Of Special Concern throughout its range. In Canada, massasaugas were listed as a threatened species by the Committee on the Status of Endangered Wildlife in 1991 (Beltz, 1993). The massasauga is the only extant venomous snake found in Ontario and has been the subject of a comprehensive conservation and education effort in the province since the late 1980s (Johnson, 1993). In the United States it is a Candidate Species (United States Fish and Wildlife Service, 2012). It is listed as Endangered in Illinois, Indiana, Iowa, Minnesota, Missouri, New York, Ohio, Pennsylvania and Wisconsin; and of Special Concern in Michigan.

Conservation: This high profile species has also been the focus of ongoing research into its ecology and natural history throughout its range. The results of this research are used by wildlife managers to optimize land management practices, improve habitat, and potentially affect the recovery of this species (Jaworski, 1993; Johnson & Breisch, 1999; Kingsbury, 1999; Reinert & Bushar, 1993).

Chapter 1. Ambient Environment

1.1 Temperature and Humidity

Animal collections within AZA-accredited institutions must be protected from weather detrimental to their health (AZA Accreditation Standard 1.5.7). Animals not normally exposed to cold weather/water temperatures should be provided heated enclosures/pool water. Likewise, protection from excessive cold weather/water temperatures should be provided to those animals normally living in warmer climates/water temperatures.

AZA Accreditation Standard

(1.5.7) The animal collection must be protected from weather detrimental to their health.

Temperature is one of the most important factors affecting living organisms, particularly for ectotherms such as reptiles. Temperature influences metabolic rate by affecting not only the rate of various biochemical reactions, it also affects the cellular environment in which they take place. For the most part, animals regulate body temperature to limit the disrupting effects of temperature variation. The majority of endothermic and ectothermic vertebrates appear to differ only in the degree of temperature homeostasis (Hutchinson et al., 1979; Varghese & Pati, 1996). Thermoregulation is essential to many physiological and ecological processes in ectothermic vertebrates. Body temperature directly affects fitness by influencing metabolic rate, which in turn has an effect on foraging, feeding, energy use, and can also influence other biological processes such as growth, development, reproduction and healing.

Thermoregulation is achieved by both physiological and behavioral means. Behavioral thermoregulation is a low energy means of controlling Tb using refined behavior patterns that regulate the intake and loss of heat.

Massasauga rattlesnakes, as ectothermic vertebrates, by definition, rely almost exclusively on behavioral thermoregulation to obtain heat required to maintain Tb from their environment. The exhibit environment should therefore provide massasauga rattlesnakes with the thermal landscape to allow for behavioral thermoregulation.

An ambient temperature range of 22–32 °C (71–90 °F) should be offered, with a specific hot spot (30–34 °C [86–93 °F]). This will provide a thermal gradient that allows the snake to select desired temperatures for proper behavior thermoregulation. Each holding area should have a thermometer to monitor changes in temperature. A humidity of 50–70% is desirable. Natural substrates also help increase humidity, which is important for ecdysis.

During winter months, ambient temperatures can drop to 18–22 °C (64–71 °F) in the enclosure, but a basking spot should still be available. Temperatures can be further lowered in order to simulate hibernation/brumation. Such cooling can be potentially dangerous for snakes and care should be exercised when cooling snakes for extended periods. Hibernation protocols are variable, however animals should be in good condition, clinically healthy, and well hydrated before they are put into hibernation. They should be maintained in an environment with sufficient humidity and should have access to water (Dutton & Taylor, 2003). Blood samples should be collected on arousal for measuring plasma uric acid levels, and if levels are high, fluid therapy should be implemented.

A common feature of natural hibernation sites across the range seems to be access to the unfrozen portion of the water table (Johnson, 1995). A high humidity hibernation environment reduces the dehydrating effects of cool air. However, substrates should not be wet with hibernating massasaugas, since this may increase the likelihood of skin infection. A shallow water dish large enough for the snake to soak in should be provided. Wild massasaugas have been reported to hibernate submerged in water this may be a strategy to prevent dehydration or buffer temperature changes. In zoos and aquariums, hibernating snakes offered a water bowl, will occasionally submerge in the water during hibernation. This may be a mechanism that aids in avoiding dehydration. At low temperatures snakes will be unable to digest food. Therefore, snakes should be fasted for 2–3 weeks prior to cooling in order to ensure their digestive tract is empty

AZA Accreditation Standard

(10.2.1) Critical life-support systems for the animal collection, including but not limited to plumbing, heating, cooling, aeration, and filtration, must be equipped with a warning mechanism, and emergency backup systems must be available. All mechanical equipment should be under a preventative maintenance program as evidenced through a record-keeping system. Special equipment should be maintained under a maintenance agreement, or a training record should show that staff members are trained for specified maintenance of special equipment.

before temperatures are lowered.

AZA institutions with exhibits which rely on climate control must have critical life-support systems for the animal collection and emergency backup systems available, while all mechanical equipment should be included in a documented preventative maintenance program. Special equipment should be maintained under a maintenance agreement or records should indicate that staff members are trained to conduct specified maintenance (AZA Accreditation Standard 10.2.1).

Environmental control (i.e., heating and air-conditioning) should be maintained as per the individual institution's standard operating procedures. Since appropriate temperature is vital to the well being of massasauga rattlesnakes, heating and cooling systems should be monitored throughout the day by appropriate staff (e.g., animal care staff, maintenance staff, security, etc.).

1.2 Light

Careful consideration should be given to the spectral, intensity, and duration of light needs for all animals in the care of AZA-accredited zoos and aquariums. The use of quality lighting will help meet the physiological requirements of snakes and promotes natural behavior. Quality lighting also allows for thermoregulation, promotes plant growth and contributes to exhibit aesthetics.

General lighting for holding cages can be provided by 40-watt double strip fluorescent light fixture suspended approximately 20 cm (7.8 in.) above holding cages. Using a black light or similar UV producing bulb in this setup will provide low intensity UV for snakes housed in small holding tanks.

Exhibit lighting can be used to provide good quality light, heat and UV. Basking sites can be provided using incandescent lamps, ceramic heat emitters or substrate heaters. UV lighting selection should be based on the size of the exhibit and the distance the lamps are from the animals and can be evaluated using a UV meter. See Burger et al. (2007), Gehrman (1987) and Gehrman et al. (2004) for details on the use of UV lighting in reptile husbandry.

The photoperiod should mimic the natural photoperiod experienced by massasauga. During winter, the photophase should be 9 hours and the scotophase 15 hours. During summer, the photophase should be 15 hours and scotophase 9 hours.

1.3 Water and Air Quality

AZA-accredited institutions must have a regular program of monitoring water quality for collections of aquatic animals and a written record must document long-term water quality results and chemical additions (AZA Accreditation Standard 1.5.9). Monitoring selected water quality parameters provides confirmation of the correct operation of filtration and disinfection of the water supply available for the collection. Additionally, high quality water enhances animal health programs instituted for aquatic collections.

AZA Accreditation Standard

(1.5.9) The institution must have a regular program of monitoring water quality for collections of fish, pinnipeds, cetaceans, and other aquatic animals. A written record must be maintained to document long-term water quality results and chemical additions.

Fresh water should be offered daily. Large water bowls or pools that allow the snake to fully submerge should be provided. Periodic heavy misting and soaking will be beneficial to encourage drinking and increase humidity. Depending on the exhibit or holding set-up, heavy misting can be done every 3–10 days. When misting heavily, ensure that the environment dries out thoroughly within 48–72 hours to avoid potential skin and respiratory infections.

Air exchange rates required in reptile exhibits and holdings are much lower than those recommended for mammals. Excessive air exchange rates can lead to problems maintaining adequate temperature and humidity for reptiles. Draft-free air exchanges in the range of 2–8 per hour should be sufficient for rooms containing massasaugas.

1.4 Sound and Vibration

Consideration should be given to controlling sounds and vibrations that can be heard by animals in the care of AZA-accredited zoos and aquariums. Snakes are able to detect both airborne and ground-borne vibrations using both the body surface and inner ear; however snakes appear to be more sensitive to ground-borne vibrations (Young, 2003). Although snakes have a limited auditory sensitivity range from approximately 50–1,000 Hz compared to human hearing of 15–18,000 Hz (Wever, 1978), prolonged exposure to excessive noise and vibration should be avoided.

Potential sources of sound/vibration that may pose a problem include pumps or compressors mounted near a holding or exhibit area. Such equipment should not be installed near in close proximity to rattlesnake housing. Portable holding and exhibit tanks can be placed on a cushioning material such as foam rubber or rigid foam (expanded polystyrene) insulation in order to minimize the effects of vibrations.

Chapter 2. Habitat Design and Containment

2.1 Space and Complexity

Careful consideration should be given to exhibit design so that all areas meet the physical, social, behavioral, and psychological needs of the species. Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs (AZA Accreditation Standard 1.5.2).

Holding enclosures used to house massasaugas should be at least as long as the snake and half as wide. The enclosure should offer adequate ventilation. A simple shelter or hide box should be available as a secure hiding place. A simple, easily removable substrate (e.g., newspaper) is suitable for off-exhibit housing. Natural substrates including sand, soil, mulch, coconut husks/coir, and leaf litter are often used in exhibits. Snakes, which will be kept in zoos indefinitely, should have access to a larger space in which a normal array of behavior may occur.

AZA Accreditation Standard

(1.5.2) Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.



Figure 1. Examples of on-exhibit and off-exhibit housing for massasaugas. The display tank on the left is 61 cm x 30.5 cm x 31.8 cm (24 in. x 12 in. x 12.5 in.). It has both fluorescent (20 W) and halogen (18 W) lighting. The off-exhibit holding area is a standard polycarbonate box with a mesh lid and lock. Photos courtesy of Y. Clippinger



Figure 2. Massasauga in a naturalistic setting and off-exhibit holdings. The exhibit measures 91.4 cm x 116.8 cm x 106.7 cm (36 in. x 46 in. x 42 in.). Lighting, heat, and UV elements are provided by fluorescent and incandescent or halogen lighting from above. Fresh water trickles through the water feature nonstop. The off-exhibit enclosure is the same as those described for hibernation utilizing fluorescent strip lights from above the enclosure.

Photos courtesy of J. Jundt



Figure 3. A mixed species snake exhibit. This zoo houses a massasauga with a timber rattlesnake. They use small river rock as a substrate, adding leaf litter in the fall. The enclosure is heated from above with one infrared 250 W bulb. Lighting is provided by incandescent room lighting and supplemented with a 60 cm (24 in.) fluorescent light above the enclosure. The enclosure's internal dimensions are 138 cm x 96.5 cm x 155 cm (54.5 in. x 38 in. x 61 in.). Photos courtesy of B. Harrison



Figure 4. A planted multispecies massasauga exhibit. Massasaugas at this zoo are exhibited in a multi-species enclosure together with *Pituophis catenifer sayi*, *Elaphe vulpina vulpine*, and *Terrapene ornata*. The enclosure is constructed of fiberglass and measures 72 cm x 48 cm x 48 cm (6 ft x 4 ft x 4 ft). The substrate consists of a sand/gravel mixture. The plantings consist of grasses and native prairie perennial flowers. Lighting is provided by two eight-foot long dual fluorescent light fixtures equipped with cool white bulbs. Heat and UV are provided via a 160 W Active UV bulb. Photos courtesy of M. Wanner



Figure 5. Off-exhibit massasauga enclosures. Massasaugas maintained off-exhibit in Neodesha ABS enclosures. The overall dimensions of the enclosure are 122 cm x 61 cm x 46 cm (4 ft x 2 ft x 1.5 ft) and it is divided into two units. Carefresh® recycled newspaper bedding is used as substrate and each unit is provided with rocks, a hide box, and a water bowl. Lighting consists of a double T12 48 in. shop light with two Verilux bulbs. Flexwatt heat affixed to the bottom of the enclosure can be utilized for supplementary heat. Photos courtesy of J. Adamski



Figure 6. Naturalistic exhibit for massasaugas. This massasauga exhibit is approximately 3 m x 1 m x 1.5 m (10 ft x 3 ft x 5 ft), and is setup to represent the exposed bedrock of Georgian Bay region of Canada. Substrate is coconut husk and mulch. Natural rocks, logs, and artificial plants are used for decoration and shelter. Lighting is provided by fluorescent and halogen bulbs. Photos courtesy of C. Cox

The same careful consideration regarding exhibit size and complexity and its relationship to the massasauga's overall well-being must be given to the design and size all enclosures, including those used in exhibits, holding areas, hospital, and quarantine/isolation (AZA Accreditation Standard 10.3.3).

It is recommended that short term holding enclosures used to house a snake should be at least 30 cm x 60 cm x 30 cm (11.8 in. x 24 in. 11.8 in.) high. The top of the container should be screened to offer adequate ventilation. A simple shelter or hide box should be available as a secure hiding place. A simple, easily removable substrate (e.g., newspaper) is suitable for off-exhibit housing.

2.2 Safety and Containment

Massasauga rattlesnakes are venomous animals that are not suitable for free range exhibits where they will be in contact with the visiting public. AZA-accredited institutions that care for potentially dangerous animals, such as venomous snakes, must have appropriate safety procedures in place to prevent attacks and injuries by these animals and appropriate response procedures must also be in place to deal with an attack resulting in an injury (AZA Accreditation Standard 11.5.3).

All emergency safety procedures must be clearly written, provided to appropriate staff and volunteers, and readily available for reference in the event of an actual emergency (AZA Accreditation Standard 11.2.4). AZA-accredited institutions must

have a communication system that can be quickly accessed in case of an emergency (AZA Accreditation Standard 11.2.6). AZA-accredited institutions must also ensure that written protocols define how and when local police or other emergency agencies are contacted and specify response times to emergencies (AZA Accreditation Standard 11.2.7)

Staff training for emergencies must be undertaken and records of such training maintained. Security personnel must be trained to handle all emergencies in full accordance with the policies and procedures of the institution and in some cases, may be in charge of the respective emergency (AZA Accreditation Standard 11.6.2). Animal injury emergency response drills must be practiced routinely to ensure that the institution's staff know their duties and

AZA Accreditation Standard

(10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.

AZA Accreditation Standard

(11.5.3) Institutions maintaining potentially dangerous animals (e.g. large carnivores, large reptiles, medium to large primates, large hoofstock, killer whales, sharks, venomous animals, and others, etc.) must have appropriate safety procedures in place to prevent attacks and injuries by these animals. Appropriate response procedures must also be in place to deal with an attack resulting in an injury. These procedures must be practiced routinely per the emergency drill requirements contained in these standards. Whenever injuries result from these incidents, a written account outlining the cause of the incident, how the injury was handled, and a description of any resulting changes to either the safety procedures or the physical facility must be prepared and maintained for five years from the date of the incident.

AZA Accreditation Standard

(11.2.4) All emergency procedures must be written and provided to staff and, where appropriate, to volunteers. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency. These procedures should deal with four basic types of emergencies: fire, weather/environment; injury to staff or a visitor; animal escape.

responsibilities and know how to handle venomous bite emergencies properly if they occur. All drills need to be recorded and evaluated to ensure that procedures are being followed, that staff training is effective, and that what is learned is used to correct and/or improve the emergency procedures. Records of these drills must be maintained and improvements in the procedures duly noted whenever such are identified (AZA Accreditation Standard 11.2.5).

Individual institutions should develop and follow their own emergency and dangerous animal policies. Venomous reptile procedures are very specific to each institution depending on staff availability, training and even local and provincial/state health and safety regulations (e.g., each institution should have its own alarm system, response protocol, lock-out protocol, etc.).

Animal exhibits and holding areas in all AZA-accredited institutions must be secured to prevent unintentional animal egress (AZA Accreditation Standard 11.3.1). Exhibits in which the visiting public is not intended to have contact with animals, such as with the massasauga rattlesnake, some means of deterring public contact with animals must be in place (AZA Accreditation Standard 11.3.6).

Holding and exhibit areas housing venomous snakes should be clearly labeled as such. Containers and snake areas should be labeled and list the species (scientific and common name) and number of animals present. All animal exhibits and holding areas must be secured to prevent unintentional animal egress (AZA Accreditation Standard 11.3.1), therefore, exhibit design must be considered carefully because all snakes are capable of squeezing through very narrow openings. Furthermore, massasaugas are livebearers, therefore enclosures should not have any gaps or holes over 3 mm (1/8 in.) that could serve as escape routes for neonates. Any potential escape routes (e.g., ventilation, plumbing, door jams, etc.) should be sealed. All holding containers should be secure and holding and exhibit areas should be kept locked with restricted access. Emergency lighting is also necessary in the event of a power outage.

All areas housing venomous snakes must be equipped with appropriate alarm systems, and/or have protocols and procedures in place which will notify staff in the event of a bite injury, attack, or escape from the enclosure. These systems and/or protocols and procedures must be routinely checked to insure proper functionality, and periodic drills must be conducted to ensure that appropriate staff members are notified (AZA Accreditation Standard 11.5.2).

Minimizing the possibility of snakebite can be achieved by restricting access to venomous snake areas to those who have received training in handling and working around venomous snakes. Further, adequate handling equipment such as snake hooks, capture tongs, catch boxes, transport boxes, restraint tubes, and holding cages should be available. A two-person policy that ensures backup staff is available during hands on restraint or handling is common in many institutions.

Procedures to deal with snakebite should be established and posted in all areas where venomous snakes are kept. These include an emergency response system (i.e., a reliable alarm system) and written response procedure that contains contact

AZA Accreditation Standard

(11.2.7) A written protocol should be developed involving local police or other emergency agencies and include response times to emergencies.

AZA Accreditation Standard

(11.6.2) Security personnel, whether staff of the institution, or a provided and/or contracted service, must be trained to handle all emergencies in full accordance with the policies and procedures of the institution. In some cases, it is recognized that Security personnel may be in charge of the respective emergency (i.e., shooting teams).

AZA Accreditation Standard

(11.2.5) Live-action emergency drills must be conducted at least once annually for each of the four basic types of emergency (fire; weather/environment appropriate to the region; injury to staff or a visitor; animal escape). Four separate drills are required. These drills must be recorded and evaluated to determine that procedures are being followed, that staff training is effective, and that what is learned is used to correct and/or improve the emergency procedures. Records of these drills must be maintained and improvements in the procedures documented whenever such are identified.

AZA Accreditation Standard

(11.3.1) All animal exhibits and holding areas must be secured to prevent unintentional animal egress.

AZA Accreditation Standard

(11.3.6) In areas where the public is not intended to have contact with animals, some means of deterring public contact with animals (e.g., guardrails/barriers) must be in place.

