ASSOCIATION OF ZOOS & AQUARIUMS

EASTERN INDIGO SNAKE (*Drymarchon couperi*) CARE MANUAL

CREATED BY THE
AZA Eastern Indigo Snake Species Survival Plan®
IN ASSOCIATION WITH THE
AZA Snake Taxon Advisory Group

Eastern Indigo Snake (*Drymarchon couperi*) Care Manual

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Author:

Fred Antonio
Director, Orianne Center for Indigo Conservation, The Orianne Society

AZA Snake TAG Reviewers:

Dino Ferri, Curator of Herpetology, Jacksonville Zoo and Gardens
Kevin Murphy, Collection Manager, Herpetology, The Maryland Zoo in Baltimore

AZA Staff Editors:

Candice Dorsey, Ph.D., Director, Animal Conservation
Shelly Grow, M.S., Conservation Biologist

Cover Photo Credit:

Dirk Stevenson

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 indigo snakes (AZA Accreditation Standard 2.6.2). Diets should be developed using the recommendations of nutritionists, the Nutrition Scientific Advisory Group (http://www.aza.org/nutrition-advisory-group/), veterinarians, as well as AZA Taxon Advisory Groups (TAGs), and Species Survival Plans® (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.

Feeding Ecology of *Drymarchon couperi*: *Drymarchon couperi* are indiscriminate carnivores known to feed on virtually any vertebrate they can overpower. *D. couperi* is a dietary generalist that opportunistically feeds on a wide range of vertebrate species including fish, frogs, toads, small alligators, hatchling aquatic turtles, hatchling and juvenile gopher tortoises, lizards, snakes (including venomous species), birds and their eggs, and small mammals (Moler, 1992). A recent review of prey records for wild indigos (Stevenson, et al. 2010) included 48 prey species, with 85% of the prey species being anurans, gopher tortoise, snakes, and rodents. An adult *D. couperi* found in southern Georgia regurgitated a pigmy rattlesnake (*Sistrurus miliarius*), a hatchling gopher tortoise (*Gopherus polyphemus*), a southern hognose snake (*Heterodon simus*), and a southern toad (*Bufo terrestris*) (Mount, 1975). *D. couperi* are sometimes cannibalistic, but observations documenting this for wild snakes are rare (Dan Speake, pers. comm.; Fred Antonio, pers. obs.). Campbell (1998) notes an instance of cannibalism in a Guatemalan *D. corais melanurus*. As all *Drymarchon* sp. appear to be opportunistic generalists, it is expected that with further field observations, cannibalism will be documented in more taxa. An incidence of carrion feeding on a decapitated shark head has also been recorded in a Florida beach dune habitat (Smith and Antonio, 2007).

D. couperi are a robust and domineering species that overpowers their prey by using strong jaws while pinning the prey item to the substrate with a body coil, often swallowing the prey alive. When feeding on snakes, they may chew until the prey is immobilized and then swallow it head first. *D. couperi* have a high degree of immunity to the venom of sympatric snakes, and usually suffer no lasting injury if they are bitten by any venomous snakes on which they prey (Allen and Neill, 1952; Moulis, 1976).

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.

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.

Feeding *D. couperi* in Managed Settings: Murphy and Campbell (1987) reviewed feeding behaviors and techniques for snakes in zoos and aquariums. These basic feeding techniques apply to *D. couperi* who, once acclimated to *ex situ* environments, exhibit an impressive feeding response to food items.

In zoos and aquariums, *D. couperi* are normally maintained on rodent prey items. At least one *D. couperi* breeder (Albury, 2001) supplements a rodent based diet with thawed frozen smelt. Large wild caught specimens and neonates may not recognize laboratory mice and rats as prey items due to dissimilarity of scent to their wild counterparts. In these instances, *D. couperi* may be enticed to feed by offering natural prey items such as fish, frogs, or snakes, and subsequently scenting rodents with these odors. Neonates, which in the wild feed almost exclusively on invertebrates, amphibians, and small reptiles, may respond well to scenting pink mice with canned sardine water (unflavored), raw egg yolk, or a piece of shed skin from another species of snake. Feeding appropriately-sized frogs (e.g., *Hyla,*

Lithobates) and small mice together in the same feeding session can also establish the scent of rodent as part of their prey repertoire. One *D. couperi* breeder (Albury, 2001) noted that it is not uncommon for hatched neonates to go 60-90 days before they consume their first meal.

