HERPETOCULTURE NOTES

CROCODYLIA — CROCODILIANS

***CROCODYLUS RHOMBIFER* (Cuban Crocodile). SUSPENSION INCUBATION.** Suspension incubation, a technique where eggs are suspended above a moistened medium, has previously been used to incubate reptile eggs in captivity (Köhler 2005. Incubation of Reptile Eggs. Krieger Publishing, Malabar, Florida. 214 pp.). In 2009, Squamata Concepts® (Staten Island, New York 10305, USA) released a commercially-available suspended incubation container (S.I.M. [Suspended Incubation Method] Container). This container elevates the eggs on a plastic grid above the incubation medium, preventing direct contact with the substrate. The purported benefits of S.I.M containers over conventional incubation techniques are shorter incubation times, fully absorbed yolk sacs, and larger hatchlings (J. Andragna Jr., pers. comm. *In* Baumer et al. 2012. Herpetol. Rev. 43:597–599). Some of these purported benefits, such as reduced incubation time, have been demonstrated with *Sauromalus ater* at the Bronx Zoo (Baumer et al. 2012, *op. cit.*).

Since 2012, seven Cuban Crocodile (*Crocodylus rhombifer*) hatchlings have been produced by a single breeding pair of adults maintained at the Smithsonian's National Zoological Park; two in 2012 and five in 2015. Ten out of 26 eggs laid in 2012 showed initial signs of development. Eight of the original 10 eggs were set up for incubation in a small plastic container (ca. 21 × 15 × 8 cm) without air holes and partially buried in a 1:1 mixture of vermiculite to water by weight; the remaining two eggs were placed in a small S.I.M. container (ca. 20 × 17 × 11 cm) suspended over saturated vermiculite. Two different incubators were used to incubate the two groups of *C. rhombifer* eggs in 2012. Eggs in the S.I.M. container were incubated inside a Grumbach compact S84 model incubator (Lyon Technologies Inc. Chula Vista, California 91911, USA), whereas the eggs placed in a 1:1 mixture of vermiculite were incubated in a GOf 110-watt reptile incubator (GOf, Savannah, Georgia 31415, USA) with a Big Apple proportional thermostat (Big Apple Pet Supply, Boca Raton, Florida 33432, USA). Both containers were vented for gas exchange weekly for the first month, increasing in frequency as the eggs developed, to

TABLE 1. *Crocodylus rhombifer* incubation, egg dimensions, and hatchling measurements from 2012 and 2015.

Year	Egg #	Egg weight (g)	Incubation method	Date pipped	Date hatched	Approx. days incubated	Hatchling weight (g)
2012	4*	95.9	1:1 Vermiculite	Never pipped	Manually opened 14 Jul 2012	77	57.5
	14**	108.5	Sm. S.I.M	6 Jul 2012	6 Jul 2012	69	64
2015	6	127.52	1:1 Vermiculite	3 Aug 2015	Manually opened 6 Aug 2015	86	81
	10	129.14	1:1 Vermiculite	3 Aug 2015	Manually opened 6 Aug 2015	86	88
	16	125.46	1:1 Vermiculite	7 Aug 2015	7 Aug 2015	87	88
	18	133.8	1:1 Vermiculite	5 Aug 2015	Assisted on 7 Aug 2015	87	75
	20	122.54	XL S.I.M	29 Jul 2015	30 Jul 2015	78	88

*Yolk not fully absorbed, treated with antibiotics.

