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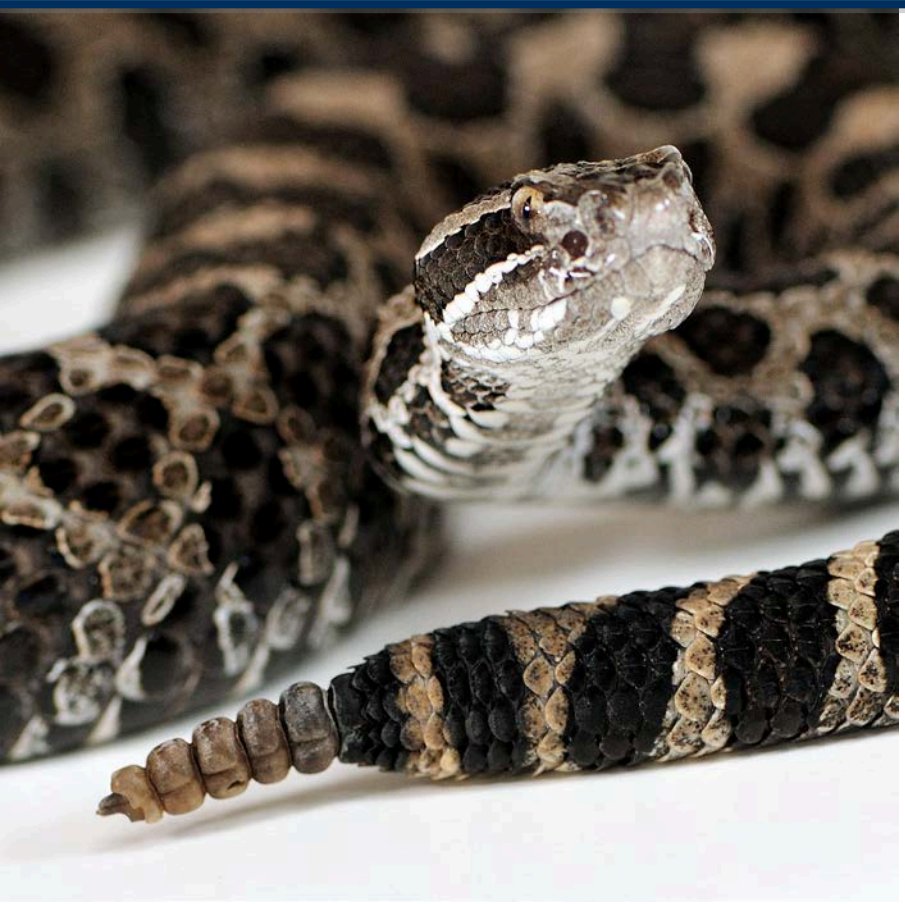

EASTERN MASSASAUGA RATTLESNAKE (*Sistrurus catenatus catenatus*) CARE MANUAL

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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This nutrition chapter is an excerpt from the complete Animal Care Manual available at the

Association of Zoos and Aquariums (AZA)'s website:

http://www.aza.org/animal-care-manuals/

Further information about diets and the nutrition of this and other species can be found at the

AZA's Nutrition Advisory Group (NAG)'s website:

http://nagonline.net

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.

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.

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

(2.6.3) 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.

AZA Accreditation Standard

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

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.

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.

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).

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