Young *Drymarchon couperi* have a high metabolic rate (research study in progress, Javan Bauder, The Orianne Society) and should be fed once or twice a week. The size of the food item should increase as the snake grows. Although snakes have the impressive ability to swallow large prey items, it is preferable to offer moderate-size food items more often than a large food item that may require a prolonged period for digestion. As young snakes grow, food item size increases and mice are replaced by young rats. Adult *D. couperi* are usually maintained on medium-sized laboratory rats. Prey items should be offered from tongs, as *D. couperi* can be very aggressive feeders, and have very strong jaws and sharp teeth. Care must be taken that during a feeding response; snakes do not inadvertently bite metal tongs and damage teeth and oral tissues. This can be accomplished by applying soft, non-toxic coatings or plastic tubing to the distal surfaces of feeding tongs. Acclimated specimens will readily take frozen/thawed or fresh killed rodents of appropriate size by jiggling the prey item in front of the snake with a pair of long tongs to elicit a feeding response.

For snakes that are problem or shy feeders, it is best to offer food items at the end of the day and leave the facility to avoid distractions or the induction of defensive behavior during the snake's feeding process. Tube-feeding is a last resort, should a specimen continue to refuse food and exhibit critical weight loss. Offering whole prey items should resume as soon as possible. Young *D. couperi* are fed weekly or three times biweekly; adults once a week or every 10 days. Obesity should be avoided. During winter months (corresponding to the breeding season), some specimens will reduce food intake or cease feeding for 4 to 12 weeks, while others may feed opportunistically throughout the year.

Individual snakes raised in zoos but scheduled for repatriation programs should be "retrained" to feed on the locally available prey items found at the specific release sites. Opportunities to practice and hone hunting skills on live prey items in complex outdoor enclosures will increase hunting success post-release.

The sources of rodents used as food items must have consistent quality control to insure that only healthy prey items, raised on an optimal plane of nutrition, are offered to *D. couperi*. Frozen food items should be thawed and handled properly prior to feeding. Offering wild-caught food items should be discouraged to avoid potential disease and parasite vectoring, except for snakes scheduled for wild release in repatriation programs. However, future studies are needed to evaluate the nutritional importance of incorporating non-rodent prey items (anurans, fish, snakes) into the diet of *D. couperi*.

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) for food safety protocols for the diet ingredients, diet preparation, and diet administration should be established for the taxa 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

Specific clinical tests for the routine monitoring of nutritional problems in snakes are lacking. As snakes consume whole prey items, nutritional problems are rare. Annual physicals and blood work can reveal health concerns, but most clinical work ups on *D. couperi* are initiated as a result of keepers noting abnormalities in appearance or behavior. At that time the feeding record, food items, and nutritional issues may be discussed and reviewed. During annual physicals, body condition scores (BCS) should be developed to show patterns over time and individual trends in body mass, with this kind of evaluation incorporated into a preventative veterinary program (see Chapter 6). However at this time, standard BCS systems have not been developed for most snake species, including *Drymarchon* spp.

7.5 Assisted Rearing

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

Neonate *D. couperi* may take 1 to 3 days to emerge from the egg following pipping. Neonates measure 432-610 mm (17-24 in) total length at hatching and may have a speckling pattern. Upon hatching, neonates should be weighed, measured, and set up individually in separate containers. Moist paper towels, a hide box, and water bowl are recommended as neonate *D. couperi* should ~~to~~ be kept in relatively moist conditions until the first shed.

Growth and longevity: *D. couperi* is the largest snake in North America. The record length of 2,629 mm (103.5 in) (Conant and Collins, 1991) translates into a massive snake, with males over 1.8 m (6 ft) in total length attaining a mid-body diameter of over 5 cm (2 in). Male *D. couperi* grow larger than females. Factors contributing to male size bias may include a faster growth rate, greater longevity, hormonal influences triggered by male-male combat, or differences in mortality factors associated with activity patterns. Females have additional energetic costs associated with reproduction (vitellogenesis), may have higher predation rates due to their smaller size, and possibly experience a higher overwinter mortality due to the costs associated with reproduction. Generally, survival improves with size.