**Egg was accidentally cracked on day 64.

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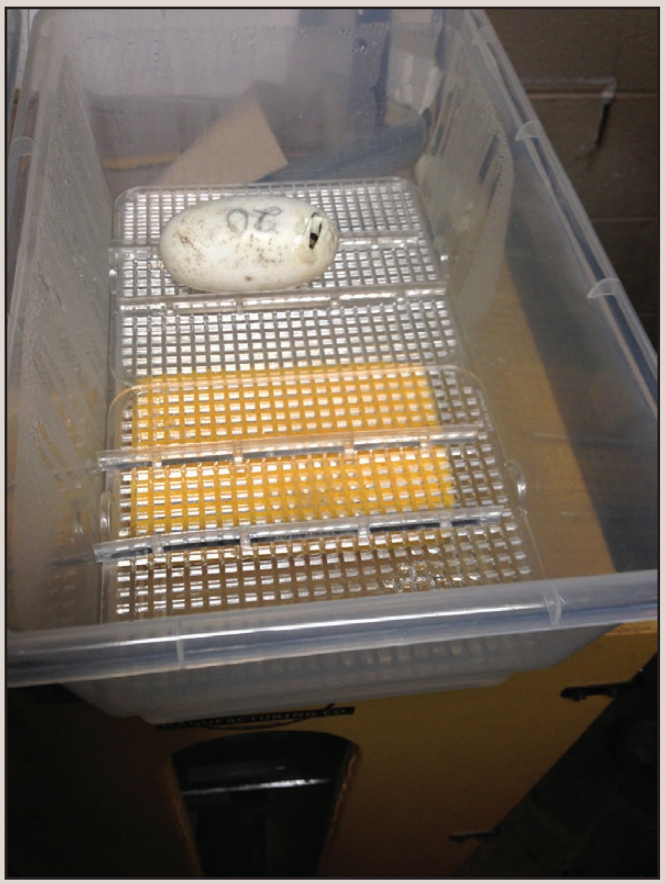

FIG. 1. *Crocodylus rhombifer* egg suspended over a fully saturated sponge in an extra-large S.I.M. container in 2015.

where they were vented daily for the final month of incubation. Only five eggs continued to develop beyond the fourth week of incubation.

After 69 days of incubation, the shell of egg #14, incubated in the S.I.M container, was accidentally cracked. The shell membrane was still intact and the shell was repaired with Duoderm® Hydroactive® sterile gel (ConvaTec, Princeton, New Jersey 08543, USA). Four days later, this egg pipped opposite the crack and successfully hatched. The remaining four eggs, incubated in vermiculite, were manually opened eight days later, revealing four deceased embryos and one live offspring with an open umbilicus and yolk sac remaining.

In 2015, ten out of the 24 eggs received showed development and were incubated in the GOf 110-watt reptile incubator with a Big Apple proportional thermostat. Eight of these eggs were partially buried in a 1:1 mixture of vermiculite and water inside a BCB 16 reptile incubation tub (Platinum Reptiles, Amherst, Ohio 44001, USA). During incubation, water was added to the vermiculite weekly to maintain the original water to vermiculite ratio. The remaining two eggs were incubated in an extra-large S.I.M. container (ca. 33 × 23 × 15 cm) suspended over a completely saturated sponge (Fig. 1). In addition to the sponge, the container also had a small amount of standing water in the bottom and was aired weekly. Five of the ten eggs incubated full term, with one egg incubated in the S.I.M container and the other four in vermiculite. Three days after initially pipping, three of the eggs incubated in vermiculite had failed to hatch and the live hatchlings were manually removed from all three eggs (see Table 1).

When visually inspected, *C. rhombifer* offspring hatched from S.I.M. containers in both 2012 and 2015 (N = 2) had more absorbed yolks and were more robust than siblings incubated conventionally in dampened vermiculite (N = 5). In 2015, all four hatchlings incubated in vermiculite hatched with open umbilici and developed retained umbilici and a widening of the linea alba, lacking apposition of ventral scales to the midline. The umbilical remnants were treated with resection and the lineae albae were closed by allowing the crocodiles to remain in the incubator with an elevated temperature (32.0–32.5°C) for four days. Hatchling measurements and incubation methods for both years of offspring are compared to assess incubation methods in Table 1.

Although two individuals incubated with the suspension technique is not an adequate sample size to draw conclusions, these preliminary results support claims that S.I.M. containers reduce incubation time and increase yolk absorption. Further investigations with S.I.M. containers and crocodilian eggs could provide more compelling evidence.

LAUREN AUGUSTINE, Smithsonian's National Zoological Park, 3001 Connecticut Ave. NW, Washington, DC 20008, USA; e-mail: Augustinel@si.edu.

SQUAMATA — SNAKES

***BOGERTOPHIS SUBOCULARIS* (Trans-Pecos Ratsnake). MOSAICISM.** Mosaicism is often expressed in animals as a color pattern mutation in which dissimilar pigment phenotypes are typically expressed in apparently random distribution in patches on the body of an individual (Hartl and Ruvolo 2011.

FIG. 1. A mosaic (or paradox) albino *Bogertophis subocularis* neonate.