AZA Accreditation Standard

(11.5.2) All areas housing venomous animals, or animals which pose a serious threat of catastrophic injury and/or death (e.g. large carnivores, large reptiles, medium to large primates, large hoofstock, killer whales, sharks, venomous animals, and others, etc.) must be equipped with appropriate alarm systems, and/or have protocols and procedures in place which will notify staff in the event of a bite injury, attack, or escape from the enclosure. These systems and/or protocols and procedures must be routinely checked to insure proper functionality, and periodic drills must be conducted to insure that appropriate staff members are notified

phone numbers for supervisory staff and emergency services. The snakebite procedure should be tested on a regular basis.

It is the responsibility of the institution to verify that appropriate antivenins are available locally for all venomous species maintained at their institution, and for which antivenin is produced. Institutions may rely on the antivenin supply of local hospitals and treatment facilities, but it is also the institution's responsibility to guarantee that these inventories are maintained adequately. Such arrangements must be documented (AZA Accreditation Standard 11.5.1).

AZA Accreditation Standard

(11.5.1) Institutions maintaining venomous animals must have appropriate antivenin readily available, and its location must be known by all staff members working in those areas. An individual must be responsible for inventory, disposal/replacement, and storage of antivenin

Chapter 3. Transport

3.1 Preparations

Animal transportation must be conducted in a manner that adheres to all laws, is safe, and minimizes risk to the animal(s), employees, and general public (AZA Accreditation Standard 1.5.11). Safe animal transport requires the use of appropriate conveyance and equipment that is in good working order.

Cloth bags are commonly used to contain snakes. Since snakes can deliver a bite through a cloth bag, transporting venomous snakes in cloth bags alone is not recommended. An additional level of containment should be used. Placing a snake bag in a secure box or crate will ensure the safe transport of the animal.

Snake bags should be as large as possible (king size pillow cases work well). Snake bags should be carefully inspected for wear and tear (i.e., holes) prior to use. Snakes should not be transported in cages with heavy items (e.g., decorative rocks, water bowls) that might shift and cause injury.

The equipment s provide for the adequate containment, life support, comfort, temperature control, food/water, and safety of the animal(s). The IATA Live Animals Regulations set a worldwide standard for the transport of venomous snakes. These specify a triple containment of venomous snakes. Translucent snake bags are available that allow for visual inspection of an animal. The snake bag containing the snake should be securely closed (i.e., tied knot further secured with a cable tie). The bag should then be placed in a clear container—to allow for inspection—and then placed within a labeled crate.

Containers should be ventilated, and if exposed to temperature extremes (i.e., direct sun or winter chill) they should be insulated. Ventilation holes should be small enough (or covered with fine mesh) to prevent the snake from biting through the hole and to prevent the escape of any newborn snakes.

Safe transport also requires the assignment of an adequate number of appropriately trained personnel (by institution or contractor) who are equipped and prepared to handle contingencies and/or emergencies that may occur in the course of transport. Planning and coordination for animal transport requires good communication among all affected parties, plans for a variety of emergencies and contingencies that may arise, and timely execution of the transport. At no time should the animal(s) or people be subjected to unnecessary risk or danger.

A two-person policy that ensures backup staff is available during hands on restraint or handling is common in many institutions.

AZA Accreditation Standard

(1.5.11) Animal transportation must be conducted in a manner that is safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to.



Figure 7. A transport box for venomous snakes.
Photo courtesy of C. Cox

3.2 Protocols

Transport protocols should be well defined and clear to all animal care staff.

Bagging: When placing a snake in a snake bag, the bag should not be held open by hand. The bag should be held open using Pilstrom tongs (i.e., long handled animal tongs), by a specially designed snake bagging system (e.g., Midwest Tongs), or by draping the bag over a bucket. Once the snake has been transferred to the bag with a snake hook or tong, the snake should be isolated at the bottom of the bag so that the bag can be knotted shut. There are different techniques available for this.

If using a bag and tongs or a bagging system, place the bag with the snake in it on a flat surface and isolate a snake at the bottom of the bag in order to tie it. This is accomplished by laying a long solid object (e.g., broom handle, snake hook, etc.) across the bag so that the snake cannot crawl beneath this barrier to the open end of the bag. Slide the barrier towards the rear of the bag so that the snake is isolated as far as possible from the end where hands are tying a knot.

If using a bucket, the snake can be isolated at the bottom of the bag by pulling the open end of the bag across the bucket lip and placing a lid on the bucket over the bag creating a barrier that the snake cannot pass. The open end of the bag will be outside the bucket where it can be knotted safely.

To untie the bag, these procedures should be reversed so that the snake will be isolated at one end of the bag while the knot is untied. To facilitate the release of a snake from a bag, the corners can be sewn to create “hot corners.” This provides a rounded bottom to the bag and leaves material at the corners that can be grasped with tongs when releasing a snake. See Figures 8–10 for details.



Figure 8. Bagging a massasauga. Using a bag, a bucket, a snake hook, and tongs to restrain a massasauga.
Photo courtesy of C. Cox



Figure 9. Securing a massasauga. Knotting the bag while using the hook to isolate the snake's movement.
Photo courtesy of C. Cox



Figure 10. Securing a massasauga without a hook. Using a bucket lid to isolate the snake so the bag can be tied safely.
Photo courtesy of C. Cox

Chapter 4. Social Environment

4.1 Group Structure and Size

Careful consideration should be given to ensure that animal group structures and sizes meet the social, physical, and psychological well-being of those animals and facilitate species-appropriate behaviors.

Massasaugas have been successfully housed in a variety of social configurations. Individual animals, mixed sex, and single sex groups can be housed for long periods without apparent problems. These snakes appear to be very tolerant of conspecifics. Rattlesnakes are often communal hibernators and there are no known reports of injurious interactions between animals. Depending on the size of the enclosure several snakes of mixed sexes and ages can be kept together. For example, an exhibit with 3 m² (32 ft²) floor space can accommodate up to 6 adult massasauga.

Males housed together may engage in ritualized combat. This is an innate behaviour and there are no associated injuries. In fact, it is thought that such combat behavior may be beneficial to induce breeding in the species.

4.2 Influence of Others and Conspecifics

Animals cared for by AZA-accredited institutions are often found residing with conspecifics, but may also be found residing with animals of other species. Mixed exhibits should include sufficient thermal resources (basking spots) and shelter areas to accommodate each animal individually.

Mixed species exhibits with massasauga have been attempted. Massasaugas have been successfully housed with other snake species including bull snakes, fox snakes, hognose snakes, and milk snakes. The potential for parasite and disease transmission should be considered. For example, turtles can be sub-clinical carriers of *Entamoeba invadens* that can cause severe illness and death in snakes. Complete parasitology and disease screening should be carried out before species are mixed.

Massasaugas do not appear to engage in any social interaction with humans. They generally view humans as potential predators and can react defensively to a human caretaker. This type of reaction varies with the individual snake. Some individuals are quite sedate and do not react while others may react by rattling and adopting a defensive pose in which it is ready to strike out. To minimize these behaviors, keepers should approach snakes gradually as not to surprise or startle them.

4.3 Introductions and Reintroductions

Managed care for and reproduction of animals housed in AZA-accredited institutions are dynamic processes. Animals born in or moved between and within institutions require introduction and sometimes reintroductions to other animals. It is important that all introductions are conducted in a manner that is safe for all animals and humans involved.

Introducing massasauga to each other is fairly straightforward. Individuals can be introduced on exhibit or in holding tanks. Animals can be released from a bag directing into the zoo/aquarium habitat or can be transferred by transport box or by hooking them from a holding container directly into the new enclosure. There is no need for gradual introductions. These snakes are not aggressive and very tolerant towards each other. Multiple males may be kept together without problems. Males may engage in ritualized combat, but will not harm each other.

Chapter 5. Nutrition

5.1 Nutritional Requirements

A formal nutrition program is recommended to meet the nutritional and behavioral needs of all massasauga (AZA Accreditation Standard 2.6.2). Diets should be developed using the recommendations of nutritionists, the Nutrition Scientific Advisory Group (NAG) feeding guidelines

(http://www.nagonline.net/Feeding%20Guidelines/feeding_guidelines.htm), and veterinarians as well as AZA Taxon Advisory Groups (TAGs), and Species Survival Plan®

(SSP) Programs. Diet formulation criteria should address the animal's nutritional needs, feeding ecology, as well as individual and natural histories to ensure that species-specific feeding patterns and behaviors are stimulated.

Massasauga feed on a variety of whole vertebrate prey. Weatherhead et al. (2009) found that adult massasaugas prey primarily on small mammals and that neonates also include snakes in their diet. Species identified as prey of wild massasaugas include masked shrew (*Sorex cinereus*), meadow jumping mouse (*Zapus hudsonicus*), Northern short-tailed shrew (*Blarina brevicauda*), deer mouse (*Peromyscus maniculatus*), boreal redback vole (*Clethrionomys gapperi*), meadow vole (*Microtus pennsylvanicus*), Eastern chipmunk (*Tamias striatus*), Northern flying squirrel (*Glaucomys sabrinus*), red squirrel (*Tamiasciurus hudsonicus*), Eastern fox squirrel (*Sciurus niger*), snowshoe hare (*Lepus americanus*), Eastern cottontail (*Sylvilagus floridanus*). Shepard et al. (2004) examined prey preference of neonate massasauga and found they demonstrated a preference for snake prey, disinterest in anuran and insect prey and indifference toward mammal prey. They also reported that free-ranging neonates prey on Southern short-tailed shrews (*Blarina carolinensis*) which are smaller than most mammals preyed upon by older age classes and would be easier for neonates to ingest.

It is often assumed that the nutrient profile of whole prey is complete, but it should be noted that the nutrient composition can vary within species, life stage, and some species' nutrient composition can vary with diet. Whole mice are most commonly used as a food item. Varying the species and life stage of prey item offered may be beneficial. In order to add variety to the zoo diet, other food items such as birds (e.g., quail or chicken chicks) can be offered occasionally. Massasaugas are commonly fed every two weeks at all life stages. Young snakes under 1 year of age can be offered food once a week if a faster growth rate is desired to meet exhibit or breeding goals. Prey animals can be offered as freshly killed or previously frozen. Live prey animals have been known to seriously injure snakes and are not recommended. Steatitis, fat necrosis, and muscular degeneration have been reported as clinical and pathological signs of vitamin E deficiency in snakes (Dierenfeld, 1989). Supplementing frozen mice with vitamin E may prevent fat metabolism problems that can be life threatening to the snake. 10–15 IU of vitamin E can be inserted (as a capsule or tablet) or injected (as a liquid) into the thawed mouse before feeding it to the snake. The size of the prey item depends on the size of the snake. A prey item weighing approximately 5–10% of the snake's body weight should be adequate for most snakes. Prey items should be fresh or fresh-frozen, stored appropriately and thawed in cool temperatures to ensure they present a wholesome diet with no sign of rancidity. To prevent parasite problems, do not feed any food items originating from the wild. Fresh, clean water should be available at all times.

5.2 Diets

The formulation, preparation, and delivery of all diets must be of a quality and quantity suitable to meet the animal's psychological and behavioral needs (AZA Accreditation Standard 2.6.3). Food should be purchased from reliable, sustainable and well-managed sources. The nutritional analysis of the food should be regularly tested and recorded.

Individual institutions should follow their own diet acquisition, quality, storage and preparation policies. The most common prey species used in zoos is the laboratory mouse which was derived from the common house mouse, *Mus musculus*. Occasionally bird chicks (quail and chicken) can also be offered.

AZA Accreditation Standard

(2.6.2) A formal nutrition program is recommended to meet the behavioral and nutritional needs of all species and specimens within the collection.

AZA Accreditation Standard

(2.6.3) Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs. Diet formulations and records of analysis of appropriate feed items should be maintained and may be examined by the Visiting Committee. Animal food, especially seafood products, should be purchased from reliable sources that are sustainable and/or well managed.

In order to prevent accidents during feeding, offer all food items using a long handled forceps or tongs (keeper's hand should be a minimum of 24 inches away from the snake). Since rattlesnakes do not tend to strike upwards, offer feed item from slightly above the snake. When multiple snakes are housed together they should be separated for feeding by placing snakes in individual containers. If this is not possible, snakes should be moved as far from each other as possible within the enclosure before food is introduced. Snakes should be closely monitored while feeding and prevented from feeding on the same prey item.

Most snakes will learn to accept dead prey. Massasaugas are pit vipers and use the heat sensitive facial pits to aid in prey acquisition. Therefore the key is to warm the prey item and move it slightly from side to side when presenting it directly in front of the snake. Once a massasauga senses the presence of the warmed prey item, it will strike and envenomate the prey, releasing it immediately. After a brief pause (30 sec–2 min) the snake will begin tongue flicking and investigating the envenomated prey and then begin consuming it. Ingestion typically takes 2–5 min.

Snakes should be offered a thawed previously frozen mouse every second week. The food item should be thawed in a refrigerator and can be warmed slightly (surface temperature to 35 °C [95 °F]) in order to give it the thermal profile of a live prey item. Hold the thawed mouse under a heat lamp for several seconds, or immerse the food item in a warm water bath.

Reluctant feeders: Some snakes are reluctant feeders and may routinely refuse diet for several weeks. Freshly killed or live food can be used to stimulate the appetite of reluctant feeders. Once a snake is feeding, it can be switched back to previously frozen food if desired. Reluctant feeders are often stimulated to feed by the scent of the exposed brain of a previously frozen mouse. Make a small incision in the head of a previously frozen mouse and expose the brain before feeding. Young massasaugas that refuse to feed on pinkie mice will sometimes readily feed on young snakes (e.g., garter snakes and green snakes). When using other snakes as food, the potential for disease transmission should be evaluated and addressed. Mice can also be scented with shed skin of other snakes. If a snake is anorexic for longer than 8 weeks, it should be evaluated by a veterinarian and supplemental nutritional support may be required.

The sources of prey used as food items should have consistent quality control to insure that only healthy prey items, raised on an optimal plane of nutrition, are offered. Frozen food items should be thawed and handled properly prior to feeding. Offering wild-caught food items should not be used to prevent introduction of potential pathogens.

Food preparation must be performed in accordance with all relevant federal, state, or local regulations (AZA Accreditation Standard 2.6.1). Meat processed on site must be processed following all USDA standards. The Appropriate Hazard Analysis and Critical Control Points (HACCP) food safety protocols for the diet ingredients, diet preparation, and diet administration should be established for the massasauga or species specified. Diet preparation staff should remain current on food recalls, updates, and regulations per USDA/FDA. Remove food within a maximum of 24 hours of being offered unless state or federal regulations specify otherwise and dispose of per USDA guidelines.

AZA Accreditation Standard

(2.6.1) Animal food preparations must meet all local, state/provincial, and federal regulations.

5.3 Nutritional Evaluations

Body mass index measurements may provide a guide to the condition of an animal, however, a body mass index is currently not available for massasauga rattlesnakes. Sexually mature adults range in weight from 180–400 g, although it may be normal for a snake to weigh over 400 g if it is a particularly long animal (greater than 75 cm [30 in.]).

It is generally accepted that snakes fed appropriate quantities of whole prey rarely experience nutritional problems. Monthly weighing is the best method of tracking the nutritional status of a massasauga. Growth in reptiles continues until death (although at a slower rate later in life). A modest (approximately 2–4%) yearly increase in mass for adult males and non-gravid females is expected.

Chapter 6. Veterinary Care

6.1 Veterinary Services

Veterinary services are a vital component of excellent animal care practices. A full-time staff veterinarian is recommended, however, in cases where this is not practical, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and to any emergencies (AZA Accreditation Standard 2.1.1). Veterinary coverage must also be available at all times so that any indications of disease, injury, or stress may be responded to in a timely manner (AZA Accreditation Standard 2.1.2). The AZA Accreditation Standards recommend that AZA-accredited institutions adopt the guidelines for medical programs developed by the American Association of Zoo Veterinarians (AAZV) that

were updated in 2009 (http://aazv.affiniscape.com/associations/6442/files/veterinary_standards_2009_final.docx).

AZA SSP Veterinary Advisor:

Dr. Randall E. Junge
Vice President for Animal Health, Columbus Zoo

AZA Snake TAG Veterinary Advisor:

Dr. Brad Lock
Assistant Curator of Herpetology, Zoo Atlanta

Protocols for the use and security of drugs used for veterinary purposes must be formally written and available to animal care staff (AZA Accreditation Standard 2.2.1). Procedures should include, but are not limited to: a list of persons authorized to administer animal drugs, situations in which they are to be utilized, location of animal drugs and those persons with access to them, and emergency procedures in the event of accidental human exposure.

Animal recordkeeping is an important element of animal care and ensures that information about individual animals and their treatment is always available. A designated staff member should be responsible for maintaining an animal record keeping system and for conveying relevant laws and regulations to the animal care staff (AZA Accreditation Standard 1.4.6). Recordkeeping must be accurate and documented on a daily basis (AZA Accreditation Standard 1.4.7). Complete and up-to-date animal records must be retained in a fireproof container within the institution (AZA Accreditation Standard 1.4.5) as well as be duplicated and stored at a separate location (AZA Accreditation Standard 1.4.4).

As a Species Survival Plan[®] (SSP) Program animal, massasaugas must have individual records and must be individually identifiable. Individual institutions are encouraged to incorporate the following practices into their own record keeping protocols. All significant occurrences (breedings, births, deaths, etc.) and yearly morphometric data should be entered into the animal's record and forwarded to the institutional registrar on a timely basis. The SSP Coordinator and Studbook Keeper should be informed of any occurrences or changes that would impact population management. Further, any novel husbandry approaches and techniques should be documented and forwarded to the Eastern Massasauga Rattlesnake Management Committee.

AZA Accreditation Standard

(2.1.1) A full-time staff veterinarian is recommended. However, the Commission realizes that in some cases such is not practical. In those cases, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and respond as soon as possible to any emergencies. The Commission also recognizes that certain collections, because of their size and/or nature, may require different considerations in veterinary care.

AZA Accreditation Standard

(2.1.2) So that indications of disease, injury, or stress may be dealt with promptly, veterinary coverage must be available to the animal collection 24 hours a day, 7 days a week.

AZA Accreditation Standard

(1.4.6) A staff member must be designated as being responsible for the institution's animal record-keeping system. That person must be charged with establishing and maintaining the institution's animal records, as well as with keeping all animal care staff members apprised of relevant laws and regulations regarding the institution's animal collection.

AZA Accreditation Standard

(1.4.5) At least one set of the institution's historical animal records must be stored and protected. Those records should include permits, titles, declaration forms, and other pertinent information.

AZA Accreditation Standard

(1.4.7) Animal records must be kept current, and data must be logged daily.

AZA Accreditation Standard

(1.4.4) Animal records, whether in electronic or paper form, including health records, must be duplicated and stored in a separate location.

6.2 Identification Methods

Ensuring that massasaugas are identifiable through various means increases the ability to care for individuals more effectively. Animals must be identifiable and have corresponding ID numbers whenever practical, or a means for accurately maintaining animal records must be identified if individual identifications are not practical (AZA Accreditation Standard 1.4.3).