Growth rates are influenced by food intake, environmental temperatures, physical activity, and sex (i.e., males grow larger than females). Growth rates are expected to be greater in the southern part of the range than individuals in the northern part of the range, correlating with a prolonged annual activity period. Zoo-hatched *D. couperi* have reached 1.8 m (6 ft) in total length in their third year (K. Russell, personal communication) under optimal conditions.

Ecdysis occurs frequently in *D. couperi* with young growing specimens shedding monthly and older specimens shedding 4 to 6 times annually. Observation on *ex situ* specimens show that *D. couperi* have a high rate of ecdysis compared to most other snake species. Snakes should be misted down daily prior to shedding to avoid the old outer skin from becoming dry and adhering to the new underlying layers. Stuck sheds are common with *D. couperi* as they are prone to cutaneous water loss. Stuck sheds should be manually removed with careful attention to retained spectacles.

Monthly maximum growth rates for free-ranging *D. couperi* in southeast Georgia (Stevenson et al., 2009) are 35.7 mm (1.41 in) for males and 22.1 mm (0.87 in) for females, with age classes and size (snout-vent length) described in Table 7.5.1.

Table 7.5.1: Age classes and size, by sex

Age	Sex	Size
2nd winter (1.5 yrs)	Males Females	960-1200 mm (38-48 in) 960-1150 mm (38-46 in)
3rd winter (2.5 yrs)	Males Females	1350-1500 mm (54-60 in) 1250-1350 mm (50-54 in)
4th winter (3.5 yrs)	Males Females	1500-1650 mm (60-66 in) 1350-1450 mm (54-58 in)
5-7 years old	Males Females	1800 mm(72 in) 1500 mm(60 in)

D. couperi is a long-lived colubrid. Two documented specimens are known to have lived over 27 years in zoos (Antonio, 2008, 2010). It is suspected that snakes in the wild may live to be 10-20 years old (Stevenson et al., 2009).

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. Fortunately for *D. couperi*, contraception is not an issue as they are maintained solitarily and not in social groups where random or unintentional matings can occur. However, long-term sperm storage has been documented in *D. couperi* (Carson, 1945), multiple paternity in successive reproductive seasons may occur, and the list of parthenogenetic snake species is growing all the time. These unusual reproductive modes should be considered when unusual reproductive events occur.

References

Allen, R., & Neil, W.T. (1952). The indigo snake. *Florida Wildlife.* 6(3):44-47.

Albury, F. (2001). Care and breeding of eastern indigo snakes, *Drymarchon couperi*. *Reptile & Amphibian Hobbyist*, 6(12):26-32.

Alessandrini, D. (2002). The great American serpent: Notes on the legal protection, captive husbandry and propagation of the eastern indigo snake. *Reptiles Magazine,* 10(4):70-83.

Antonio, F. (2008). Eastern Indigo Snake Studbook, *Drymarchon couperi*. Central Florida Zoo and Botanical Gardens. Pp.79.

Antonio, F. (2010). Eastern Indigo Snake Studbook, *Drymarchon couperi*. Second edition. The Orianne Society. Pp. 59.

Bitgood S., Patterson D., Benefield A. (1986). Understanding your visitors: ten factors that influence visitor behavior. Annual Proceedings of the American Association of Zoological Parks and Aquariums, 726-743.

Bitgood, S., Patterson, D., Benefield A. (1988). Exhibit design and visitor behavior. *Environment and Behavior*, 20(4): 474-491.

Breininger, D.R., Legare, M.L., & Smith, R.B.. (2004). Eastern indigo snakes (*Drymarchon couperi*) in Florida: influence of edge effects on population viability. Pp. 299-311 *In* Species Conservation and Management: Case Studies. Akcakaya, H., M. Burgman, O. Kindvall, C. Wood, P. Sjögren-Gulve, J. Hatfield, and M. McCarthy (Eds.). Oxford University Press, New York, New York, USA.