Genetics: Analysis of Genes and Genomes, 8th ed. Jones & Bartlett Publishers. 804 pp.). Mosaicism (usually referred to as *paradoxism* in herpetoculture) has been documented in a broad number of squamate taxa (Mutton 2012. Herp Nation Mag. 2[5]:12–17). Only one instance of mosaicism has heretofore been reported in *Bogertophis subocularis* (Rhoads 2008. The Complete Suboc: A Comprehensive Guide to the Natural History, Care, and Breeding of the Trans-Pecos Ratsnake. Eco Herpetological Publishing and Distribution, Lansing, Michigan. 291 pp.), manifested in a double-recessive homozygous axanthic-colored specimen with the "Blonde" pattern (Lamoreaux 1980. Herpetol. Rev. 11:117; Lamoreaux and Wuerch 1981. Occas. Pap. Dallas Herpetol. Soc. 1:9–13). That specimen had seemingly random patches of normal straw-yellow pigmentation along its dorsum—especially on several of its light-centered dorsal saddles—whereas most of its body was aberrantly silver-colored and devoid of xanthophores. Here, I report a second but altogether different-in-kind example of mosaicism in a partially amelanistic specimen of this taxon.

A three-year-old (hatched in late 2012) sexual pair of normally pigmented and typical "H-patterned" *B. subocularis* that were heterozygous for albinism were kept together year-round in a 28-quart (26.5 L) plastic tub at 25.6–27.8°C with no external heat, clean water provided continuously, and aspen bedding as a substrate. They fed once weekly on a diet of frozen-thawed mice. No winter hibernation period was simulated. On 2 October 2015, the adult female laid a clutch of four eggs, which were incubated in damp sphagnum moss at 25.6–26.7°C and hatched 100 days later on 10 January 2016. All four neonates were male and H-patterned; three were normally pigmented, and one was partially amelanistic (Fig. 1). Melanin expression on the partially amelanistic specimen was not entirely random in distribution; it had 33 dorsal H-markings on the neck, trunk, and tail, and 23 of those have some black pigment bleeding through, especially on what would otherwise be the darkest part in a normally pigmented *B. subocularis*, at the junction of where the dorsolateral arms and inner, mid-dorsal saddle markings of the H -markings meet (Fig. 1). This specimen also exhibits a type of pleiotropy, a heritable trait in this taxon in which only affected (i.e., homozygous amelanistic) individuals lack the frontal scale while heterozygous individuals have the scale intact; however, there is a separate strain of albinism in this taxon that has the frontal scale always intact (Rhoads 2011. Herp Nation Mag. 2[1]:50–57).

I thank Kayla Bell, who hatched the aberrant snake, for providing me with the pertinent notes and photograph.

DUSTIN D. RHOADS, 20606 Raingreen Drive, Katy, Texas 77449, USA; e-mail: subocs@gmail.com.

***SISTRURUS MILIARIUS BARBOURI* (Dusky Pygmy Rattlesnake). RECORD SIZE.** In 2007, a female *Sistrurus miliarius barbouri* (ca. 25.5 cm TL) was collected near the southeastern side of State Road 50 and Saint Johns River, Brevard Co., Florida, USA (28.543368°N, 80.93209°W; WGS84). After eight years in captivity (FWC permit #411-120674), on 17 December 2015 this individual was taken alive to the Reptile Discovery Center, DeLand, Florida, where it measured 84.45 cm in total length (TL) excluding rattle, 10.79 cm in midbody girth, and weighed 506.32 g. A photograph and shed skin were deposited as vouchers in the Division of Herpetology, Florida Museum of Natural History, University of Florida (UF-Herpetology 177325). This exceeds the maximum reported size of 83.2 cm TL for another captive individual of the species (Powell et al. 2016. Field Guide to Reptiles and Amphibians of Eastern and Central North America, 4th ed. Houghton Mifflin Co., New York, New York. 494 pp.).

KENNETH L. KRYSKO, Division of Herpetology, Florida Museum of Natural History, 1659 Museum Road, University of Florida, Gainesville, Florida 32611, USA (e-mail: kenneyk@ufl.edu); **EMMETT H. L. SNELLINGS, JR.**, 2748 Greendale Place, Sarasota, Florida 34232, USA (e-mail: louemm@aol.com).