Permanent identification is essential for following the life history of individual animals, whether in the field or in managed settings. Non-invasive identification methods include paint or nail polish spots (temporary until the next skin shed or rattle breakage). With well patterned snakes such as the massasauga, recording the individual's dorsal patterns of the entire body by diagram, photo or shed skin can serve as a permanent marking technique. The pattern of each snake is an individual "fingerprint" and can be used to identify an individual throughout its life. A copy of an identification photo ("mug shot") should be placed into the individual's permanent record file for future reference.

Mildly invasive identification methods include scute clips, rattle tags, or PIT tags (passive integrated transponder) (e.g., Trovan or AVID), under the skin. The key requirements of marking techniques are that they do not affect the survival or the performance of the marked animal (i.e., the least invasive procedure is desired) and that marks not be lost over time. While scale-clipping and branding have been used to mark snakes (Fitch 1987), the injection of small glass-encapsulated microchip transponders termed Passively Integrated Transponders (PIT tags) satisfies these requirements to the greatest extent and is now standard practice.

Subcutaneous insertion involves injecting the PIT tag under the lateral scales at about the second scale row (counting up from the ventral scutes) anterior to the cloaca on the left side. Although it is physically easier to inject PIT tags anteriorly (because of the way the scales overlap), injecting posteriorly (towards the tail) is recommended because of the tendency of injected bodies to migrate posteriorly. This technique will minimize the probability of the tag being expelled through the original insertion hole.

Two people are required for this procedure. One person should carefully restrain the snake using a restraint tube. It is important to prevent movement or flexion that can cause partial tearing of the skin at the injection site. The second person will insert the PIT tag. The following protocol describes PIT tag insertion in massasaugas.

1. Raise the snake's skin at the injection site by pinching dorso-ventrally using thumb and forefinger.
2. Position the needle so that it is parallel to the long axis of the snake's body and pointed towards its tail.
3. Advance the needle between two scales until it has penetrated to 0.5 to 1 cm past the bevel of the needle.
4. While holding the injector assembly steady, push the injector plunger forward, then withdraw the needle (keeping the injector assembly stationary while the tag is injected is important because otherwise the tag will not be inserted a sufficient distance from the injection hole).
5. If the needle did not contact the underlying musculature during the insertion or pierce one of the skin vessels, then bleeding will likely be absent; however, if the site is bleeding apply pressure at the injection site with a fresh Q-tip until bleeding has stopped (Note: the increased vascularization of the skin that occurs during the approximately two-week shed cycle can substantially increase, the occurrences of, and the amount of bleeding resulting from PIT tag insertion).
6. When the injection site is dry, apply tissue adhesive to close the opening.

AZA Accreditation Standard

(1.4.3) Animals must be identifiable, whenever practical, and have corresponding ID numbers. For animals maintained in colonies or other animals not considered readily identifiable, the institution must provide a statement explaining how record keeping is maintained.

AZA Accreditation Standard

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisitions and dispositions in the animal collection.

AZA Accreditation Standard

(1.4.2) All species owned by the institution must be listed on the inventory, including those animals on loan to and from the institution. In both cases, notations should be made on the inventory.

7. Scan the tag again to confirm functionality and to verify the tag number recorded on the snake's record.
8. Ensure that the tissue adhesive applied to the injection site has fully dried before performing other procedures or releasing the snake.

Scute clipping leaves an open wound subject that is to possible infection and is therefore not recommended. For free-ranging snakes included in special field studies, a surgically implanted radio telemetry transmitter may be appropriate. This is an invasive procedure and should only be implanted in larger massasaugas (i.e., those weighing greater than 200 g), surgical anesthesia and sterile conditions. Use of surgically implanted transmitters is discussed further in Chapter 10.

AZA member institutions must inventory their massasauga population at least annually and document all massasauga acquisitions and dispositions (AZA Accreditation Standard 1.4.1). Transaction forms help document that potential recipients or providers of the animals should adhere to the AZA Code of Professional Ethics, the AZA Acquisition/Disposition Policy (see Appendix B), and all relevant AZA and member policies, procedures and guidelines. In addition, transaction forms should insist on compliance with the applicable laws and regulations of local, state, federal and international authorities. All AZA-accredited institutions must abide by the AZA Acquisition and Disposition policy (Appendix B) and the long-term welfare of animals should be considered in all acquisition and disposition decisions. All species owned by an AZA institution must be listed on the inventory, including those animals on loan to and from the institution (AZA Accreditation Standard 1.4.2).

6.3 Transfer Examination and Diagnostic Testing Recommendations

The transfer of animals between AZA-accredited institutions or certified related facilities due to AZA Animal Program recommendations occurs often as part of a concerted effort to preserve these species. These transfers should be done as altruistically as possible and the costs associated with specific examination and diagnostic testing for determining the health of these animals should be considered.

Pre-shipment health screening protocols: Individual institutions should follow their own incoming and outgoing animal testing protocols and incorporate the following specific to massasaugas. Pre-shipment health assessment should include a complete physical examination with a whole body doro-ventral radiograph, complete blood count (CBC), blood chemistry, fecal enteric bacterial culture, faecal parasitological examination (direct and float). Diagnostics for *Cryptosporidia* should be performed [acid fast staining of feces, indirect fluorescent antibody test (IFA) if available]. Ophidian paramyxovirus (OPMV) testing is required by the AZA Eastern Massasauga Rattlesnake SSP. Details are provided in section 6.4.

6.4 Quarantine

AZA institutions must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals (AZA Accreditation Standard 2.7.1). All quarantine, hospital, and isolation areas should be in compliance with AZA standards/guidelines (AZA Accreditation Standard 2.7.3; Appendix C). All quarantine procedures should be supervised by a veterinarian, formally written and available to staff working with quarantined animals (AZA Accreditation Standard 2.7.2). If a specific quarantine facility is not present, then newly acquired animals should be kept separate from the established collection to prohibit physical contact, prevent disease transmission, and avoid aerosol and drainage contamination. If the receiving institution lacks appropriate facilities for quarantine, pre-shipment quarantine at an AZA or American Association for Laboratory Animal Science (AALAS) accredited institution may be applicable. Local, state, or federal regulations that are more stringent than AZA Standards and recommendation have precedence.

AZA Accreditation Standard

(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards or guidelines adopted by the AZA.

AZA Accreditation Standard

(2.7.1) The institution must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals.

AZA Accreditation Standard

(2.7.2) Written, formal procedures for quarantine must be available and familiar to all staff working with quarantined animals.

Isolation of any new massasauga is an essential aspect of preventive medicine, whether the snake is confined for a few days or intended for long-term breeding. Strict isolation and hygiene will prevent transmission of any diseases between the new animal and others that are already established in the collection.

Quarantined massasaugas should be housed separately from established animals to reduce the possibility of cross contamination. For massasaugas intended for release, it is strongly recommended that they be kept in a separate facility from long-term specimens.

AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases (AZA Accreditation Standard 11.1.2) with all animals, including those newly acquired in quarantine. Keepers should be designated to care only for quarantined

AZA Accreditation Standard

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

animals if possible. If keepers must care for both quarantined and resident animals of the same class, they should care for the quarantined animals only after caring for the resident animals. Equipment used to feed, care for, and enrich animals in quarantine should be used only with these animals. If this is not possible, then all items must be appropriately disinfected, as designated by the veterinarian supervising quarantine before use with resident animals. Staff should wash hands thoroughly after working with these animals. Disposable gloves can also be used, but hand washing is still required.

Quarantine durations span of a minimum of 30 days (unless otherwise directed by the staff veterinarian). If additional reptiles of the same order are introduced into their corresponding quarantine areas, the minimum quarantine period must begin over again.

For any snakes that are to be long-term residents, the quarantine period should last at least 90 days. In this time period, any viral or bacterial diseases should express themselves. At least three fecal checks should be performed during the quarantine period, and parasites detected should be treated.

Animal handlers should be diligent in their hygiene practices. Hygiene considerations are important for staff safety, to avoid possible human infection (zoonoses), as well as avoiding the transmission of disease between animals. Newly quarantined animals should be cared for after established or long-term quarantine animals. A handler should either wash their hands or change latex gloves between animals. Separate cleaning and handling equipment should be used for each animal's container—if this is not possible, then equipment should be thoroughly cleaned and disinfected before use for another animal.

A 1.0% sodium hypochlorite (chlorine bleach) solution may be used to disinfect holding cage, props, and some tools. Household chlorine bleach ranges from 3–5% sodium hypochlorite and commercially available bulk solutions can be of much higher concentration (i.e., up to 12%). It is therefore vital to confirm the concentration with the manufacturer or supplier before preparing a dilute working solution. Since chlorine bleach is corrosive to metal hooks and tools, contact should be minimal or an iodine based disinfectant may be used.

During the quarantine period, specific diagnostic tests should be conducted with each animal if possible or from a representative sample of a larger population (e.g., birds in an aviary or frogs in a terrarium) (see Appendix C). A complete physical, including a dental examination if applicable, should be performed. Animals should be evaluated for ectoparasites and treated accordingly. Blood should be collected, analyzed and the sera banked in either a -70 °C (-94 °F) freezer or a frost-free -20 °C (-4 °F) freezer for retrospective evaluation. Fecal samples should be collected and analyzed for gastrointestinal parasites and the animals should be treated accordingly.

Animals should be permanently identified by their natural markings or, if necessary, marked when anesthetized or restrained (e.g., PIT tagging). Release from quarantine should be contingent upon normal results from diagnostic testing and two negative fecal tests that are spaced a minimum of two weeks apart. Medical records for each animal should be accurately maintained and easily available during the quarantine period.

Fecal Sampling for Detection of Parasites: This is done to assess the prevalence of oocysts of coccidia and eggs of helminth worms.

- Relatively fresh (up to 2 days) fecal material from massasaugas should be collected and submitted to a laboratory for direct and float examinations.
- Acid-fast stain preparations can also be prepared and examined in order to detect the presence of *Cryptosporidium* ssp.

- Fecal PCR for *C. serpentis* and *C. saurophilum* are available from clinical laboratories and provide a reliable means of detecting cryptosporidia in feces. If fresh samples cannot be submitted they can be stored frozen at -20 °C (68 °F), or in a regular freezer.

Ophidian paramyxovirus (OPMV) is a serious viral infection of snakes. No clinical OPMV infection in eastern massasauga rattlesnakes has been documented.

OPMV Symptoms:

- Inappetance
- Regurgitation
- Incoordination
- Pneumonia.

It is the respiratory system that appears to be targeted by OPMV infections and pneumonia develops from secondary bacterial infections. In other snake species (primarily viperids) the virus has been reported in both juveniles and adults but there are no reports of infection in neonates. If a snake demonstrates these clinical signs, a sample should be submitted. Please contact:

AZA EMR SSP Vet Advisor: Randy Junge at Randy.Junge@columbuszoo.org

AZA SSP Coordinator: Jeff Jundt at jjundt@dzs.org

Death is likely to occur in several days to weeks after clinical signs develop. Eastern massasauga rattlesnakes are more likely to be at risk of infection than being infective as it is assumed that they would likely die. Persistent/latent infections of OPMV have not been demonstrated in vipers. It is not expected that this species would clear an infection and become a carrier. However, when death occurs, especially with consistent OPMV clinical signs, SSP members need to be diligent about performing necropsies and submit appropriate samples (minimally lung and splenopancreas, potentially with brain) for viral isolation. If death occurs, please contact:

AZA EMR SSP Vet Advisor: Randy Junge at Randy.Junge@columbuszoo.org

AZA SSP Coordinator: Jeff Jundt at jjundt@dzs.org

Laboratory tests: Tests for presence of OPMV include:

- Serology
- Histopathology
- PCR/sequencing of a pulmonary wash

Currently, the common test for antemortem evaluation is the hemagglutination inhibition (HI) assay, which is conducted at a laboratory to detect exposure to OPMV. Although a single assay can be used to determine past exposure, it is recommended that serial assays conducted eight weeks apart are appropriate for monitoring infection status.

Conflicting views exist on the value of serology testing. Challenges exist for both measuring and interpretation. Depending on the testing procedure, false positives are common and the predictive value is probably near zero. A single point antibody titer is inconclusive about the current presence of the agent in a snake. A snake that presents a “positive titre” may not be infected.

Results vary between laboratories. From a study by Allender et al., 2008: “The results demonstrate that current HI assays are not reliable as a sole diagnostic assay in the eastern Massasauga.” In their study, matching samples from 26 wild massasaugas were submitted to three separate laboratories to measure agreement among HI assays that differ based on different OPMV strains. Laboratory 1 found positive results in half the tested samples, Laboratory 2 found no positive results in any of the tested samples, and Laboratory 3 found positive results in all the tested samples.

The presence of antibodies doesn’t mean the presence of a virus. Even if the test is a true positive, it may be due to a past infection, a measure of that animal’s baseline with that test, or to another paramyxoviral particle that is not OPMV.

OPMV can be confirmed by viral isolation, but absence of the viral bodies in the presence of consistent clinical signs and histopathology does not exclude OPMV as a diagnosis. A snake that is serologically positive for OPMV but otherwise healthy should not be euthanized, as persistent/latent infections of OPMV have not been demonstrated in this species. Institutions may choose to maintain the animals separated from their other collection animals if that increases their comfort.

Due to the differences in results for HI assays, zoos in the AZA Eastern Massasauga Rattlesnake SSP should use a single laboratory rather than zoos selecting different laboratories. This approach would

allow comparisons and could establish baselines for the population. The University of Tennessee College of Veterinary Medicine has been selected as the single laboratory recommended for use by the AZA Eastern Massasauga Rattlesnake SSP zoos.

UT College of Veterinary medicine submission forms at:

<http://www.vet.utk.edu/diagnostic/virology/index.php>

Clinical Virology Laboratory

Department of Comparative Medicine Room A239

Veterinary Teaching Hospital

2407 River Drive,

Knoxville, TN 37996-4543,

Tel: (865) 974-5643.

If a massasauga should die in quarantine, a necropsy should be performed on all it and the subsequent disposal of the body must be done in accordance with any local or federal laws (AZA Accreditation Standard 2.5.1). Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples from the body organs should be submitted for histopathological examination (see Chapter 6.7).

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

6.5 Preventive Medicine

AZA-accredited institutions should have an extensive veterinary program that must emphasize disease prevention (AZA Accreditation Standard 2.4.1). The American Association of Zoo Veterinarians (AAZV) has developed an outline of an effective preventative veterinary medicine program that should be implemented to ensure proactive veterinary care for all animals.

AZA Accreditation Standard

(2.4.1) The veterinary care program must emphasize disease prevention.

(www.aazv.org/associations/6442/files/zoo_aquarium_vet_med_guidelines.pdf).

Blood Sampling: Relatively small samples of blood are required (0.2–0.3 ml) for clinical analysis. The maximum volume that can be safely drawn from a snake is 7–10% of the total blood volume. This is roughly 1% of the snake's total weight. Blood sampling is appropriate for all age-classes (neonates to adults), but is more difficult in smaller snakes.

The site of blood collection should not affect the quality of the blood sample (Cuadrado et al., 2003). However, the possibility of lymphatic contamination is higher when using a peripheral blood collection site such as the tail. Cardiocentesis will likely provide more consistent blood sample results. It is recommended that blood sampling by cardiocentesis only be attempted while snakes are anaesthetized. Blood can also be collected via caudal vein puncture from an un-anaesthetized and restrained snake.

Blood samples should be collected and processed according to institutional standard operating procedures. If your institution does not have standard operating procedures for blood sampling, the following instruction may be helpful.

Caudal Vein Technique: Insulin syringes are appropriate for sampling blood and are widely available. Once collected, two blood smears should be prepared and the remaining sample should be transferred to a Microtainer™ blood collection vial. Details of the sampling procedure, smear preparation, and storage and shipping instructions are outlined below. Please read through the procedures before you attempt to obtain a sample.

- Pull back and forth on the syringe plunger several times to ensure smooth action.
- With an assistant holding the snake (safely restrained), clean the ventral surface of the tail with an alcohol swab.
- Elevate the snake's body vertically so as to ensure blood flow toward the tail.
- Hold the tail in one hand (with the snake's head facing away from you) and the syringe in your other hand.
- Gently insert the needle an angle of approximately 45 degrees between the ventral scutes of the tail at a location 1/2–2/3 between the cloaca and the tip of the tail. The closer to the midline of the

ventral surface of the tail that you insert the needle, the better your odds of hitting the centrally located caudal vein/artery. (Be prepared for the snake to flinch in your hand at this point).

- Continue to slowly insert the needle until you feel a slight resistance from the caudal vertebrae, withdraw the needle slightly (i.e., 0.5–2.0 mm), and then gently draw back on the syringe plunger. If you have hit the caudal vein, the syringe tip should fill with blood.
- Slowly draw back on the plunger until you secure an adequate blood sample. Do not pull back too hard on the plunger as too much vacuum pressure can cause hemolysis of the blood (depending on how the syringe is oriented in your hand, you should be able to draw back on the plunger with either your thumb or pinkie finger of the same hand, leaving your other hand free to secure the tail of the snake).
- In the event that you do not get adequate blood flow immediately, or the flow of blood stops, you may have to either move the needle in and out slightly (i.e., a few mm) or rotate the needle until blood flow resumes. Alternatively, you may have to completely withdraw the needle and try again.
- Once an adequate blood sample has been collected, withdraw the needle and apply light pressure to the point on the tail from which blood was drawn in order to stem further blood flow.
- Prepare two blood smears on clean microscope slides. Then slowly deliver the blood into the Microtainer™ by removing the needle from the syringe and gently expelling the blood. If the needle cannot be removed, gently expel the sample through the needle; do not force the blood through the needle, as this will cause hemolysis.
- Cap the tube securely and then gently invert the tube to mix the blood sample with the heparin. It is very important to ensure the blood is well mixed to prevent clotting. **Do not shake the tube.**
- Dispose of the syringe in a biohazard sharps container.
- Use a new syringe for each individual snake sampled.
- Label tubes containing blood samples with the specimen's identification number. Store labeled blood samples upright in the storage box, in a cool dark place (preferably in a refrigerator) until you can spin the blood down. **The maximum time between collection and spinning down should be no more than 24 hours.** The longer the blood cells are in contact with the plasma portion of the blood, the more the clinical results will be affected.

Blood Smears: The squash technique is used to prepare reptilian blood differential smears. This method is gentle on the delicate cells, and gives a good distribution of the cells on the slide. What is needed is an area of the slide where the cells are one cell layer thick. (If the cells are piled on top of one another, it becomes difficult to differentiate the cells accurately.) Always prepare two smears, one for reading and one for future reference.