Campbell, J.A. (1998). Amphibians and Reptiles of Northern Guatemala, the Yucatan, and Belize. University of Oklahoma Press, Norman. pp 380.

Carr, A.F., Jr. (1940). A contribution to the herpetology of Florida. University of Florida Publications, Biological Science Series: Volume 3, No. 1.

Carson, H.L. (1945). Delayed fertilization in a captive indigo snake with notes on feeding and shedding. Copeia.4:222-225.

Churchman D. (1985). How and what do recreational visitors learn at zoos? Annual Proceedings of the American Association of Zoological Parks and Aquariums, 160-167.

Clark, N., & F. Antonio. (2009). Reproduction in the eastern diamondback rattlesnake, *Crotalus adamanteus*, under optimal conditions in captivity. *In* The Biology of the Rattlesnakes. Hayes, W.K., K.R. Beaman, M.D. Cardwell, and S.P. Bush (Eds.). Loma Linda University Press, Loma Linda, California, USA. Pp.413-418.

Collins, J.T. (1991). Viewpoint: a new taxonomic arrangement for some North American amphibians and reptiles. *Herpetological Review* 22:42-43.

Conant, R., & J.T. Collins. (1991). A Field Guide to Reptiles and Amphibians of Eastern and Central North America. 3rd Edition. Houghton Mifflin Company, Boston, Massachusetts, USA.

Conway W. (1995). Wild and zoo animal interactive management and habitat conservation. *Biodiversity and Conservation,* 4: 573-594.

Cowan, D.F. (1980). Adaption, maladaptation and disease. *In* Reproductive Biology and Diseases of Captive Reptiles. J.B. Murphy and J.T. Collins (Eds.), Lawrence, Kansas, Society for the Study of Amphibians and Reptiles. Pp.191-196.

Crother, B. I. (ed.). (2008). Scientific and standard English names of amphibians and reptiles of North America, north of Mexico, with comments regarding confidence in our understanding. Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 37. Shoreview, MN. Iv + 82 pp.

Davison V.M..McMahon, L., Skinner, T.L., Horton, C.M., & Parks, B.J. (1993). Animals as actors: take 2. Annual Proceedings of the American Association of Zoological Parks and Aquariums, pp. 150-155.

Diemer, J.E., & D.W. Speake. (1983). The distribution of the eastern indigo snake, *Drymarchon corais couperi*, in Georgia. *Journal of Herpetology,* 17:256-264.

Dodd, C.K. Jr., & W.J. Barichivich. (2007). Movements of large snakes (*Drymarchon, Masticophis*) in north-central Florida. *Florida Scientist,* 70(1):83-94.

Gillingham, J.C. (1987). Social behavior. *In* Snakes: Ecology and Evolutionary Biology. R.A. Seigel; J.T. Collins; S.S. Novak (Eds.), MacMillan Publ. Co. Pp. 184-209

Gunzburger, M.S., & M.J. Aresco. (2007). Status of the eastern indigo snake in the Florida Panhandle and adjacent areas of Alabama and Georgia. Report to U.S. Fish and Wildlife Service, Jackson, Mississippi Field Office. Purchase Order No: 43910-6-M022. pp 63.

Hallam, C.O., K. Wheaton & R.A. Fischer. (1998). Species profile: Eastern indigo snake (*Drymarchon corais couperi*) on military installations in the Southeastern United States. Technical report SERDP-98-2. Army Engineer Waterways Experimental Station, Vicksburg, MS. pp 18.

Hyslop, N.L. (2007). Movements, habitat use, and survival of the threatened Eastern Indigo Snake (*Drymarchon couperi*) in Georgia. PhD dissertation, University of Georgia, Athens. pp 132.

Johnston RJ. (1998). Exogenous factors and visitor behavior: a regression analysis of exhibit viewing time. *Environment and Behavior,* 30(3): 322-347.

King, S.T., & J.R. Schrock. (1985). Controlled wildlife; a three-volume guide to U.S. wildlife laws and permit procedures. Association Systematics Collections, Univ. Kansas, Lawrence, KS.

