Captive husbandry and reproduction of the Madagascan tree boa *Sanzinia madagascariensis* (Duméril & Bibron, 1844)

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SANZINIA madagascariensis is one of the most spectacular of all species from the Boidae. Its distinguishing features include a large off-set head and colour ranging from dark to light green with large rhomboid markings that continue down the body. In some individuals these markings are heavily bordered with white (Henkel & Schmidt, 2000). Neonates are a reddish-brown for the first few months of life (Henkel & Schmidt, 2000).

The species is listed as vulnerable on the IUCN Red List and CITES appendix 1 (IUCN, 2011). *S. madagascariensis* can inhabit a range of habitats from dry and moist forests, to savanna grasslands and is distributed throughout northwestern, northern and eastern Madagascar (O'Shea, 2007). It has heat sensitive pits between the upper and lower labial scales which is a feature not shared with the other two Madagascan boa species (Mattison, 1998). Juveniles lead an arboreal life whilst adults are commonly found basking on the ground or in low branches (Henkel & Schmidt, 2000). Their diet comprises small mammals and birds (O'Shea, 2007). *S. madagascariensis* is ovoviviparous with four to sixteen young born after a gestation period of six to eight months (Ross & Marzec, 1990).

MANAGEMENT

Three *S. madagascariensis* were used for the breeding programme (one male/two females). The male was an 11-year-old wild caught specimen. Both females were eight-year-old first generation captive bred specimens. Female 1 (Fig. 1) was the larger specimen and weighed 2500 g, female 2 weighed 2100 g.

The snakes were housed individually and only introduced together for breeding purposes. Specimens were housed in large fibreglass vivariums measuring 120 x 60 x 60 cm. Abundant branches were provided inside enclosures to facilitate climbing. A large basking area was also provided.

Ambient day temperature was 24 to 28°C with a basking area that reached up to 35°C. Ambient night temperature was 20 to 22°C. Humidity was maintained at 40 to 60% RH by spraying with warm water every two days. Specimens were fed on one adult rat every three to five weeks.

REPRODUCTION

The decision was made to breed the larger female (female 1) in year one (end of 2008-2009) and the smaller female (female 2) in year 2 (end of 2009-2010). Breeding behaviour was very similar in both females. Therefore the breeding observations from both years are presented together.

From November to February, night time temperatures were gradually lowered between 14 to 16°C over five days. On day six, the male was introduced to the female's enclosure and copulation commenced 30 minutes later. The male was observed using his spurs during every introduction.

Copulation was observed mainly in the morning from 8:00 to 11:00 when body temperatures were between 16 and 18°C. Copulation was sporadic throughout November and the male was removed. All specimens refused food after their first introduction. The male was then reintroduced in December when female behaviour became constant in activity and thermoregulation. The male was deliberately introduced when it showed increased rapid tongue flicking. Copulation was frequently observed for a few days after reintroduction. After a week together, copulation was induced by spraying the enclosure and the specimens with warm water. When mating behaviour and copulation ceased, the male was removed. This method was continued

from December through January. Copulation was observed on sixteen separate occasions with female 1 and on six occasions with female 2.

Ovulation in both females could not be observed but continued periods of basking were, from mid-March (2009) in female 1 and the beginning of March (2010) in female 2. Basking occurred every morning and usually lasted all day in both specimens. Female 1 raised her body temperature to 38°C by the afternoon whilst female 2 sought shelter if her body temperature had risen above 33°C. Temperatures were taken using an infrared heat gun. Both females began to darken in colour after their first slough to retain body heat for longer to bring on the developing ova (Ross & Marzec, 1990). This continued through to parturition.

Female 1 sloughed almost two months prior to giving birth and female 2 was in slough whilst giving birth. The day prior to parturition, female 1 was offered, and consumed, one large rat whereas female 2 refused food until her post parturition slough. Female 1 gave birth to three live neonates at the end of August weighing 52 to 56 g and six infertile ova. Female 2 gave birth to five live neonates (Fig. 2) at the end of August weighing 42 to 47 g, three still-born weighing 25 to 44 g and one infertile ova. Both specimens returned to normal colours after a post parturition slough.

REARING NEONATES

All three neonates from female 1 were housed individually in contico boxes on a rack system measuring 37 x 25 x 13 cm (L x W x H). Bark chippings and sphagnum moss were used as substrate and small sticks were used to provide climbing opportunities. Neonates were offered one small thawed mouse each. For the first two months specimens struck at food items but released and did not eat. After this period freshly killed mice were offered and all three specimens accepted. Eventually all three were weaned on to thawed mice after four months. All five neonates from female 2 were housed individually in plastic Hagen tanks measuring 27 x 16 x 20 cm.The enclosures were furnished using the same method as the neonates from female 1. All neonates accepted thawed, small mice after a month from birth.

Humidity lower than 40% RH resulted in dry sloughs and neonates had to be submerged in warm water for a few hours for the skin to be manually removed. Humidity was generally kept above 50% RH and sphagnum moss piles were always damp. Neonates were kept between 25 to 30°C.

After approximately four sloughs, and over six to eight months, the juvenile boas began their ontogenetic colour change from a red/brown to a light/dark green background (Fig. 3 and 4).

DISCUSSION

Sanzinia madagascariensis has been kept at the Birmingham Nature Centre for over 15 years. Specimens have included wild caught and captive bred individuals. Various methods for breeding have been tried over the years with the three specimens used in this breeding programme but with no success. The first successful breeding occurred using the above method. This was later replicated using a different female confirming the factors necessary for successful reproduction.

From the observations made herein, *S. madagascariensis* copulates readily in captivity. This was observed more frequently in female 1 and could possibly be caused by compatibility between individuals although in both cases, fertile mating took place.

S. madagascariensis seemed to be able to withstand lower temperatures during the cycling period than other boa species, without becoming susceptible to respiratory infections (pers. obs.). Keeping *S. madagascariensis* at temperatures as low as 14°C for short periods of time may aid fertility in the species (Ross & Marzec, 1990).

In previous breeding attempts, specimens were introduced only at the end of the temperature cycling period. Introducing the sexes at the beginning and throughout the cycling period may be beneficial in allowing the male to mate during the onset of ovulation. *Sanzinia madagascariensis* will mate throughout the year if introduced together under the correct conditions (pers. obs). However, successful reproduction appears to occur only with temperature fluctuations from November and neonates being born in August of the following year. Youll (2007) observed similar breeding success during these months.

Figure 1. Green adult female *Sanzinia madagascariensis*.

Figure 3. *Sanzinia madagascariensis* neonate showing red/orange coloration.

Figure 2. *Sanzinia madagascariensis* neonates.

During gestation, *S. madagascariensis* basks continually, however, if the basking temperature is not appropriate (between 30 to 38°C in this study) it may cause the developing ova to be re-absorbed (Ross & Marzec, 1990). Whilst writing this paper (July 2011) female 1 gave birth again nearly two years after her first breeding success using the same method for breeding.

Further studies of future breeding of *S. madagascariensis* in larger numbers may help to define whether the method for breeding used in this study can be successfully replicated in other collections. Captive breeding of snakes often needs to be performed more than once to allow accurate analysis of results and to determine factors that may or may not affect reproduction.

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Figure 4. Juvenile *Sanzinia madagascariensis* after ontogenetic colour change at approximately eight months from birth. Specimen is showing adult coloration.