- Place two clean glass microscope slides on a clean surface.
- After drawing a blood sample, place one small drop on each slide near the frosted end (but not touching), by allowing ONE drop from the needle tip to drop onto the slide surface. After placing the drop, place the rest of the blood gently into a Microtainer™. (Do not force the blood through the needle, as this will cause hemolysis).
- To prevent the blood drops from drying on the slide, this needs to be done quickly. If a second person can place the blood in the Microtainer™, the first person can smear the blood without delay.
- To smear the blood, gently place a clean slide on top of the drop of blood. Allow the blood to spread out a little between the slides, without pressing down at all, for a count of 1–2 seconds. You will be trying to achieve a monolayer of cells on the smear (If the slides are together too long the WBC's (white blood cells) will move to the periphery of the smear thereby affecting the count).
- Fairly quickly, but gently, slide the slides apart. Again, do not press down on the slides as you pull apart (this will crush the delicate cells).
- Repeat steps 3 and 4 for the second smear. It is important that the smears be made quickly to avoid drying and clotting of the blood drop.

- Dry the completed smears by gently waving them back and forth in the air. Do not blow on the slides.
- With a pencil or a permanent marker-pen, label the frosted end of the slides with the ID of the animal, the date and the species.

Plasma storage: To store the remaining blood, it is necessary to separate the plasma from the cellular portion of the blood by centrifuge. The blood should have been collected and carefully placed in a heparin Microtainer™. A feature of these tubes is the addition of a separating jelly which, when spun down, forms a layer between the plasma and the cells. Place the Microtainer™ in a blood centrifuge and spin it for ten minutes. Then place the Microtainer™ upright in a freezer for storage. Ensure that each sample has been clearly labeled.

As stated in the Chapter 6.4, AZA institutions must have zoonotic disease prevention procedures and training protocols established to minimize the risk of transferable diseases (AZA Accreditation Standard 11.1.2) with all animals. Keepers should be designated to care for only healthy resident animals, however if they need to care for both quarantined and resident animals of the same class, they should care for the resident animals before caring for the quarantined animals. Care should be taken to ensure that these keepers are “decontaminated” before caring for the healthy resident animals again. Equipment used to feed, care for, and enrich the healthy resident animals should only be used with those animals.

Staff should wash hands thoroughly after working with these animals. Disposable gloves can also be used, but hand washing is still required.

Animals that are taken off zoo/aquarium grounds for any purpose have the potential to be exposed to infectious agents that could spread to the rest of the institution’s healthy population. AZA-accredited institutions must have adequate protocols in place to avoid this (AZA Accreditation Standard 1.5.5).

Any massasauga that has been taken off site should be quarantined as described above if there was any potential contact with other reptiles.

Also stated in Chapter 6.4, a tuberculin testing and surveillance program must be established for animal care staff, as appropriate, to protect the health of both staff and animals (AZA Accreditation Standard 11.1.3). Depending on the disease and history of the animals, testing protocols for animals may vary from an initial quarantine test, to annual repetitions of diagnostic tests as determined by the veterinarian. To prevent specific disease transmission, vaccinations should be updated as appropriate for the species.

AZA Accreditation Standard

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

AZA Accreditation Standard

(1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.

AZA Accreditation Standard

(11.1.3) A tuberculin testing and surveillance program must be established for appropriate staff in order to ensure the health of both the employees and the animal collection.

6.6 Capture, Restraint, and Immobilization

The need for capturing, restraining and/or immobilizing an animal for normal or emergency husbandry procedures may be required. All capture equipment must be in good working order and available to authorized and trained animal care staff at all times (AZA Accreditation Standard 2.3.1).

AZA Accreditation Standard

(2.3.1) Capture equipment must be in good working order and available to authorized, trained personnel at all times.

All snakes are capable of biting and will need to be restrained by an experienced assistant in order to ensure both animal and human health, safety, and welfare. Working with venomous species requires advanced skills and experience and should only be undertaken by qualified persons. The following are some general principles to consider when handling a venomous snake. Never reach into an occupied enclosure even if you “know” the snake is not in a position to bite. Use utensils to manipulate/remove objects out of cages or move the snake to a shift box/container if necessary. Under no circumstances should a snake be handled by the tail or grabbed behind the head. Snake hooks, squeeze boxes, shifts and tubes are to be used for all hands on procedures. Never work venomous reptiles unless you are alert and 100% focused. Do not work venomous reptiles if you are feeling ill, mentally preoccupied, or under the influence of prescription or non-prescription substances that can impair judgment, vision or mobility.

The following protocols describe the specific restraint handling techniques recommended for massasaugas.

Tubing: When it is necessary to restrain a snake for hands-on procedures such as blood collection or sexing, it is recommended that the snake be restrained using a clear plastic or acrylic tube. The snake is directed into the tube using a snake hook. This can be done on a worktable, on the floor, in a bucket or directly from a snake bag. With small snakes, the tube can be held by hand, but with larger snakes the tube should be held with tongs.

Once approximately one-third of the snake has entered the tube, the tube and snake are grasped together with the same hand and held firmly so that the snake cannot proceed further into the tube or back out of the tube. By tilting the tube vertically, slight pressure can be put on the snake against the tube and working surface to restrain the snake. One should be careful not to put too much pressure or the snake may be injured or it will react and fight back by thrashing. Both the snake and the tube are grasped securely to prevent the snake from moving in the tube. See Figures 11–13.



Figure 11. Coaxing into a tube with a snake hook.
Photo courtesy of K. Ardill



Figure 12. Guiding the snake into the tube.
Photo courtesy of K. Ardill



Figure 13. Grasping the snake to ensure it remains in the tube.
Photo courtesy of K. Ardill

The tube should be approximately 24 in. long and the diameter should be wide enough to accommodate the thickest part of the snake, but not too wide or the snake will be able to turn around in the tube and make its way back to the hand of the person holding it. Once the snake is in the tube, the back end is available for a variety of procedures (e.g., sexing, blood samples, ultrasound, injections, etc.).

By manipulating the size and length of tubes used, the front end can also be accessed safely for a variety of procedures (e.g., endotracheal intubation, force feeding, eye-cap removal, etc.). Slots can also be cut into the sides of the tube to grant access to various sections of the snake.

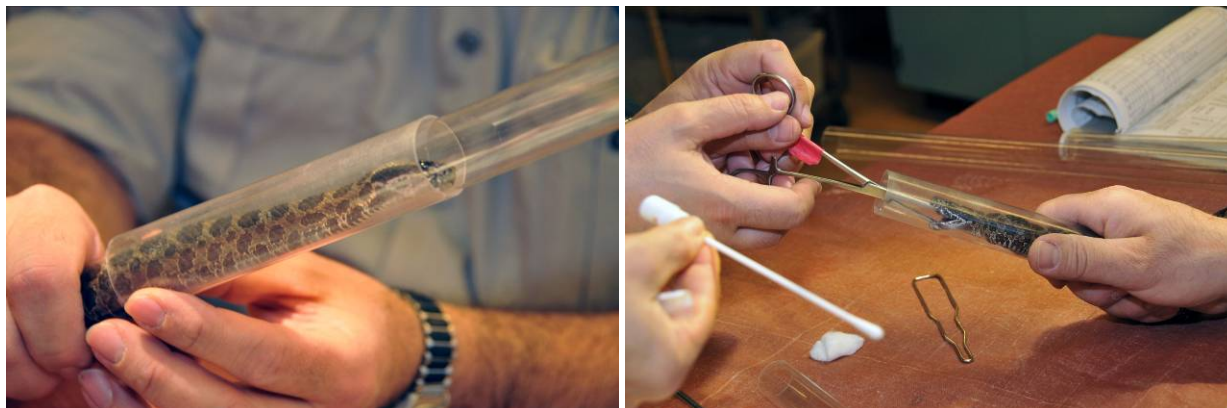


Figure 14. Using the tube to safely perform medical procedures on a massasauga.
Photos courtesy of K. Ardill

Pinning: Safely restraining rattlesnakes by pinning requires a high level of training and experience. This technique is potentially dangerous and is not recommended.

Squeeze cage: A specially constructed squeeze cage can be used to restrain venomous snakes for safe handling. Squeeze cages can be incorporated into the enclosure design and serve as a shift area. Snakes can also be hooked and placed into an open squeeze cage. A screen lid can be lowered onto the snake thus restraining it safely for a variety of procedures.

A restraint box of plywood construction with a lockable Plexiglas® front that slides open is shown in Figure 15. The top is welded half-inch mesh in a wooden frame. The mesh top frame, supported by threaded rods that are secured to handles, can be lowered along tracks in the sides of the box, onto the snake and acts as a restraint squeeze. Wing nuts on the rods can be tightened to prevent the snake from

moving the mesh top. By placing the box on its side and with the Plexiglas front opened, the snake can be safely hooked into the restraint box. Once the sliding Plexiglas lid is closed and locked, the snake is safely contained. By lowering the mesh top, the snake is gently “squeezed” at the bottom. Minor procedures, such as injections, can be performed safely through the mesh.



Figure 15. A squeeze cage used for humanely restraining the movements of a venomous snake. Photos courtesy of K. Ardill

Anesthesia: Snakes can be captured and manually restrained using a clear acetate tube for anesthetic administration. Gas anesthesia is commonly used. With the snake in a restraint tube, a mask or tube can be affixed and 5% isoflurane (with or without nitrous oxide) can be administered until anesthesia is induced.

Alternatively, propofol (Diprivan[®], AstraZeneca; 1.5 mg) can be injected into the caudal vein (ventral coccygeal vein) for induction of anesthesia. Induction using this method is rapid (approximately 1 minute).

Snakes can be intubated using a catheter (Abbocath[®] T; 16 gauge or 18-gauge depending on size of snake) as an endotracheal tube and maintained on inhalant anesthetic (1–2%). Intubation allows for more control and for ventilation if breathing is interrupted. Snakes should be ventilated approximately four times per minute. The heart rate of the snake should be monitored during procedures using a Doppler blood flow monitor. A heating pad can be used to maintain the animal’s body temperature within desired limits.



Figure 16. An intubated snake. Photo courtesy of D. McLelland

6.7 Management of Diseases, Disorders, Injuries and/or Isolation

AZA-accredited institutions should have an extensive veterinary program that manages animal diseases, disorders, or injuries and has the ability to isolate these animals in a hospital setting for treatment if necessary. Massasauga keepers should be trained for meeting the animal’s dietary, husbandry, and enrichment needs, as well as in restraint techniques, and recognizing behavioral

indicators animals may display if their health becomes compromised (AZA Accreditation Standard 2.4.2). Protocols should be established for reporting these observations to the veterinary department. Massasauga hospital facilities should have x-ray equipment or access to x-ray services (AZA Accreditation Standard 2.3.2), contain appropriate equipment and supplies on hand for treatment of diseases, disorders or injuries, and have staff available that are trained to address health issues, manage short and long term medical treatments and control for zoonotic disease transmission.

Reptiles are generally very good at masking illness. Lack of appetite, weight loss, abnormal posture, and gaping are among the subtle signs that may indicate illness.

Mycobacteriosis (Tuberculosis): Mycobacteriosis has caused the death of several massasaugas in zoos and aquariums. The *Mycobacterium* species involved has not been identified in most of these cases. Control of the disease is limited by the ubiquitous nature of the organism, and by the lack of knowledge of its transmission and pathogenesis in reptiles. There are many things that need to be learned about mycobacteriosis in wild and zoo-kept reptiles. The clinical picture of mycobacteriosis is of an animal demonstrating poor appetite and progressive weight loss. Death occurs after months of progressive loss of general condition. Diagnosis in the living animal is difficult. Gross postmortem lesions are usually limited to abscesses in a variety of internal organs, with recognition of the bacteria in acid-fast stain preparations of abscess smears, and in histological sections of affected tissues.

Cryptosporidiosis: Cryptosporidiosis is an insidious parasitic disease of snakes, and occasionally of lizards and turtles. *Cryptosporidium serpentis* is a small protozoan parasite (coccidian), which inhabits the surface of the gastro-intestinal (GI) tract, causing massive thickening of the wall of the stomach in snakes. Clinical signs include regurgitation, weight loss, and palpable swelling in the midbody. Some snakes may show little or no sign of disease, but may shed the organisms during periods of stress. In other cases, snakes may show signs for many months before death, and persistently shed *Cryptosporidium* in the feces. Infected massasaugas have been severely affected. *Cryptosporidium* is highly resistant to drugs and chemicals, and there is no definitive cure for the disease. Control in the zoo environment depends on adequate screening of new animals during quarantine, using special staining techniques on weekly faecal samples. An animal which is positive should not be introduced to an established group. Cryptosporidiosis has been recognized in a road kill massasauga.

Coccidiosis: Coccidians are common protozoan parasites of wild lizards and snakes, which undergo development in the lining of the GI tract. Some species have a direct life cycle: infective sporulated oocysts are ingested during feeding. Other species, including *Sarcocystis*, have an indirect life cycle involving both sexual development in the intestine of the reptile and asexual stages in a prey species. Cysts in the muscle of the prey are released upon digestion.

Coccidian infections usually cause no clinical signs, except for the presence of oocysts in faeces. However, a very heavy infection may produce weight loss, enteritis, anaemia, and death. At this time, there are no drugs effective at reducing the excretion of oocysts. Many wild caught massasaugas have been excreting coccidian oocysts, identified as *Sarcocystis* and *Caryospora*—further development of the organism takes place in meadow voles. The snakes appear to be unaffected by the infection. Ponazuril (toltrazuril sulfone) has been used to treat massasauga with coccidiosis at a dose of 25 mg/kg PO once a week for 3 weeks.

Stress: Disturbance, handling, and translocations can produce degrees of stress. Long-term stress can be more insidious, and can have a detrimental effect on the functioning of the immune system. As in other reptiles, many aspects of massasauga metabolism, including immune function, are controlled by external influences. Whether in the wild or in managed settings, confinement, handling, environmental, social, and nutritional stresses can affect the snake's ability to fend off infections and parasites.

Mites: Several species of mites have been reported to infest snakes, but *Ophionyssus natricis* is the most common. Heavy infestations of mites can compromise snakes, and can potentially transmit disease.

AZA Accreditation Standard

(2.4.2) Keepers should be trained to recognize abnormal behavior and clinical symptoms of illness and have knowledge of the diets, husbandry (including enrichment items and strategies), and restraint procedures required for the animals under their care. However, keepers should not evaluate illnesses nor prescribe treatment.

AZA Accreditation Standard

(2.3.2) Hospital facilities should have x-ray equipment or have access to x-ray services.

Because mites can live for extended periods off of the host, it is essential to clean and disinfect the environment while treating the animal. There are several approaches commonly used in snakes for mite infestations. Soaking in untreated water will kill many mites, and may be adequate in minor infestations; however this method may not clear mites on the face. Dilute pyrethrin products are also recommended and effective in many snake species. Be aware of the concentration of pyrethrin—products marketed for reptiles are typically 0.03%, while products marketed for dogs and cats may be 0.18% and may be toxic. The pyrethrin spray should be applied to a cloth and rubbed over the snake (not applied directly), and then the snake rinsed to reduce transcutaneous absorption. Ivermectin, either topically or by injection, has also been recommended for snakes. However, care should be taken with ivermectin due to difficulty accurately administering very small doses. There is no information on any of these products specifically for massasaugas but all should be effective. Care should be taken with this species due to the small body size, which may increase potential for toxicity. The clinical experience and preferences of the attending veterinarian should guide any treatment.

Entamoeba: *Entamoeba invadens* is a protozoal parasite of reptiles. While this organism may be commensal in chelonians, it may cause fatal disease in snakes. The parasite invades the intestinal tract and may spread to internal organs and cause high mortality. The parasite has a direct life cycle so may spread easily in a collection. Because turtles and tortoises may harbor this parasite without clinical disease, mixed species exhibits of chelonians and snakes may result in amoebiasis and mortality in snakes.

Haemoparasites: Haemoprotozoa occur frequently in reptiles. These represent parasites of various genera, including *Plasmodium*, *Haemoproteus*, *Haemogregarina*, *Hepatozoon*, *Shellackia*, *Lainsonia* and *Trypanosoma*. Although haemoparasites are generally considered as non-pathogenic some genera may cause clinical disease or even death when the animal harbors a significant level of parasitaemia. Blood parasites of clinical significance may also predispose the hosts to other diseases. In a study of haemoprotozoa in massasauga rattlesnake, only two massasauga rattlesnakes were found positive among the 54 sampled, which can be calculated as a prevalence of 3.7% (Savary, 2001).

AZA-accredited institutions must have a clear process for identifying and addressing massasauga animal welfare concerns within the institution (AZA Accreditation Standard 1.5.8) and should have an established Institutional Animal Welfare Committee. This process should identify the protocols needed for animal care staff members to communicate animal welfare questions or concerns to their supervisors, their Institutional Animal Welfare Committee or if necessary, the AZA Animal Welfare Committee. Protocols should be in place to document the training of staff about animal welfare issues, identification of any animal welfare issues, coordination and implementation of appropriate responses to these issues, evaluation (and adjustment of these responses if necessary) of the outcome of these responses, and the dissemination of the knowledge gained from these issues. Individual institutions should follow their own animal welfare policies.

AZA Accreditation Standard

(1.5.8) The institution must develop a clear process for identifying and addressing animal welfare concerns within the institution.

AZA-accredited zoos and aquariums provide superior daily care and husbandry routines, high quality diets, and regular veterinary care, to support massasauga longevity. In the occurrence of death however, information obtained from necropsies is added to a database of information that assists researchers and veterinarians in zoos and aquariums to enhance the lives of massasauga both in their care and in the wild. As stated in Chapter 6.4, necropsies should be conducted on deceased massasauga to determine their cause of death, and the subsequent disposal of the body must be done in accordance with local, state, or federal laws (AZA Accreditation Standard 2.5.1). Necropsies should include a detailed external and internal gross morphological examination and representative tissue samples from the body organs should be submitted for histopathological examination. Many institutions utilize private labs, partner with Universities or have their own in-house pathology department to analyze these samples. The AZA and American Association of Zoo Veterinarians (AAZV) website should be checked for any AZA massasauga SSP Program approved active research requests that could be filled from a necropsy.

AZA Accreditation Standard

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

Snakes can be humanely euthanized by injecting sodium pentobarbital (60–100 mg/kg intravenously or intracoelomically). Snakes should be safely restrained before any injection is administered.

Dead rattlesnakes still pose a snakebite threat. In a study of reported snakebites at Good Samaritan Regional Medical Center in Phoenix, 14.7% of cases were bitten by snakes that had been fatally injured and were presumed to be dead (Suchard & LoVecchio, 1999). It is therefore recommended that dead rattlesnakes be handled with caution.