Layne, J.N., & T.M. Steiner. (1984). Sexual dimorphism in occurrence of keeled scales in the eastern indigo snake (*Drymarchon corais couperi*). *Copeia*, 776-778.

Layne, J.N., & T.M. Steiner. (1996). Eastern Indigo Snake (*Drymarchon corais couperi*): Summary of research conducted on Archbold Biological Station. U.S. Fish and Wildlife Service Biological Report, Order No. 43910-6-0134, Jackson, Mississippi. Pp 33.

Laszlo J. (1975). Probing as a practical method of sex recognition in snakes. International Zoo Yearbook 15:178-179.

MacMillen O. (1994). Zoomobile effectiveness: sixth graders learning vertebrate classification. Annual Proceedings of the American Association of Zoological Parks and Aquariums, 181-183.

Means, D.B. (2008). Stalking the Plumed Serpent and Other Adventures in Herpetology.. Pineapple Press, Inc., Sarasota, Florida. Pp.238.

Moler. P.E. (1985). Home range and seasonal activity of the eastern indigo snake, *Drymarchon corais couperi*, in northern Florida. Final performance report, Study E-1-06, III-A-5. Florida Game and Fresh Water Fish Commission, Tallahassee, Florida.

Moler, P.E. (1992). Eastern Indigo Snake *Drymarchon corais couperi* (Holbrook). In Rare and Endangered Biota of Florida, Volume 3, Amphibians and Reptiles. Moler, P. (Ed.). University Press of Florida, Gainesville, Florida, USA. Pp. 181-186.

Morgan JM, Hodgkinson M. (1999). The motivation and social orientation of visitors attending a contemporary zoological park. *Environment and Behavior*, 31(2): 227-239.

Moulis, R.A. (1976). Autecology of the eastern indigo snake, *Drymarchon corais couperi*. *Bulletin of New York Herpetological Society*, 12:14-23.

Mount, R.H. (1975). The Reptiles and Amphibians of Alabama. Auburn University Agricultural Experimental Station, Auburn, AL. pp 347.

Murphy, J.B. & J.A. Campbell. (1987). Captive maintenance. *In* Snakes: Ecology and Evolutionary Biology Seigel, R.J., J. Collins, and S. Novak (Eds). MacMillan Publ. Co., New York, New York, USA. Pp.165-181.

Newberry, L., J.B. Jensen, & D.J. Stevenson. (2009). Natural History Notes–Nesting habitat and egg depredation: *Drymarchon couperi* (Eastern Indigo Snake). Herpetological Review 40:97.

O'Connor, P.F. (1991). Captive propagation and post-copulatory plugs of the eastern indigo snake, *Drymarchon corais couperi*. *Vivarium.* 3(3):32-35.

Parker, W.S. & M.V. Plummer. (1987). Population ecology. *In* Snakes: Ecology and Evolutionary Biology. Seigel, R.J., J. Collins, and S. Novak (Eds). MacMillan Publ. Co., New York, New York, USA. Pp.253-301.

Povey K.D.. (2002). Close encounters: the benefits of using education program animals. Annual Proceedings of the Association of Zoos and Aquariums, 117-121

Povey K.D., Rios J. (2002). Using interpretive animals to deliver affective messages in zoos. *Journal of Interpretation Research*, 7: 19-28.

Radcliffe C.W. & J.B. Murphy. (1984). Precopulatory and related behaviours in captive crotalids and other reptiles: suggestions for future investigations. International Zoo Yearbook 23:163-166.

Sherwood, K.P., Rallis, S.F., Stone, J. (1989). Effects of live animals vs. preserved specimens on student learning. *Zoo Biology,* 8: 99-104.

Shine, R. (1993). Sexual dimorphism in snakes. In Snakes: Ecology and Behavior. Seigel, R.A. and J.T. Collins (Eds). McGraw-Hill, Inc., USA. Pp.49-86

Smith, C.R. (1987). Ecology of juvenile and gravid eastern indigo snakes in north Florida. Unpublished M.S. thesis, Auburn University; Auburn, Alabama.

Smith, A. & F. Antonio. (2007). *Drymarchon Corais couperi* (Eastern Indigo Snake): Feeding Behavior. *Herpetological Review,* 38(1):88.