Any massasauga that is found dead should be submitted for a thorough post-mortem examination. Information gleaned from the examination will add to the database of disease incidence and the level of susceptibility of massasaugas. Snakes should be placed in a clearly labeled plastic bag and refrigerated until the necropsy can be performed. If a necropsy cannot be performed within 48 hours of death, the carcass should be preserved chemically. This can be done by opening the coelomic cavity fully submerged the carcass in 10% formalin or 70% ethanol. Freezing is the least desirable method of preservation since freezing damages cell and makes histopathology less rewarding.

A protocol for necropsy of wildlife species from The Wildlife Health Center School of Veterinary Medicine at UC Davis is available at: <http://www.vetmed.ucdavis.edu/whc/pdfs/necropsy.pdf>

Chapter 7. Reproduction

7.1 Reproductive Physiology and Behavior

It is important to have a comprehensive understanding of the reproductive physiology and behaviors of the animals in our care. This knowledge facilitates all aspects of reproduction, artificial insemination, birthing, rearing, and even contraception efforts that AZA-accredited zoos and aquariums strive to achieve.

Sexing: A non-invasive method of sexing massasauga involves counting subcaudal scales since the sexes are dimorphic. Females have 22–25 subcaudal scales and males have 27–30. This can be done while the snake is restrained, or by placing a snake in a clear bottomed box and photographing the ventral surface of the snake. Digital photographs can be enlarged to facilitate scale counting.

Probing the hemipenal space with special probes can also be done on larger specimens; Fowler described this technique in (1995). A probe is gently passed into the hemipenal sac. In males the probe will reach the 7th to 15th subcaudal scale, whereas in female it will only reach the 3rd to 5th subcaudal scale. The probe selected should be the largest that will likely fit into the hemipenal space. This ensures that a sufficiently small probe does not penetrate into the hemipenial homologs of a female. The probe should be lubricated and gently guided into the hemipenal space and never forced or this could cause damage to the tissues in this area.

Reproductive behavior: Massasaugas reproduce biennially and in the northern parts of the range possibly every three years. This species typically has a late summer breeding season, sperm storage has been documented and it is likely that ovulation occurs shortly before hibernation or immediately following spring emergence. A gestation period of 65–70 days has been reported, and a litter of 6–18 young are born in late summer. Reproduction in zoos follows a similar pattern.

Replicating seasonal temperature and photoperiod changes in the *ex situ* environment may be beneficial to induce breeding and reproduction. As mentioned earlier, seasonality can be reproduced by combining a shortened day length during fall and winter months with a corresponding decrease in ambient temperature. A spring and summer ambient temperature gradient of 22–32 °C (71–90 °F) should be maintained, with a specific hot spot of 30–34 °C (86–93 °F); during winter months the ambient temperature gradient should be decreased to 18–22 °C (64–71 °F) but a basking spot should still be available. Temperatures can be further lowered in order to simulate hibernation/brumation (see Chapter 1, section 1.1). Under these conditions, breeding in zoos and aquariums occurs in late summer (August and September), and parturition takes place in late winter and early spring (February and March).

Characteristic of massasauga breeding behavior is the ritualized combat between two males. Males face each other and lift the first thirds of their body vertically and they attempt to push each other down in order to pin the head and body of the opponent to the ground. These disputes end with the strongest or biggest snake mating the female. Male combat during breeding attempts may be beneficial since it stimulates both males and females.

For snakes housed as a group, breeding may take place spontaneously during late summer and early fall (just as temperature and day lengths are decreasing). For animals not housed together throughout the year, introduce the female destined for breeding to a male's enclosure during late summer or early fall to allow potential breeding. Breeding behavior should start within hours of the introduction.

If no breeding is seen within 24 hours, an additional male can be introduced. Combat behavior between the males should start right away. The males should be allowed to combat for 20–30 minutes before interrupting the combat and removing the non-breeding male. If the snakes are allowed to combat until a victor is evident, there is the chance that the intended breeding male may lose the combat and will be inhibited from breeding.

7.2 Assisted Reproductive Technology

The practical use of artificial insemination (AI) with animals was developed during the early 1900s to replicate desirable livestock characteristics to more progeny. Over the last decade or so, AZA-accredited zoos and aquariums have begun using AI processes more often with many of the animals residing in their care. AZA Studbooks are designed to help manage animal populations by providing detailed genetic and demographic analyses to promote genetic diversity with breeding pair decisions within and between our institutions. While these decisions are based upon sound biological reasoning, the efforts needed to

ensure that transports and introductions are done properly to facilitate breeding between the animals are often quite complex, exhaustive, and expensive, and conception is not guaranteed.

AI has become an increasingly popular technology that is being used to meet the needs identified in the AZA Studbooks without having to re-locate animals. Males are trained to voluntarily produce semen samples and females are being trained for voluntary insemination and pregnancy monitoring procedures such as blood and urine hormone measurements and ultrasound evaluations. Techniques used to preserve and freeze semen have been achieved with a variety, but not all, massasauga and should be investigated further.

AI has not been attempted in massasauga rattlesnakes. AI has been performed in other snake species, including another species of rattlesnake (Langlada et al., 1994). That method involved euthanizing the males to obtain sperm that was then diluted and introduced into the uterus via the vaginal opening in the cloaca. Sperm has been collected from snakes by electroejaculation (Quinn et al., 1989) and by using a gentle massage technique (Mattson et al., 2007).

7.3 Pregnancy and Birth

It is extremely important to understand the physiological and behavioral changes that occur throughout an animal's pregnancy. Massasaugas are ovoviviparous, with the young delivered live after hatching from internal membranous eggs. Six to twenty young, approximately 20 cm long, are born. Gravid females typically spend more time thermoregulating in order to elevate their body temperature to facilitate gestation. In the wild gravid females select more open terrain where temperatures are higher.

After a successful breeding, a female may begin to act or look gravid, that is, she spends more time exposed and thermoregulating in tight, circular coils with the head resting flat on the uppermost coil of the body. Females will also begin to increase in girth, becoming quite plump. If a keeper suspects a female is gravid, that snake should be maintained in an enclosure with access to adequate heat. Gravid females may stop feeding late in gestation, however food should be offered on the regular feeding schedule since gravid females may continue to feed up to two weeks before giving birth.

There is no need to remove a gravid female from an exhibit even if housed with other snakes. There are no reports of conspecific aggression or predation in this species.

7.4 Birthing Facilities

As parturition approaches, animal care staff should ensure that the mother is comfortable in the area where the birth will take place, and that this area is "baby-proofed." Massasaugas are livebearers, therefore enclosures should not have any gaps or holes over 3 mm (1/8 in.) that could serve as escape routes for neonates. Gravid females should be provided with a secure sheltered place to give birth with natural substrate such as moss or mulch. This can be done on exhibit or in a holding area.

The young are born encased in the membranous eggs and will break free of the membrane within minutes of parturition. In order to prevent the egg membrane from drying out and trapping the neonates, the enclosure should have adequate humidity and the substrate should remain damp. If they neonates appear to have difficulty emerging from the egg membrane, it may be necessary to gently open the membrane to free the neonate. This can be done by grasping part of the membrane using long (45–61 cm [18–24 in.]) hemostats and manipulating the membrane to cause a small tear.

Massasauga females are not known to provide any maternal care, however it has been observed that in the wild mother and young remain at the site of birth for several days. In managed settings neonates can be separated from the mother 24–48 hours after birth. If the female was separated from a group or taken off exhibit during gestation, she can be returned at this time. Approximately one week after birth, the young snakes shed their skin for the first time and should be offered food (one very small "pinkie" mouse) at this time.

7.5 Assisted Rearing

Although mothers may successfully give birth, there are times when they are not able to properly care for their offspring, both in the wild and in *ex-situ* populations. Fortunately, animal care staff in AZA-accredited institutions are able to assist with the rearing of these offspring if necessary.

Massasauga rattlesnakes are generally hardy babies and feed well soon after birth, usually within 7–10 days. Occasionally a neonate may not accept food and force-feeding may be necessary. This can be done with the snake in a tube (as described in Chapter 6).

7.6 Contraception

Many animals cared for in AZA-accredited institutions breed so successfully that contraception techniques are implemented to ensure that the population remains at a healthy size. There are no recommended oral or injectable contraceptives for this species. In order to prevent reproduction, sexes should be maintained separated from each other.

Chapter 8. Behavior Management

8.1 Animal Training

Classical and operant conditioning techniques have been used to train animals for over a century. Classical conditioning is a form of associative learning demonstrated by Ivan Pavlov. Classical conditioning involves the presentation of a neutral stimulus that will be conditioned (CS) along with an unconditioned stimulus (US) that evokes an innate, often reflexive, response. If the CS and the US are repeatedly paired, eventually the two stimuli become associated and the animal will begin to produce a conditioned behavioral response to the CS.

Operant conditioning uses the consequences of a behavior to modify the occurrence and form of that behavior. Reinforcement and punishment are the core tools of operant conditioning. Positive reinforcement occurs when a behavior is followed by a favorable stimulus to increase the frequency of that behavior. Negative reinforcement occurs when a behavior is followed by the removal of an aversive stimulus to also increase the frequency of that behavior. Positive punishment occurs when a behavior is followed by an aversive stimulus to decrease the frequency of that behavior. Negative punishment occurs when a behavior is followed by the removal of a favorable stimulus also to decrease the frequency of that behavior.

AZA-accredited institutions are expected to utilize reinforcing conditioning techniques to facilitate husbandry procedures and behavioral research investigations.

Training has not been reported in this species; however, other species of reptiles have been successfully trained. One zoo has developed programs which utilize operant conditioning instead to manage their collections, specifically with groups of 2.6 American Alligators (*Alligator mississippiensis*), 0.0.3 Fresh Water Crocodiles (*Crocodylus johnstoni*), 1.0 coastal taipan (*Oxyuranus scutellatus*), 2.0 Collett's snakes (*Pseudechis colletti*) and 2.0 cape cobras (*Naja nivea*). Using scent trails, sound cues from attaching the shift box and positive reinforcement, three species of large elapids went through training to shift into a separate feed box that could be connected to the exhibit. 1.0 coastal taipan (*Oxyuranus scutellatus*), 2.0 Collett's snakes (*Pseudechis colletti*) and 2.0 cape cobras (*Naja nivea*) all were encouraged to shift. Though keepers continued to routinely handle the animals on hooks for safety purposes, this method would allow for some management without handling the animals. Within five training sessions the coastal taipan shifted consistently on and off exhibit, with training sessions being done weekly. Though results were mixed with the rest of the group, successful shifting was achieved in many cases. These behaviors can be extremely beneficial when working with potentially dangerous animals.

8.2 Environmental Enrichment

Environmental enrichment, also called behavioral enrichment, refers to the practice of providing a variety of stimuli to the animal's environment, or changing the environment itself to increase physical activity, stimulate cognition, and promote natural behaviors. Stimuli, including natural and artificial objects, scents, and sounds are presented in a safe way for the massasauga to interact with. Some suggestions include providing food in a variety of ways (i.e., frozen in ice or in a manner that requires an animal to solve simple puzzles to obtain it), using the presence or scent/sounds of other animals of the same or different species, and incorporating an animal training (husbandry or behavioral research) regime in the daily schedule.

Enrichment programs for massasauga should take into account the natural history of the species, individual needs of the animals, and facility constraints. The massasauga enrichment plan should include the following elements: goal setting, planning and approval process, implementation, documentation/record-keeping, evaluation, and subsequent program refinement. The massasauga enrichment program should ensure that all environmental enrichment devices (EEDs) are "massasauga" safe and are presented on a variable schedule to prevent habituation AZA-accredited institutions must have a formal written enrichment

AZA Accreditation Standard

(1.6.1) The institution must have a formal written enrichment program that promotes species-appropriate behavioral opportunities.

AZA Accreditation Standard

(1.6.2) The institution must have a specific staff member(s) or committee assigned for enrichment program oversight, implementation, training, and interdepartmental coordination of enrichment efforts.

program that promotes massasauga-appropriate behavioral opportunities (AZA Accreditation Standard 1.6.1).

Massasauga enrichment programs should be integrated with veterinary care, nutrition, and animal training programs to maximize the effectiveness and quality of animal care provided. AZA-accredited institutions must have specific staff members assigned to oversee, implement, train, and coordinate interdepartmental enrichment programs (AZA Accreditation Standard 1.6.2).

There are many interesting possibilities for snake enrichment especially with respect to their extreme sensitivity to chemical information (Greene, 1997). Because snakes rely heavily on olfaction, odors can often provide an excellent avenue for enrichment. How the animal perceives its environment is an important factor in providing appropriate and stimulating enrichment. Reactions can include no response, increased activity, or rapid tongue flicking for extended periods. Tongue flicking has been used as a metric for gauging interest. (Burghardt, 1968)

Common enrichment practices for reptiles include altering exhibit furniture, adding different hide boxes, toilet paper, or PVC tubes. These can provide great stimulus, but special precautions should be taken in order to ensure safe access to venomous animals. Natural items such as leaves, assorted substrates, branches, and rocks can also increase the variability of the exhibit design. These items should be properly disinfected before being introduced to a new exhibit.

Zoo staff members have observed rapid tongue flicking by eastern massasauga rattlesnakes after the addition of perfumes and spices to the exhibit. While considering that enrichment items can also be potential vectors for parasite and disease transmission, especially with related massasauga such as other reptiles or even birds, items that have been used by other animals can make excellent enrichment. Feathers and bird nests have also elicited strong reactions, including increased locomotion (e.g., encircling the item) and tongue flicking. Items that have been in contact with small mammals can also be stimulating. Hide tubes and boxes from these animals can induce rapid tongue flicking. Shed skins from conspecifics or other snakes can also provide stimulus.

Another possibility for providing enrichment appropriate for pit vipers can include the utilization of items that alter local temperatures without compromising the recommended ambient and basking temperatures. Additional basking areas may also increase exhibit exploration. Enrichment techniques that may further enhance the thermal environment for snakes may be possible using novel tools such as ice cubes or heat packs.

8.3 Staff and Animal Interactions

Animal training and environmental enrichment protocols and techniques should be based on interactions that promote safety for all involved. As a venomous species, all interactions with massasauga should utilize appropriate safety equipment. No unprotected contact is permitted.

8.4 Staff Skills and Training

Massasauga staff members should be trained in all areas of massasauga behavior management. Funding should be provided for AZA continuing education courses, related meetings, conference participation, and other professional opportunities. A reference library appropriate to the size and complexity of the institution should be available to all staff and volunteers to provide them with accurate information on the behavioral needs of the animals with which they work.

Working with venomous species requires advanced skills and experience. Most institutions will have their own training program and standard operating procedures for working with venomous reptiles. The AAZK conducted a Venomous Animal Safety and Husbandry Workshop in 2008 that included instruction on taxonomy, phylogeny, zoogeography, toxicology, facility design, handling methods, species-specific husbandry, operant conditioning, regulation and transportation, nutrition health care, quarantine, crisis management protocols and staff training. The AZA Snake TAG is currently discussing the development of a similar course for keeper training. Another resource that may be helpful is the SSAR's publication *Venomous Snakes: A Safety Guide for Reptile Keepers* by William Altimari (1998).

Chapter 9. Program Animals

9.1 Program Animal Policy

AZA recognizes many public education and, ultimately, conservation benefits from program animal presentations. AZA's Conservation Education Committee's Program Animal Position Statement (Appendix D) summarizes the value of program animal presentations.

For the purpose of this policy, a program animal is described as an animal presented either within or outside of its normal exhibit or holding area that is intended to have regular proximity to or physical contact with trainers, handlers, the public, or will be part of an ongoing conservation education/outreach program.

Program animal presentations bring a host of responsibilities, including the welfare of the animals involved, the safety of the animal handler and public, and accountability for the take-home, educational messages received by the audience. Therefore, AZA requires all accredited institutions that give program animal presentations to develop an institutional program animal policy that clearly identifies and justifies those species and individuals approved as program animals and details their long-term management plan and educational program objectives.

AZA's accreditation standards require that the conditions and treatment of animals in education programs must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, sound and environmental enrichment, access to veterinary care, nutrition, and other related standards (AZA Accreditation Standard 1.5.4). In addition, providing program animals with options to choose among a variety of conditions within their environment is essential to ensuring effective care, welfare, and management. Some of these requirements can be met outside of the primary exhibit enclosure while the animal is involved in a program or is being transported. For example, housing may be reduced in size compared to a primary enclosure as long as the animal's physical and psychological needs are being met during the program; upon return to the facility the animal should be returned to its species-appropriate housing as described above. The following conditions apply for massasauga used as program animals:

AZA Accreditation Standard

(1.5.4) A written policy on the use of live animals in programs should be on file. Animals in education programs must be maintained and cared for by trained staff, and housing conditions must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, social and environmental enrichment, access to veterinary care, nutrition, etc. Since some of these requirements can be met outside of the primary enclosure, for example, enclosures may be reduced in size provided that the animal's physical and psychological needs are being met.

Security: The snake should not be left unattended in a public access area at any time. When used for outreach, the snake should be kept in a warm (24–32 °C [75–89 °F]) and in a secure area (e.g., in a locked room and/or container with controlled access).

Housing: The snake should be housed in a locked and secure holding. The locked transport box is appropriate for short-term housing. The snake can be moved to another secure container when food and/or water are offered and for cleaning.

The snake should be permanently housed in an area with a temperature range of 24–32 °C (75–89 °F). Minor variations in temperature are acceptable; however a specific hot spot (30–34 °C [86–93 °F]) should always be available. The snake should not be exposed to temperatures below 16 °C (60 °F) or above 35 °C (95 °F) even for short periods of time.

The rattlesnake is under permanent quarantine. In order to prevent any possible exposure to disease the snake should not be exposed to any other snakes or any holding areas, tools, bowls, hooks, etc. that have been used for other snakes.

Transport: The snake is to be transported in a locked and insulated box and labeled as a venomous snake. An insulated transport box should be used at all times to ensure the snake is kept at a temperature of 20–25 °C (68–77 °F) during transport. Handling equipment (e.g., hooks, tongs) should accompany the snake at all times.

Husbandry and Feeding: Fresh clean water should be available at all times, except when the snake is being transported or used in outreach programs. Do not leave a water bowl or other heavy objects in with the snake when transporting it.

Snakes are not to be fed except in the case of long-term outings (i.e., more than two weeks). If feeding is required, the snake should be given the same food as it would receive at its home institution. Do not feed any food items originating from the wild.

A record of daily occurrences and husbandry is to be kept and returned with the snake at the end of the outing. This will provide details of temperature, feeding, use for outreach, etc. Any significant events or signs of illness are to be reported immediately to the appropriate animal care staff.

9.2 Institutional Program Animal Plans

AZA's policy on the presentation of animals is as follows: AZA is dedicated to excellence in animal care and welfare, conservation, education, research, and the presentation of animals in ways that inspire respect for wildlife and nature. AZA's position is that animals should always be presented in adherence to the following core principles:

- Animal and human health, safety, and welfare are never compromised.
- Education and a meaningful conservation message are integral components of the presentation.
- The individual animals involved are consistently maintained in a manner that meets their social, physical, behavioral, and nutritional needs.

AZA-accredited institutions that have designated program animals are required to develop their own Institutional Program Animal Policy that articulates and evaluates the program benefits (see Appendix E for recommendations). Program animals should be consistently maintained in a manner that meets their social, physical, behavioral, and nutritional needs. Education and conservation messaging must be an integral component of any program animal demonstration (AZA Accreditation Standard 1.5.3).

The AZA Massasauga SSP Education Advisor should be consulted when developing messaging for outreach programs. Key messages include:

- Living with wildlife
- Safety
- Respect

Animal care and education staff should be trained in program animal-specific handling protocols, conservation, and education messaging techniques, and public interaction procedures. These staff members should be competent in recognizing stress or discomfort behaviors exhibited by the program animals and be able to address any safety issues that arise.

Program animals that are taken off zoo or aquarium grounds for any purpose have the potential to be exposed to infectious agents that could spread to the rest of the institution's healthy population. AZA-accredited institutions must have adequate protocols in place to avoid this (AZA Accreditation Standard 1.5.5).

Following any approved contact with a program snake, visitors should use a hand sanitizer product, and are encouraged to also wash their hands with soap and water.

Careful consideration must be given to the design and size of all program animal enclosures, including exhibit, off-exhibit holding, hospital, quarantine, and isolation areas, such that the physical, social, behavioral, and psychological needs of the species are met and species-appropriate behaviors are facilitated (AZA Accreditation Standard 10.3.3; AZA Accreditation Standard 1.5.2).

Similar consideration needs to be given to the means in which an animal will be transported both within the Institution's grounds, and to/from an off-grounds program. Animal transportation must

AZA Accreditation Standard

(1.5.3) If animal demonstrations are a part of the institution's programs, an education and conservation message must be an integral component.

AZA Accreditation Standard

(1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.

AZA Accreditation Standard

(10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; exhibit enclosures must include provisions for the behavioral enrichment of the animals.

AZA Accreditation Standard

(1.5.2) Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.

be conducted in a manner that is lawful, safe, well planned, and coordinated, and minimizes risk to the animal(s), employees, and general public (AZA Accreditation Standard 1.5.11).

Massasaugas used for programs are to be transported in clearly labeled and secure containers. Containers should be ventilated, and if exposed to temperature extremes (e.g., direct sun or winter use) they should be insulated. Ventilation holes should be small enough (or covered with fine mesh) to prevent the snake from biting through the hole and to prevent the escape of any newborn snakes.

Never transport a snake in a container with unsecured heavy objects (e.g., water dish, rocks, perching, etc.) that may shift during transport and injure the snake. Massasaugas used for programs should be housed, cared for and maintained as described in chapters 1, 2 and 3 of this document.

AZA Accreditation Standard

(1.5.11) Animal transportation must be conducted in a manner that is safe, well planned, and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to. Planning and coordination for animal transport requires good communication among all involved parties, plans for a variety of emergencies and contingencies that may arise, and timely execution of the transport. At no time should the animal(s) or people be subjected to unnecessary risk or danger

9.3 Program Evaluation

AZA-accredited institutions which have Institutional Program Animal Plan are required to evaluate the efficacy of the plan routinely (see Appendix E for recommendations). Education and conservation messaging content retention, animal health and well-being, guest responses, policy effectiveness, and accountability and ramifications of policy violations should be assessed and revised as needed.

Education and outreach programs should be reviewed and evaluated as per individual institution's own methodologies. Pre- and post-program surveys or questionnaires are helpful and easy to administer. These can be implemented periodically or following any changes to programs.

Chapter 10. Research

10.1 Known Methodologies

AZA believes that contemporary massasauga management, husbandry, veterinary care and conservation practices should be based in science, and that a commitment to scientific research, both basic and applied, is a trademark of the modern zoological park and aquarium. AZA-accredited institutions have the invaluable opportunity, and are expected, to conduct or facilitate research both in *in situ* and *ex situ* settings to advance scientific knowledge of the animals in our care and enhance the conservation of wild populations. This knowledge might be achieved by participating in AZA Taxon Advisory Group (TAG) or Species Survival Plan® (SSP) Program sponsored research, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials (AZA Accreditation Standard 5.3).

The AZA Massasauga SSP has an active research committee working with a variety of partners to facilitate research that will benefit this species and promote the conservation and recovery of these snakes. Institutions should liaise with the SSP Research Committee to determine what projects they may wish to undertake or support that will benefit this species

Research investigations, whether observational, behavioral, physiological, or genetically based, should have a clear scientific purpose with the reasonable expectation that they will increase our understanding of the species being investigated and may provide results which benefit the health or welfare of animals in wild populations. Many AZA-accredited institutions incorporate superior positive reinforcement training programs into their routine schedules to facilitate sensory, cognitive, and physiological research investigations and these types of programs are strongly encouraged by the AZA. AZA-accredited institutions are required to have a clearly written research policy that identifies the types of research being conducted, methods used, staff involved, evaluations of the projects, the animals included, and guidelines for the reporting or publication of any findings (AZA Accreditation Standard 5.2). Institutions must designate a qualified individual to oversee and direct its research program (AZA Accreditation Standard 5.1). If institutions are not able to conduct in-house research investigations, they are strongly encouraged to provide financial, personnel, logistical, and other support for priority research and conservation initiatives identified by AZA Taxon Advisory Groups (TAGs) or AZA Species Survival Plans® (SSP) Programs.

Radio telemetry is a technique that is commonly used to study secretive species such as the massasauga. The minimum size/weight of a snake that can receive an implant depends on how small the transmitter is, and the skills of the surgeon. Generally the transmitter should be no more than 50% of the width of the snake at the surgery site, and the weight of the transmitter should be no more than 5% of the snake's body weight. With a large-bodied snake such as a massasauga, animals as small as 30–40 cm SVL could be implanted with transmitters.

For gravid females (which lose up to 50% of their body weight when they gave birth) the transmitter should be no more than 2.5% of the snake's body weight. Unless the availability of study animals is a limiting factor strict adherence to this standard is particularly important, because the stress of gestation and parturition may result in increased mortality among post-parturition females, and transmitter implantation could compound that stress.

Implantation of transmitters from the time that females are heavily gravid to the time of parturition could result in an increased incidence of complications and is less than ideal. The muscular activity of parturition could also result in dehiscence of an incompletely healed implant incision. Four weeks prior to expected parturition should be the latest date scheduled for implant surgery (i.e., no surgery after mid June). It is important to note that parturition dates can vary considerably between years within a given

AZA Accreditation Standard

(5.3) Institutions should maximize the generation of scientific knowledge gained from the animal collection. This might be achieved by participating in AZA TAG/SSP sponsored research when applicable, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials.

AZA Accreditation Standard

(5.2) Institutions must have a written policy that outlines the type of research that it conducts, methods, staff involvement, evaluations, animals to be involved, and guidelines for publication of findings.

AZA Accreditation Standard

(5.1) Research activities must be under the direction of a person qualified to make informed decisions regarding research

population. The effect of local inflammation from a newly implanted transmitter on the process of ovulation and uptake of follicles by the oviduct is unknown but may also result in complications. The standard location for transmitter implantation is two-thirds of the distance from the snout to the vent, which places the transmitter immediately adjacent or anterior to the ovaries. If a female has large pre-ovulatory follicles, insertion of a transmitter could be traumatic. Debilitation at ovulation could result in regurgitation of ova from the oviduct into the coelom, both resulting in yolk peritonitis.

Implanting gravid snakes early in gestation may also result in follicle re-absorption. Parturition likely causes some degree of stress and debilitation in female snakes, which immediate surgery would compound. It is recommended that female snakes should be allowed two weeks to recover from parturition prior to implant surgery.

Following surgery the snake should be kept in a warm (28–30 °C [82–86 °F]) holding for a minimum of 24 hours. To ensure the snake is released well hydrated, intracoelomic fluids (e.g., sterile normal saline) of a volume equal to 2% of the snake's body weight should be administered intraperitoneally. Ideally a 3–6 day stay would allow for antibiotic injections at three and six days post-surgery. This extended recovery time would allow the snake to maintain its preferred body temperature for the first few days post-operatively with minimal effort. Some suggest that to minimize the stress experienced by the snake it should be released as soon as possible, as long as the snake has regained full locomotion abilities. In this case antibiotics can be injected on the day of release.

A snake requires at least four weeks post-operatively during which it can achieve its preferred body temperature to heal completely. A snake will not likely heal at all during hibernation, and late season surgeries have been shown to affect behavior and increase mortality (Rudolph et al., 1998). Therefore, snakes should not be implanted after the end of August.

Use of surgically implanted transmitters should only be considered where there is a question of sufficient importance to justify the potential negative consequences of this technique. Researchers should rationally evaluate if telemetry is the best option for the research they wish to undertake.

10.2 Future Research Needs

This Animal Care Manual is a dynamic document that will need to be updated as new information is acquired. Knowledge gaps have been identified throughout the Manual and are included in this section to promote future research investigations. Knowledge gained from areas will maximize AZA-accredited institutions' capacity for excellence in animal care and welfare as well as enhance conservation initiatives for the species.

The SSP encourages the use of the *ex situ* population to conduct noninvasive studies and research that answers questions about species biology and management. As examples, studies on group composition (structure and size – multiple males), housing (sensory components), enrichment options are some of the areas that need to be investigated. The AZA Eastern Massasauga Rattlesnake SSP has a protocol for approving research projects (see website www.emrssp.org). As of 2013, the SSP has approved several research projects that will enhance our understanding of the biology and management of this species. These projects are identified with accompanying abstracts on the AZA Eastern Massasauga Rattlesnake SSP website. The projects investigate growth patterns (weight and length) with comparisons between zoo and wild, nutrition status (again a comparison between zoo and wild), a longitudinal study of a stable wild population in SW Michigan to obtain life history parameter values, blood and fecal endocrine studies to assess potential for identifying reproductive status, and molecular genetic studies to assess genetic variation across the natural range and the relationships of individuals within the managed breeding population. Institutions should liaise with the SSP Research Committee to determine what projects they may wish to undertake or support that will benefit this species. Institutions should liaise with the SSP Research Committee to determine what projects they may wish to undertake or support that will benefit this species.

Chapter 5. Nutrition

5.2. Diets: Studies are needed to assess the nutritional status of zoo massasauga rattlesnakes as compared to wild counterparts.

5.3. Nutritional Evaluation: A project to assimilate measurement data and determine body condition in cooperation with the SSP from managed eastern massasauga rattlesnakes for comparison to wild populations is needed.

Chapter 7. Reproduction

7.1. Reproductive Physiology and Behavior: Research into the environmental and physiological requirements for inducing reproductive behavior and fecal endocrine studies to assess potential for identifying reproductive status of individuals is needed.

7.5 Assisted Rearing: Growth and longevity studies of wild populations are needed to help develop growth rate targets and a morphometric classification for age classes.

Chapter 11. Confiscations

11.1 Confiscations

Zoos are often called upon to assist regulatory agencies when illegally possessed massasaugas are confiscated. Some of the animals may be destined for repatriation to the source population. It is strongly recommended that massasaugas brought into zoos for a short period, and designated for eventual release, be kept in a separate facility from long-term (i.e., 3 months or more) residents. Refer to Chapter 6.4 for details on quarantine recommendations.

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SSP Management Committee

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Bob Johnson (Toronto Zoo)

Dr. Randy Junge (Columbus Zoo)

Jeff Jundt (Detroit Zoo)

Dr. Shana Lavin (Lincoln Park Zoo)

Mark Wanner (Saint Louis Zoo)

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Appendix A: Accreditation Standards by Chapter

The following specific standards of care relevant to eastern massasauga rattlesnake are taken from the AZA Accreditation Standards and Related Policies (AZA, 2011) and are referenced fully within the chapters of this animal care manual:

General Information

- (1.1.1)** The institution must comply with all relevant local, state, and federal wildlife laws and regulations. It is understood that, in some cases, AZA accreditation standards are more stringent than existing laws and regulations. In these cases the AZA standard must be met.

Chapter 1

- (1.5.7)** The animal collection must be protected from weather detrimental to their health.
- (10.2.1)** Critical life-support systems for the animal collection, including but not limited to plumbing, heating, cooling, aeration, and filtration, must be equipped with a warning mechanism, and emergency backup systems must be available. All mechanical equipment should be under a preventative maintenance program as evidenced through a record-keeping system. Special equipment should be maintained under a maintenance agreement, or a training record should show that staff members are trained for specified maintenance of special equipment.
- (1.5.9)** The institution must have a regular program of monitoring water quality for collections of fish, pinnipeds, cetaceans, and other aquatic animals. A written record must be maintained to document long-term water quality results and chemical additions.

Chapter 2

- (1.5.2)** Animals should be displayed, whenever possible, in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single specimens should be avoided unless biologically correct for the species involved.
- (10.3.3)** All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.
- (11.3.3)** Special attention must be given to free-ranging animals so that no undue threat is posed to the animal collection, free-ranging animals, or the visiting public. Animals maintained where they will be in contact with the visiting public must be carefully selected, monitored, and treated humanely at all times.
- (11.3.1)** All animal exhibits and holding areas must be secured to prevent unintentional animal egress.
- (11.3.6)** Guardrails/barriers must be constructed in all areas where the visiting public could have contact with other than handleable animals.
- (11.2.3)** All emergency procedures must be written and provided to staff and, where appropriate, to volunteers. Appropriate emergency procedures must be readily available for reference in the event of an actual emergency. These procedures should deal with four basic types of emergencies: fire, weather/environment; injury to staff or a visitor; animal escape.
- (11.6.2)** Security personnel, whether staff of the institution, or a provided and/or contracted service, must be trained to handle all emergencies in full accordance with the policies and procedures of the institution. In some cases, it is recognized that Security personnel may be in charge of the respective emergency (i.e., shooting teams).
- (11.2.4)** The institution must have a communication system that can be quickly accessed in case of an emergency.
- (11.2.5)** A written protocol should be developed involving local police or other emergency agencies and include response times to emergencies.
- (11.5.3)** Institutions maintaining potentially dangerous animals (sharks, whales, tigers, bears, etc.) must have appropriate safety procedures in place to prevent attacks and injuries by these animals. Appropriate response procedures must also be in place to deal with an attack resulting in an injury. These procedures must be practiced routinely per the emergency drill requirements contained in these standards. Whenever injuries result from these incidents, a written account outlining the cause of the incident, how the injury was handled, and a description of any resulting changes to either the

safety procedures or the physical facility must be prepared and maintained for five years from the date of the incident.

Chapter 3

(1.5.11) Animal transportation must be conducted in a manner that is safe, well-planned and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to.

Chapter 5

(2.6.2) A formal nutrition program is recommended to meet the behavioral and nutritional needs of all species and specimens within the collection.

(2.6.3) Animal diets must be of a quality and quantity suitable for each animal's nutritional and psychological needs. Diet formulations and records of analysis of appropriate feed items should be maintained and may be examined by the Visiting Committee. Animal food, especially seafood products, should be purchased from reliable sources that are sustainable and/or well managed.

(2.6.1) Animal food preparations must meet all local, state/provincial, and federal regulations.

(2.6.4) The institution should assign at least one person to oversee appropriate browse material for the collection.

Chapter 6

(2.1.1) A full-time staff veterinarian is recommended. However, the Commission realizes that in some cases such is not practical. In those cases, a consulting/part-time veterinarian must be under contract to make at least twice monthly inspections of the animal collection and respond as soon as possible to any emergencies. The Commission also recognizes that certain collections, because of their size and/or nature, may require different considerations in veterinary care.

(2.1.2) So that indications of disease, injury, or stress may be dealt with promptly, veterinary coverage must be available to the animal collection 24 hours a day, 7 days a week.

(2.2.1) Written, formal procedures must be available to the animal care staff for the use of animal drugs for veterinary purposes and appropriate security of the drugs must be provided.

(1.4.6) A staff member must be designated as being responsible for the institution's animal record-keeping system. That person must be charged with establishing and maintaining the institution's animal records, as well as with keeping all animal care staff members apprised of relevant laws and regulations regarding the institution's animal collection.

(1.4.7) Animal records must be kept current, and data must be logged daily.

(1.4.5) At least one set of the institution's historical animal records must be stored and protected. Those records should include permits, titles, declaration forms, and other pertinent information.

(1.4.4) Animal records, whether in electronic or paper form, including health records, must be duplicated and stored in a separate location.

(1.4.3) Animals must be identifiable, whenever practical, and have corresponding ID numbers. For animals maintained in colonies or other animals not considered readily identifiable, the institution must provide a statement explaining how record keeping is maintained.

(1.4.1) An animal inventory must be compiled at least once a year and include data regarding acquisitions and dispositions in the animal collection.

(1.4.2) All species owned by the institution must be listed on the inventory, including those animals on loan to and from the institution. In both cases, notations should be made on the inventory.

(2.7.1) The institution must have holding facilities or procedures for the quarantine of newly arrived animals and isolation facilities or procedures for the treatment of sick/injured animals.

(2.7.3) Quarantine, hospital, and isolation areas should be in compliance with standards or guidelines adopted by the AZA.

(2.7.2) Written, formal procedures for quarantine must be available and familiar to all staff working with quarantined animals.

(11.1.2) Training and procedures must be in place regarding zoonotic diseases.

(11.1.3) A tuberculin testing and surveillance program must be established for appropriate staff in order to ensure the health of both the employees and the animal collection.

(2.5.1) Deceased animals should be necropsied to determine the cause of death. Disposal after necropsy must be done in accordance with local/federal laws.

(2.4.1) The veterinary care program must emphasize disease prevention.

- (1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.
- (2.3.1) Capture equipment must be in good working order and available to authorized, trained personnel at all times.
- (2.4.2) Keepers should be trained to recognize abnormal behavior and clinical symptoms of illness and have knowledge of the diets, husbandry (including enrichment items and strategies), and restraint procedures required for the animals under their care. However, keepers should not evaluate illnesses nor prescribe treatment.
- (2.3.2) Hospital facilities should have x-ray equipment or have access to x-ray services.
- (1.5.8) The institution must develop a clear process for identifying and addressing animal welfare concerns within the institution.

Chapter 8

- (1.6.1) The institution must have a formal written enrichment program that promotes species-appropriate behavioral opportunities.
- (1.6.2) The institution must have a specific staff member(s) or committee assigned for enrichment program oversight, implementation, training, and interdepartmental coordination of enrichment efforts.