Speake, D.W. (1993). Indigo snake recovery plan revision. U. S. Fish and Wildlife Service, Atlanta, Georgia. pp 27.

Speake, D.W., McGlincy, J.A., & Colvin, T.R. (1978). Ecology and management of the eastern indigo snake in Georgia: a progress report. *In* Proceedings Rare and Endangered Wildlife Symposium. Odum, R., and L. Landers (Eds.). Georgia Department of Natural Resources, Game and Fish Division Technical Bulletin WL4, Athens, Georgia, USA. Pp. 64-73.

Speake, D.W., McGlincy D., & Smith C.. (1987). Captive breeding and experimental reintroduction of the eastern indigo snake. *In* Proceedings of the Third Southeastern Nongame and Endangered Wildlife Symposium. Odum, R., K. Riddleberger, and J. Ozier (Eds.). Georgia Department of Natural Resources, Game and Fish Division, Social Circle, Athens, Georgia, USA. Pp. 84-90

Stevenson, D.J. (2003). *Drymarchon corais couperi* (eastern indigo snake). Combat ritual. Herpetological Review 34:251.

Stevenson, D.J. (2006). Distribution and status of the eastern indigo snake in Georgia: 2006. Unpublished Report to the Georgia Department of Natural Resources Nongame Endangered Wildlife Program. Forsyth. Pp 7.

Stevenson, D.J.,. Enge, K.M, Carlile, L.D., Dyer, K.J., Norton, T.M.,. Hyslop, N.L., & Kiltie, R.A. (2009). An eastern indigo snake (*Drymarchon couperi*) mark-recapture study in southeastern Georgia. *Herpetological Conservation and Biology,* 4(1):30-42.

Stevenson, D.J., Bolt, M.R., Smith, D.J., Enge K.M., Hyslop, N.L., Norton, T.M., & Dyer, K.J. (2010). Prey records for the Eastern indigo Snake (*Drymarchon couperi*). *Southeastern Naturalist,* 9(1):1-18.

Stevenson, D.J., & Hyslop, N.L.. (2010). *Drymarchon couperi* (Eastern Indigo Snake). Long-distance interpopulation movement. *Herpetological Review,* 41(1):91-92.

U.S. Fish and Wildlife Service. (1978). Endangered and Threatened Wildlife and Plants. Listing of the Eastern Indigo Snake as a Threatened Species. Federal Register 43:4026.

U.S. Fish and Wildlife Service. (1982). Eastern Indigo Snake Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. pp 23.

U.S. Fish and Wildlife Service. (1998). Eastern indigo snake. *In*: Multispecies recovery plan for the threatened and endangered species of south Florida, Vol. 1. Pp. 4.567-4.581. U.S. Fish and Wildlife Service, Atlanta, Georgia. USA.

U.S. Fish and Wildlife Service. (2008). Eastern Indigo Snake (*Drymarchon couperi*). 5-Year Review: Summary and Evaluation. Jackson, Mississippi Field Office. pp 30.

Wharton, C.H. (1978). The Natural Environments of Georgia. Georgia Department of Natural Resources, Atlanta, GA. pp 227.

Wolf, R.L., Tymitz, B.L. (1981). Studying visitor perceptions of zoo environments: a naturalistic view. In: Olney.

PJS. (Ed.), International Zoo Yearbook. Dorchester: The Zoological Society of London. pp.49-53.

Wuster, W., Yrausquin, J.L., & Mijares-Urrutia, A. (2001). A new species of indigo snake from north-west Venezuela. *Herpetological Journal,* 11:157-165.

Yerke, R., Burns, A. (1991). Measuring the impact of animal shows on visitor attitudes. Annual Proceedings of the American Association of Zoological Parks and Aquariums, 532-534.

Yerke, R., Burns, A. (1993). Evaluation of the educational effectiveness of an animal show outreach program for schools. Annual Proceedings of the American Association of Zoological Parks and Aquariums, 366-368.

Personal Communications

Murphy, K., The Maryland Zoo in Baltimore

Norton, T., St. Catherine's Island Center

Russell, K., Santa Fe College Teaching Zoo