Chapter 9

- (1.5.4) A written policy on the use of live animals in programs should be on file. Animals in education programs must be maintained and cared for by trained staff, and housing conditions must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, social and environmental enrichment, access to veterinary care, nutrition, etc. Since some of these requirements can be met outside of the primary enclosure, for example, enclosures may be reduced in size provided that the animal's physical and psychological needs are being met.
- (1.5.3) If animal demonstrations are a part of the institution's programs, an education and conservation message must be an integral component.
- (1.5.5) For animals used in offsite programs and for educational purposes, the institution must have adequate protocols in place to protect the rest of the collection from exposure to infectious agents.
- (10.3.3) All animal enclosures (exhibits, holding areas, hospital, and quarantine/isolation) must be of a size and complexity sufficient to provide for the animal's physical, social, and psychological well-being; and exhibit enclosures must include provisions for the behavioral enrichment of the animals.
- (1.5.2) Animals should be displayed in exhibits replicating their wild habitat and in numbers sufficient to meet their social and behavioral needs. Display of single animals should be avoided unless biologically correct for the species involved.
- (1.5.11) Animal transportation must be conducted in a manner that is safe, well planned, and coordinated, and minimizes risk to the animal(s), employees, and general public. All applicable local, state, and federal laws must be adhered to. Planning and coordination for animal transport requires good communication among all involved parties, plans for a variety of emergencies and contingencies that may arise, and timely execution of the transport. At no time should the animal(s) or people be subjected to unnecessary risk or danger.

Chapter 10

- (5.3) Institutions should maximize the generation of scientific knowledge gained from the animal collection. This might be achieved by participating in AZA TAG/SSP sponsored research when applicable, conducting original research projects, affiliating with local universities, and/or employing staff with scientific credentials.
- (5.2) Institutions must have a written policy that outlines the type of research that it conducts, methods, staff involvement, evaluations, animals to be involved, and guidelines for publication of findings.
- (5.1) Research activities must be under the direction of a person qualified to make informed decisions regarding research.

Appendix B: Acquisition/Disposition Policy

I. Introduction: The Association of Zoos and Aquariums (AZA) was established, among other reasons, to foster continued improvement in the zoological park and aquarium profession. One of its most important roles is to provide a forum for debate and consensus building among its members, the intent of which is to attain high ethical standards, especially those related to animal care and professional conduct. The stringent requirements for AZA accreditation and high standards of professional conduct are unmatched by similar organizations and also far surpass the United States Department of Agriculture's Animal and Plant Health Inspection Service's requirements for licensed animal exhibitors. AZA member facilities must abide by a Code of Professional Ethics — a set of standards that guide all aspects of animal management and welfare. As a matter of priority, AZA institutions should acquire animals from other AZA institutions and dispose of animals to other AZA institutions.

AZA-accredited zoological parks and aquariums cannot fulfill their important missions of conservation, and science without living animals. Responsible management of living animal populations necessitates that some individuals be acquired and that others be removed from the collection at certain times. Acquisition of animals can occur through propagation, trade, donation, loan, purchase, capture, or rescue. Animals used as animal feed are not accessioned into the collection.

Disposition occurs when an animal leaves the collection for any reason. Reasons for disposition vary widely, but include cooperative population management (genetic or demographic management), reintroduction, behavioral incompatibility, sexual maturation, animal health concerns, loan or transfer, or death.

The AZA Acquisition/Disposition Policy (A/D) was created to help (1) guide and support member institutions in their animal acquisition and disposition decisions, and (2) ensure that all additions and removals are compatible with the Association's stated commitment to "save and protect the wonders of the living natural world." More specifically, the AZA A/D Policy is intended to:

- Ensure that the welfare of individual animals and conservation of populations, species and ecosystems are carefully considered during acquisition and disposition activities;
- Maintain a proper standard of conduct for AZA members during acquisition and disposition activities;
- Ensure that animals from AZA member institutions are not transferred to individuals or organizations that lack the appropriate expertise or facilities to care for them.
- Support the goal of AZA's cooperatively managed populations and associated programs, including Species Survival Plans (SSPs), Population Management Plans (PMPs), and Taxon Advisory Groups (TAGs).

The AZA Acquisition/Disposition Policy will serve as the default policy for AZA member institutions. Institutions may develop their own A/D Policy in order to address specific local concerns. Any institutional policy must incorporate and not conflict with the AZA acquisition and disposition standards.

Violations of the AZA Acquisition/Disposition Policy will be dealt with in accordance with the AZA Code of Professional Ethics. Violations can result in an institution's or individual's expulsion from membership in the AZA.

II. Group or Colony-based Identification: For some colonial, group-living, or prolific species, such as certain insects, aquatic invertebrates, schooling fish, rodents, and bats, it is often impossible or highly impractical to identify individual specimens. These species are therefore maintained, acquisitioned, and disposed of as a group or colony. Therefore, when this A/D Policy refers to animals or specimens, it is in reference to both individuals and groups/colonies.

III. Germplasm: Acquisition and disposition of germplasm should follow the same guidelines outlined in this document if its intended use is to create live animal(s). Ownership of germplasm and any resulting animals should be clearly defined. Institutions acquiring or dispositioning germplasm or any animal parts or samples should consider not only its current use, but also future possible uses as new technologies become available.

IV(a). General Acquisitions: Animals are to be acquisitioned into an AZA member institution's collection if the following conditions are met:

1. Acquisitions must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. The Director or Chief Executive Officer of the institution is charged with the final authority and responsibility for the monitoring and implementation of all acquisitions.
3. Acquisitions must be consistent with the mission of the institution, as reflected in its Institutional Collection Plan, by addressing its exhibition/education, conservation, and/or scientific goals.
4. Animals that are acquired for the collection, permanently or temporarily, must be listed on institutional records. All records should follow the Standards for Data Entry and Maintenance of North American Zoo and Aquarium Animal Records Databases®.
5. Animals may be acquired temporarily for reasons such as, holding for governmental agencies, rescue and/or rehabilitation, or special exhibits. Animals should only be accepted if they will not jeopardize the health, care or maintenance of the animals in the permanent collection or the animal being acquired.
6. The institution must have the necessary resources to support and provide for the professional care and management of a species, so that the physical and social needs of both specimen and species are met.
7. Attempts by members to circumvent AZA conservation programs in the acquisition of SSP animals are detrimental to the Association and its conservation programs. Such action may be detrimental to the species involved and is a violation of the Association's Code of Professional Ethics. All AZA members must work through the SSP program in efforts to acquire SSP species and adhere to the AZA Full Participation policy.
8. Animals are only to be acquired from sources that are known to operate legally and conduct their business in a manner that reflects and/or supports the spirit and intent of the AZA Code of Professional Ethics as well as this policy. Any convictions of state, federal, or international wildlife laws should be reviewed, as well as any previous dealings with other AZA-accredited institutions.
9. When acquiring specimens managed by a PMP, institutions should consult with the PMP manager.
10. Institutions should consult AZA Wildlife Conservation and Management Committee (WCMC)-approved Regional Collection Plans (RCPs) when making acquisition decisions.

IV(b). Acquisitions from the Wild: The maintenance of wild animal populations for education and wildlife conservation purposes is a unique responsibility of AZA member zoos and aquariums. To accomplish these goals, it may be necessary to acquire wild-caught specimens. Before acquiring animals from the wild, institutions are encouraged to examine sources including other AZA institutions or regional zoological associations.

When acquiring animals from the wild, careful consideration must be taken to evaluate the long-term impacts on the wild population. Any capture of free-ranging animals should be done in accordance with all local, state, federal, and international wildlife laws and regulations and not be detrimental to the long-term viability of the species or the wild or captive population(s). In crisis situations, when the survival of a population is at risk, rescue decisions are to be made on a case-by-case basis.

V(a). Disposition Requirements – living animals: Successful conservation and animal management efforts rely on the cooperation of many entities, both within and outside of AZA. While preference is given to placing animals within AZA member institutions, it is important to foster a cooperative culture among those who share the primary mission of AZA-accredited facilities. The AZA draws a strong distinction between the mission, stated or otherwise, of non-AZA member organizations and the mission of professionally managed zoological parks and aquariums accredited by the AZA.

An accredited AZA member balances public display, recreation, and entertainment with demonstrated efforts in education, conservation, and science. While some non-AZA member organizations may meet minimum daily standards of animal care for wildlife, the AZA recognizes that this, by itself, is insufficient to warrant either AZA membership or participation in AZA's cooperative animal management programs. When an animal is sent to a non-member of AZA, it is imperative that the member be confident that the animal will be cared for properly.

Animals may only be disposed of from an AZA member institution's collection if the following conditions are met:

1. Dispositions must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. The Director or Chief Executive Officer of the institution is charged with the final authority and responsibility for the monitoring and implementation of all dispositions.
3. Any disposition must abide by the Mandatory Standards and General Advisories of the AZA Code of Professional Ethics. Specifically, "a member shall make every effort to assure that all animals in his/her collection and under his/her care are disposed of in a manner which meets the current disposition standards of the Association and do not find their way into the hands of those not qualified to care for them properly."
4. Non-domesticated animals shall not be disposed of at animal auctions. Additionally, animals shall not be disposed of to any organization or individual that may use or sell the animal at an animal auction. In transactions with AZA non-members, the recipient must ensure in writing that neither the animal nor its offspring will be disposed of at a wild animal auction or to an individual or organization that allows the hunting of the animal.
5. Animals shall not be disposed of to organizations or individuals that allow the hunting of these animals or their offspring. This does not apply to individuals or organizations which allow the hunting of only free-ranging game species (indigenous to North America) and established long-introduced species such as, but not limited to, white-tailed deer, quail, rabbit, waterfowl, boar, ring-necked pheasant, chukar, partridge, and trout. AZA distinguishes hunting/fishing for sport from culling for sustainable population management and wildlife conservation purposes.
6. Attempts by members to circumvent AZA conservation programs in the disposition of SSP animals are detrimental to the Association and its conservation programs. Such action may be detrimental to the species involved and is a violation of the Association's Code of Professional Ethics. All AZA members must work through the SSP program in efforts to deacquisition SSP species and adhere to the AZA Full Participation policy.
7. Domesticated animals are to be disposed of in a manner consistent with acceptable farm practices and subject to all relevant laws and regulations.
8. Live specimens may be released within native ranges, subject to all relevant laws and regulations. Releases may be a part of a recovery program and any release must be compatible with the AZA Guidelines for Reintroduction of Animals Born or Held in Captivity, dated June 3, 1992.
9. Detailed disposition records of all living or dead specimens must be maintained. Where applicable, proper animal identification techniques should be utilized.
10. It is the obligation of every loaning institution to monitor, at least annually, the conditions of any loaned specimens and the ability of the recipient to provide proper care. If the conditions and care of animals are in violation of the loan agreement, it is the obligation of the loaning institution to recall the animal. Furthermore, an institution's loaning policy must not be in conflict with this A/D Policy.
11. If live specimens are euthanized, it must be done in accordance with the established policy of the institution and the Report of the American Veterinary Medical Association Panel on Euthanasia (Journal of the American Veterinary Medical Association 218 (5): 669-696, 2001).
12. In dispositions to non-AZA members, the non-AZA member's mission (stated or implied) must not be in conflict with the mission of AZA, or with this A/D Policy.
13. In dispositions to non-AZA member facilities that are open to the public, the non-AZA member must balance public display, recreation, and entertainment with demonstrated efforts in conservation, education, and science.
14. In dispositions to non-AZA members, the AZA members must be convinced that the recipient has the expertise, records management practices, financial stability, facilities, and resources required to properly care for and maintain the animals and their offspring. It is recommended that this documentation be kept in the permanent record of the animals at the AZA member institution.
15. If living animals are sent to a non-AZA member research institution, the institution must be registered under the Animal Welfare Act by the U.S. Department of Agriculture Animal and Plant

Health Inspection Service. For international transactions, the receiving facility should be registered by that country's equivalent body with enforcement over animal welfare.

16. No animal disposition should occur if it would create a health or safety risk (to the animal or humans) or have a negative impact on the conservation of the species.
17. Inherently dangerous wild animals or invasive species should not be dispositioned to the pet trade or those unqualified to care for them.
18. Under no circumstances should any primates be dispositioned to a private individual or to the pet trade.
19. Fish and aquatic invertebrate species that meet ANY of the following are inappropriate to be disposed of to private individuals or the pet trade:
 - a. species that grow too large to be housed in a 72-inch long, 180 gallon aquarium (the largest tank commonly sold in retail stores)
 - b. species that require extraordinary life support equipment to maintain an appropriate captive environment (e.g., cold water fish and invertebrates)
 - c. species deemed invasive (e.g., snakeheads)
 - d. species capable of inflicting a serious bite or venomous sting (e.g., piranha, lion fish, blue-ringed octopus)
 - e. species of wildlife conservation concern
21. When dispositioning specimens managed by a PMP, institutions should consult with the PMP manager.
22. Institutions should consult WCMC-approved RCPs when making disposition decisions.

V(b). Disposition Requirements – dead specimens: Dead specimens (including animal parts and samples) are only to be disposed of from an AZA member institution's collection if the following conditions are met:

1. Dispositions of dead specimens must meet the requirements of all applicable local, state, federal and international regulations and laws.
2. Maximum utilization is to be made of the remains, which could include use in educational programs or exhibits.
3. Consideration is given to scientific projects that provide data for species management and/or conservation.
4. Records (including ownership information) are to be kept on all dispositions, including animal body parts, when possible.
5. AZA SSP and AZA TAG necropsy protocols are to be accommodated insofar as possible.

VI. Transaction Forms: AZA member institutions will develop transaction forms to record animal acquisitions and dispositions. These forms will require the potential recipient or provider to adhere to the AZA Code of Professional Ethics, the AZA Acquisition/Disposition Policy, and all relevant AZA and member policies, procedures and guidelines. In addition, transaction forms must insist on compliance with the applicable laws and regulations of local, state, federal and international authorities.

Appendix C: Recommended Quarantine Procedures

Quarantine facility: A separate quarantine facility, with the ability to accommodate mammals, birds, reptiles, amphibians, and fish should exist. If a specific quarantine facility is not present, then newly acquired animals should be isolated from the established collection in such a manner as to prohibit physical contact, to prevent disease transmission, and to avoid aerosol and drainage contamination.

Such separation should be obligatory for primates, small mammals, birds, and reptiles, and attempted wherever possible with larger mammals such as large ungulates and carnivores, marine mammals, and cetaceans. If the receiving institution lacks appropriate facilities for isolation of large primates, pre-shipment quarantine at an AZA or American Association for Laboratory Animal Science (AALAS) accredited institution may be applied to the receiving institutions protocol. In such a case, shipment must take place in isolation from other primates. More stringent local, state, or federal regulations take precedence over these recommendations.

Quarantine length: Quarantine for all species should be under the supervision of a veterinarian and consist of a minimum of 30 days (unless otherwise directed by the staff veterinarian). Mammals: If during the 30-day quarantine period, additional mammals of the same order are introduced into a designated quarantine area, the 30-day period must begin over again. However, the addition of mammals of a different order to those already in quarantine will not have an adverse impact on the originally quarantined mammals. Birds, Reptiles, Amphibians, or Fish: The 30-day quarantine period must be closed for each of the above Classes. Therefore, the addition of any new birds into a bird quarantine area requires that the 30-day quarantine period begin again on the date of the addition of the new birds. The same applies for reptiles, amphibians, or fish.

Quarantine personnel: A keeper should be designated to care only for quarantined animals or a keeper should attend quarantined animals only after fulfilling responsibilities for resident species. Equipment used to feed and clean animals in quarantine should be used only with these animals. If this is not possible, then equipment must be cleaned with an appropriate disinfectant (as designated by the veterinarian supervising quarantine) before use with post-quarantine animals.

Institutions must take precautions to minimize the risk of exposure of animal care personnel to zoonotic diseases that may be present in newly acquired animals. These precautions should include the use of disinfectant foot baths, wearing of appropriate protective clothing and masks in some cases, and minimizing physical exposure in some species; e.g., primates, by the use of chemical rather than physical restraint. A tuberculin testing/surveillance program must be established for zoo/aquarium employees in order to ensure the health of both the employees and the animal collection.

Quarantine protocol: During this period, certain prophylactic measures should be instituted. Individual fecal samples or representative samples from large numbers of individuals housed in a limited area (e.g., birds of the same species in an aviary or frogs in a terrarium) should be collected at least twice and examined for gastrointestinal parasites. Treatment should be prescribed by the attending veterinarian. Ideally, release from quarantine should be dependent on obtaining two negative fecal results spaced a minimum of two weeks apart either initially or after parasiticide treatment. In addition, all animals should be evaluated for ectoparasites and treated accordingly.

Vaccinations should be updated as appropriate for each species. If the animal arrives without a vaccination history, it should be treated as an immunologically naive animal and given an appropriate series of vaccinations. Whenever possible, blood should be collected and sera banked. Either a -70° C (-94° F) frost-free freezer or a -20° C (-4° F) freezer that is not frost-free should be available to save sera. Such sera could provide an important resource for retrospective disease evaluation.

The quarantine period also represents an opportunity to, where possible, permanently identify all unmarked animals when anesthetized or restrained (e.g., tattoo, ear notch, ear tag, etc.). Also, whenever animals are restrained or immobilized, a complete physical, including a dental examination, should be performed. Complete medical records should be maintained and available for all animals during the quarantine period. Animals that die during quarantine should have a necropsy performed under the supervision of a veterinarian and representative tissues submitted for histopathologic examination.

Quarantine procedures: The following are recommendations and suggestions for appropriate quarantine procedures for eastern massasauga rattlesnake:

Eastern massasauga rattlesnake:

Required:

1. Direct and floatation fecals

Strongly Recommended:

1. CBC profile
2. Radiograph

Appendix D: Program Animal Policy and Position Statement

Program Animal Policy

Originally approved by the AZA Board of Directors – 2003

Updated and approved by the Board – July 2008 & June 2011

The Association of Zoos & Aquariums (AZA) recognizes many benefits for public education and, ultimately, for conservation in program animal presentations. AZA's Conservation Education Committee's *Program Animal Position Statement* summarizes the value of program animal presentations (see pages 42-44).

For the purpose of this policy, a Program Animal is defined as “an animal whose role includes handling and/or training by staff or volunteers for interaction with the public and in support of institutional education and conservation goals”. Some animals are designated as Program Animals on a full-time basis, while others are designated as such only occasionally. Program Animal-related Accreditation Standards are applicable to all animals during the times that they are designated as Program Animals.

There are three main categories of Program Animal interactions:

1. On Grounds with the Program Animal Inside the Exhibit/Enclosure:
 - i. Public access outside the exhibit/enclosure. Public may interact with animals from outside the exhibit/enclosure (e.g., giraffe feeding, touch tanks).
 - ii. Public access inside the exhibit/enclosure. Public may interact with animals from inside the exhibit/enclosure (e.g., lorikeet feedings, ‘swim with’ programs, camel/pony rides).
2. On Grounds with the Program Animal Outside the Exhibit/Enclosure:
 - i. Minimal handling and training techniques are used to present Program Animals to the public. Public has minimal or no opportunity to directly interact with Program Animals when they are outside the exhibit/enclosure (e.g., raptors on the glove, reptiles held “presentation style”).
 - ii. Moderate handling and training techniques are used to present Program Animals to the public. Public may be in close proximity to, or have direct contact with, Program Animals when they're outside the exhibit/enclosure (e.g., media, fund raising, photo, and/or touch opportunities).
 - iii. Significant handling and training techniques are used to present Program Animals to the public. Public may have direct contact with Program Animals or simply observe the in-depth presentations when they're outside the exhibit/enclosure (e.g., wildlife education shows).
3. Off Grounds:
 - i. Handling and training techniques are used to present Program Animals to the public outside of the zoo/aquarium grounds. Public may have minimal contact or be in close proximity to and have direct contact with Program Animals (e.g., animals transported to schools, media, fund raising events).

These categories assist staff and accreditation inspectors in determining when animals are designated as Program Animals and the periods during which the Program Animal-related Accreditation Standards are applicable. In addition, these Program Animal categories establish a framework for understanding increasing degrees of an animal's involvement in Program Animal activities.

Program animal presentations bring a host of responsibilities, including the safety and welfare of the animals involved, the safety of the animal handler and public, and accountability for the take-home, educational messages received by the audience. Therefore, AZA requires all accredited institutions that make program animal presentations to develop an institutional program animal policy that clearly identifies and justifies those species and individuals approved as program animals and details their long-term management plan and educational program objectives.

AZA's accreditation standards require that education and conservation messages must be an integral component of all program animal presentations. In addition, the accreditation standards require that the conditions and treatment of animals in education programs must meet standards set for the remainder of the animal collection, including species-appropriate shelter, exercise, appropriate environmental enrichment, access to veterinary care, nutrition, and other related standards. In addition, providing program animals with options to choose among a variety of conditions within their environment is

essential to ensuring effective care, welfare, and management. Some of these requirements can be met outside of the primary exhibit enclosure while the animal is involved in a program or is being transported. For example, free-flight birds may receive appropriate exercise during regular programs, reducing the need for additional exercise. However, the institution must ensure that in such cases, the animals participate in programs on a basis sufficient to meet these needs or provide for their needs in their home enclosures; upon return to the facility the animal should be returned to its species-appropriate housing as described above.

Program Animal Position Statement

Last revision 1/28/03

Re-authorized by the Board June 2011

The Conservation Education Committee (CEC) of the Association of Zoos and Aquariums supports the appropriate use of program animals as an important and powerful educational tool that provides a variety of benefits to zoo and aquarium educators seeking to convey cognitive and affective (emotional) messages about conservation, wildlife and animal welfare.

Utilizing these animals allows educators to strongly engage audiences. As discussed below, the use of program animals has been demonstrated to result in lengthened learning periods, increased knowledge acquisition and retention, enhanced environmental attitudes, and the creation of positive perceptions concerning zoo and aquarium animals.

Audience Engagement

Zoos and aquariums are ideal venues for developing emotional ties to wildlife and fostering an appreciation for the natural world. However, developing and delivering effective educational messages in the free-choice learning environments of zoos and aquariums is a difficult task.

Zoo and aquarium educators are constantly challenged to develop methods for engaging and teaching visitors who often view a trip to the zoo as a social or recreational experience (Morgan and Hodgkinson, 1999). The use of program animals can provide the compelling experience necessary to attract and maintain personal connections with visitors of all motivations, thus preparing them for learning and reflection on their own relationships with nature.

Program animals are powerful catalysts for learning for a variety of reasons. They are generally active, easily viewed, and usually presented in close proximity to the public. These factors have proven to contribute to increasing the length of time that people spend watching animals in zoo exhibits (Bitgood, Patterson and Benefield, 1986, 1988; Wolf and Tymitz, 1981).

In addition, the provocative nature of a handled animal likely plays an important role in captivating a visitor. In two studies (Povey, 2002; Povey and Rios, 2001), visitors viewed animals three and four times longer while they were being presented in demonstrations outside of their enclosure with an educator than while they were on exhibit. Clearly, the use of program animals in shows or informal presentations can be effective in lengthening the potential time period for learning and overall impact.

Program animals also provide the opportunity to personalize the learning experience, tailoring the teaching session to what interests the visitors. Traditional graphics offer little opportunity for this level of personalization of information delivery and are frequently not read by visitors (Churchman, 1985; Johnston, 1998). For example, Povey (2001) found that only 25% of visitors to an animal exhibit read the accompanying graphic; whereas, 45% of visitors watching the same animal handled in an educational presentation asked at least one question and some asked as many as seven questions. Having an animal accompany the educator allowed the visitors to make specific inquiries about topics in which they were interested.

Knowledge Acquisition

Improving our visitors' knowledge and understanding regarding wildlife and wildlife conservation is a fundamental goal for many zoo educators using program animals. A growing body of evidence supports the validity of using program animals to enhance delivery of these cognitive messages as well.

- MacMillen (1994) found that the use of live animals in a zoomobile outreach program significantly enhanced cognitive learning in a vertebrate classification unit for sixth grade students.
- Sherwood and his colleagues (1989) compared the use of live horseshoe crabs and sea stars to the use of dried specimens in an aquarium education program and demonstrated that students made the greatest cognitive gains when exposed to programs utilizing the live animals.
- Povey and Rios (2002) noted that in response to an open-ended survey question (“Before I saw this animal, I never realized that . . .”), visitors watching a presentation utilizing a program animal provided 69% cognitive responses (i.e., something they learned) versus 9% made by visitors viewing the same animal in its exhibit (who primarily responded with observations).
- Povey (2002) recorded a marked difference in learning between visitors observing animals on exhibit versus being handled during informal presentations. Visitors to demonstrations utilizing a raven and radiated tortoises were able to answer questions correctly at a rate as much as eleven times higher than visitors to the exhibits.

Enhanced Environmental Attitudes

Program animals have been clearly demonstrated to increase affective learning and attitudinal change.

- Studies by Yerke and Burns (1991) and Davison and her colleagues (1993) evaluated the effect live animal shows had on visitor attitudes. Both found their shows successfully influenced attitudes about conservation and stewardship.
- Yerke and Burns (1993) also evaluated a live bird outreach program presented to Oregon fifth-graders and recorded a significant increase in students' environmental attitudes after the presentations.
- Sherwood and his colleagues (1989) found that students who handled live invertebrates in an education program demonstrated both short and long-term attitudinal changes as compared to those who only had exposure to dried specimens.
- Povey and Rios (2002) examined the role program animals play in helping visitors develop positive feelings about the care and well-being of zoo animals.
- As observed by Wolf and Tymitz (1981), zoo visitors are deeply concerned with the welfare of zoo animals and desire evidence that they receive personalized care.

Conclusion

Creating positive impressions of aquarium and zoo animals, and wildlife in general, is crucial to the fundamental mission of zoological institutions. Although additional research will help us delve further into this area, the existing research supports the conclusion that program animals are an important tool for conveying both cognitive and affective messages regarding animals and the need to conserve wildlife and wild places.

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Appendix E: Developing an Institutional Program Animal Policy

Last revision 2003

Re-authorized by the Board June 2011

Rationale

Membership in AZA requires that an institution meet the AZA Accreditation Standards collectively developed by our professional colleagues. Standards guide all aspects of an institution's operations; however, the accreditation commission has asserted that ensuring that member institutions demonstrate the highest standards of animal care is a top priority. Another fundamental AZA criterion for membership is that education be affirmed as core to an institution's mission. All accredited public institutions are expected to develop a written education plan and to regularly evaluate program effectiveness.

The inclusion of animals (native, exotic and domestic) in educational presentations, when done correctly, is a powerful tool. CEC's **Program Animal Position Statement** describes the research underpinning the appropriate use of program animals as an important and powerful educational tool that provides a variety of benefits to zoo and aquarium educators seeking to convey cognitive and affective messages about conservation and wildlife.

Ongoing research, such as AZA's Multi-Institutional Research Project (MIRP) and research conducted by individual AZA institutions will help zoo educators to determine whether the use of program animals conveys intended and/or conflicting messages and to modify and improve programs accordingly and to ensure that all program animals have the best possible welfare.

When utilizing program animals our responsibility is to meet both our high standards of animal care and our educational goals. Additionally, as animal management professionals, we must critically address both the species' conservation needs and the welfare of the individual animal. Because "wild creatures differ endlessly," in their forms, needs, behavior, limitations and abilities (Conway, 1995), AZA, through its Animal Welfare Committee, has recently given the responsibility to develop taxon- and species-specific animal welfare standards and guidelines to the Taxon Advisory Groups (TAG) and Species Survival Plan® Program (SSP). Experts within each TAG or SSP, along with their education advisors, are charged with assessing all aspects of the taxons' and/or species' biological and social needs and developing Animal Care Manuals (ACMs) that include specifications concerning their use as program animals.

However, even the most exacting standards cannot address the individual choices faced by each AZA institution. Therefore, each institution is required to develop a program animal policy that articulates and evaluates program benefits. The following recommendations are offered to assist each institution in formulating its own Institutional Program Animal Policy, which incorporates the AZA Program Animal Policy and addresses the following matters.

The Policy Development Process

Within each institution, key stakeholders should be included in the development of that institution's policy, including, but not limited to representatives from:

- the Education Department
- the Animal Husbandry Department
- the Veterinary and Animal Health Department
- the Conservation & Science Department
- the Behavioral Husbandry Department
- any animal show staff (if in a separate department)
- departments that frequently request special program animal situations (e.g., special events, development, marketing, zoo or aquarium society, administration)

Additionally, staff from all levels of the organization should be involved in this development (e.g., curators, keepers, education managers, interpreters, volunteer coordinators).

To develop a comprehensive Program Animal Policy, we recommend that the following components be included:

I. Philosophy

In general, the position of the AZA is that the use of animals in up close and personal settings, including animal contact, can be extremely positive and powerful, as long as:

1. The use and setting is appropriate.
2. Animal and human welfare is considered at all times.
3. The animal is used in a respectful, safe manner and in a manner that does not misrepresent or degrade the animal.
4. A meaningful conservation message is an integral component. Read the AZA Board-approved Conservation Messages.
5. Suitable species and individual specimens are used.

Institutional program animal policies should include a philosophical statement addressing the above, and should relate the use of program animals to the institution's overall mission statement.

II. Appropriate Settings

The Program Animal Policy should include a listing of all settings both on and off site, where program animal use is permitted. This will clearly vary among institutions. Each institution's policy should include a comprehensive list of settings specific to that institution. Some institutions may have separate policies for each setting; others may address the various settings within the same policy. Examples of settings include:

- I. On-site programming
 - A. Informal and non-registrants:
 1. On-grounds programming with animals being brought out (demonstrations, lectures, parties, special events, and media)
 2. Children's zoos and contact yards
 3. Behind-the-scenes open houses
 4. Shows
 5. Touch pools
 - B. Formal (registration involved) and controlled settings
 1. School group programs
 2. Summer Camps
 3. Overnights
 4. Birthday Parties
 5. Animal rides
 6. Public animal feeding programs
- II. Offsite and Outreach
 1. PR events (TV, radio)
 2. Fundraising events
 3. Field programs involving the public
 4. School visits
 5. Library visits
 6. Nursing Home visits (therapy)
 7. Hospital visits
 8. Senior Centers
 9. Civic Group events

In some cases, policies will differ from setting to setting (e.g., on-site and off-site use with media). These settings should be addressed separately, and should reflect specific animal health issues, assessment of distress in these situations, limitations, and restrictions.

III. Compliance with Regulations

All AZA institutions housing mammals are regulated by the USDA's Animal Welfare Act. Other federal regulations, such as the Marine Mammal Protection Act, may apply. Additionally, many states, and some cities, have regulations that apply to animal contact situations. Similarly, all accredited institutions are bound by the AZA Code of Professional Ethics. It is expected that the Institution Program Animal Policy address compliance with appropriate regulations and AZA Accreditation Standards.

IV. Collection Planning

All AZA accredited institutions should have a collection planning process in place. Program animals are part of an institution's overall collection and must be included in the overall collection planning process. The AZA Guide to Accreditation contains specific requirements for the institution collection plan. For more information about collection planning in general, please see the Collection Management pages in the Members Only section.

The following recommendations apply to program animals:

1. Listing of approved program animals (to be periodically amended as collection changes). Justification of each species should be based upon criteria such as:
 - o Temperament and suitability for program use
 - o Husbandry requirements
 - o Husbandry expertise
 - o Veterinary issues and concerns
 - o Ease and means of acquisition / disposition according to the AZA code of ethics
 - o Educational value and intended conservation message
 - o Conservation Status
 - o Compliance with TAG and SSP guidelines and policies
2. General guidelines as to how each species (and, where necessary, for each individual) will be presented to the public, and in what settings
3. The collection planning section should reference the institution's acquisition and disposition policies.

V. Conservation Education Message

As noted in the AZA Accreditation Standards, if animal demonstrations are part of an institution's programs, an educational and conservation message must be an integral component. The Program Animal Policy should address the specific messages related to the use of program animals, as well as the need to be cautious about hidden or conflicting messages (e.g., "petting" an animal while stating verbally that it makes a poor pet). This section may include or reference the AZA Conservation Messages.

Although education value and messages should be part of the general collection planning process, this aspect is so critical to the use of program animals that it deserves additional attention. In addition, it is highly recommended to encourage the use of biofacts in addition to or in place of the live animals. Whenever possible, evaluation of the effectiveness of presenting program animals should be built into education programs.

VI. Human Health and Safety

The safety of our staff and the public is one of the greatest concerns in working with program animals. Although extremely valuable as educational and affective experiences, contact with animals poses certain risks to the handler and the public. Therefore, the human health and safety section of the policy should address:

1. Minimization of the possibility of disease transfer from non-human animals to humans, and vice-versa (e.g., handwashing stations, no touch policies, use of hand sanitizer)
2. Safety issues related to handlers' personal attire and behavior (e.g., discourage or prohibit use of long earrings, perfume and cologne, not eating or drinking around animals, smoking etc.)

AZA's Animal Contact Policy provides guidelines in this area; these guidelines were incorporated into accreditation standards in 1998.

VII. Animal Health and Welfare

Animal health and welfare are the highest priority of AZA accredited institutions. As a result, the Institutional Program Animal Policy should make a strong statement on the importance of animal welfare. The policy should address:

1. General housing, husbandry, and animal health concerns (e.g. that the housing and husbandry for program animals meets or exceeds general AZA standards and that the physical, social and psychological needs of the individual animal, such as adequate rest periods, provision of enrichment, visual cover, contact with conspecifics as appropriate, etc., are accommodated).
2. Where ever possible provide a choice for animal program participation, e.g., retreat areas for touch tanks or contact yards, evaluation of willingness/readiness to participate by handler, etc.)
3. The empowerment of handlers to make decisions related to animal health and welfare; such as withdrawing animals from a situation if safety or health is in danger of being compromised.
4. Requirements for supervision of contact areas and touch tanks by trained staff and volunteers.
5. Frequent evaluation of human / animal interactions to assess safety, health, welfare, etc.
6. Ensure that the level of health care for the program animals is consistent with that of other animals in the collection.
7. Whenever possible have a “cradle to grave” plan for each program animal to ensure that the animal can be taken care of properly when not used as a program animal anymore.
8. If lengthy “down” times in program animal use occur, staff should ensure that animals accustomed to regular human interactions can still maintain such contact and receive the same level of care when not used in programs.

VIII. Taxon Specific Protocols

We encourage institutions to provide taxonomically specific protocols, either at the genus or species level, or the specimen, or individual, level. Some taxon-specific guidelines may affect the use of program animals. To develop these, institutions refer to the Conservation Programs Database.

Taxon and species -specific protocols should address:

1. How to remove the individual animal from and return it to its permanent enclosure, including suggestions for operant conditioning training.
2. How to crate and transport animals.
3. Signs of stress, stress factors, distress and discomfort behaviors.

Situation specific handling protocols (e.g., whether or not animal is allowed to be touched by the public, and how to handle in such situations)

1. Guidelines for disinfecting surfaces, transport carriers, enclosures, etc. using environmentally safe chemicals and cleaners where possible.
2. Animal facts and conservation information.
3. Limitations and restrictions regarding ambient temperatures and or weather conditions.
4. Time limitations (including animal rotation and rest periods, as appropriate, duration of time each animal can participate, and restrictions on travel distances).
5. The numbers of trained personnel required to ensure the health and welfare of the animals, handlers and public.
6. The level of training and experience required for handling this species
7. Taxon/species-specific guidelines on animal health.
8. The use of hand lotions by program participants that might touch the animals

IX. Logistics: Managing the Program

The Institutional Policy should address a number of logistical issues related to program animals, including:

1. Where and how the program animal collection will be housed, including any quarantine and separation for animals used off-site.
2. Procedures for requesting animals, including the approval process and decision making process.
3. Accurate documentation and availability of records, including procedures for documenting animal usage, animal behavior, and any other concerns that arise.

X. Staff Training

Thorough training for all handling staff (keepers, educators, and volunteers, and docents) is clearly critical. Staff training is such a large issue that many institutions may have separate training protocols and procedures. Specific training protocols can be included in the Institutional Program Animal Policy or reference can be made that a separate training protocol exists.

It is recommended that the training section of the policy address:

1. Personnel authorized to handle and present animals.
2. Handling protocol during quarantine.
3. The process for training, qualifying and assessing handlers including who is authorized to train handlers.
4. The frequency of required re-training sessions for handlers.
5. Personnel authorized to train animals and training protocols.
6. The process for addressing substandard performance and noncompliance with established procedures.
7. Medical testing and vaccinations required for handlers (e.g., TB testing, tetanus shots, rabies vaccinations, routine fecal cultures, physical exams, etc.).
8. Training content (e.g., taxonomically specific protocols, natural history, relevant conservation education messages, presentation techniques, interpretive techniques, etc.).
9. Protocols to reduce disease transmission (e.g., zoonotic disease transmission, proper hygiene and hand washing requirements, as noted in AZA's Animal Contact Policy).
10. Procedures for reporting injuries to the animals, handling personnel or public.
11. Visitor management (e.g., ensuring visitors interact appropriately with animals, do not eat or drink around the animal, etc.).

XI. Review of Institutional Policies

All policies should be reviewed regularly. Accountability and ramifications of policy violations should be addressed as well (e.g., retraining, revocation of handling privileges, etc.). Institutional policies should address how frequently the Program Animal Policy will be reviewed and revised, and how accountability will be maintained.

XII. TAG and SSP Recommendations

Following development of taxon-specific recommendations from each TAG and SSP, the institution policy should include a statement regarding compliance with these recommendations. If the institution chooses not to follow these specific recommendations, a brief statement providing rationale is recommended.