Captive husbandry and management of the Rio Fuerte beaded lizard *Heloderma exasperatum*

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ABSTRACT - Eight eggs from a pair of Rio Fuerte beaded lizards, *Heloderma exasperatum* were laid under the substrate in a large zoological exhibit and four hatchlings emerged in March 2013 after an unknown incubation period. The nest was excavated and a further two fertile eggs, one with a partially hatched dead lizard and one partially formed foetus in addition to two infertile eggs were found.

INTRODUCTION

The Rio Fuerte beaded lizard, *Heloderma exasperatum* was one of four subspecies of *H. horridum* until recent taxonomic elevations (see Reiserer et al, 2013). *H. exasperatum* occurs primarily in the Sierra Madre and is the northernmost species of beaded lizard (Beck, 2005). Habitat includes subtropical dry forest and occasionally specimens have been located in pine-oak forest in Alamos, Sonora (Reiserer et al, 2013). According to the IUCN Red List (06/08/13) the conservation status of *H. horridum* is LC (least concern). Reiserer et al (2013) suggests that due to habitat threats and a fragmented distribution, the IUCN will likely elevate the conservation status to VU (vulnerable) or a higher threat category. In this paper, we describe the successful captive breeding of *H. exasperatum* without using conventional reptilian incubation techniques.

MATERIALS & METHODS

One male and one female *H. exasperatum* (born 01/09) were kept in a large enclosure measuring 3 x 1.5 x 1.5m (L x W x H). Specimens were introduced together in the exhibit during May 2011. The male weighed 1200 g and the female weighed 950 g. Specimens continued to grow and in May 2012, the male weighed 1500 g and the female weighed 1200 g. Specimens were sexed using morphological characteristics. Males have a larger head, longer neck, longer body and have a large bulge at the base of the tail. These characteristics may be difficult to see in obese specimens (Pers. obs). A 2 KW fan heater was positioned in the corner of the exhibit and attached to a thermostat to allow a constant ambient air temperature. Four 60 W spot bulbs were recessed into the ceiling to add light and extra ambient heat. A basking area was provided for both specimens by using 160 W ZooMed Powersun bulbs, which also contain a high output of UVB and were positioned 30 cm from the substrate. Additional light was provided by using three Aracadia T5 UVB tubes. Diurnal temperatures in the enclosure ranged from 35-40°C under the basking areas and 21-25°C in other areas on the enclosure. Noctural temperatures were between 17-20°C. A photoperiod of 14-16 hours in the summer and 10-12 hours in the winter was implemented. The enclosure was furnished with large rocks and driftwood with branches to facilitate climbing. Bird sand mixed with Sphagnum moss blocks (these expand when added to water) was used as a substrate and depths varied from 10-60cm. Potted live plants were installed including some fern species, *Asplenium bulbiferum* and mother-in-law's tongue, *Sanseveria trifoliate* (Fig. 1). Both specimens were fed together with no need for separation. Two weaned rats were given to both specimens every four-six weeks. Two raw eggs were fed every six-eight weeks. These were cracked and the contents whisked up in a bowl and left in the enclosure. The enclosure was sprayed once daily with 2 litres of water to increase humidity, hydrate plants and ensure the substrate remained moist. Specimens would drink daily from the water jets. Good ventilation and heat prevented the enclosure from becoming too wet.

Figure 1. Enclosure for 1.1 *H. exasperatum*.

Figure 2. H4 and adult female together.

Figure 3. Contents of the nest; four empty hatched eggs, one partially hatched and dead, one partially formed and dead and two infertile.

RESULTS

On 09/03/13, a hatchling (H1) *H. exasperatum* was observed basking on a rock under a UVB Powersun bulb. Both adult specimens were present in the enclosure and did not show interest in the hatchling. The hatchling was removed and found to weigh 17 g. Subsequently three more hatchlings appeared and were removed from the enclosure and weighed; On 14/03/13, hatchling (H2, weighed 24 g) was observed moving around in a fern; on 17/03/13, hatchling (H3, weighed 27 g) was observed basking on the same rock as the first specimen; On 19/03/13 the final hatchling (H4, weighed 25 g) was observed moving around the enclosure. This neonate still had the umbilical cord attached. The adult specimens were active at the time, and the female was observed moving slowly towards the hatchling with rapid tongue flicking. Once the female's tongue touched the hatchling, it quickly moved away. The female slowly followed the scent of the hatchling with rapid tongue flicking. No aggression or feeding response was observed (Fig. 2).

Hatchlings were housed in Hagen tanks measuring 35 x 20 x 16cm (L x W x H). Due to the highly venomous nature of Helodermatid lizards, the hatchling enclosures were secured in a vivarium and locked and during enclosure maintenance, hatchlings were moved to a secure container. Two small snake hooks were used to support the body. Hatchling *H. exasperatum* move quickly and employ a sideways "head swipe" making them difficult to work with in close proximity. Paper towel was used as a substrate and a small hide and water bowl was added. Paper towel was sprayed daily to allow for extra humidity. This process had a positive effect on H4 and the umbilical cord detached after four days leaving a clean wound that healed after a further five days. Owens, (2006) expressed success using this method with hatchling *H. charlesbogerti*. Hatchlings were also sprayed and observed drinking from the spray bottle. Hatchlings were often observed fully submerged in their water bowls. This behaviour was more commonly seen when temperatures exceeded 29°C. Enclosures were heated using a spot bulb connected to a thermostat and ambient temperatures were between 25-27°C with a basking temperature of 30°C.

Hatchling *H. exasperatum* were offered one pink mouse each, two weeks after the last hatchling emerged. H3 and H4 fed immediately. H2 was coaxed into feeding by gently tapping the pink mouse on the specimens head with forceps. This caused a defensive reaction and the pink mouse was gently pushed into the specimens gaping mouth. Only H1 refused to feed. This specimen was offered a pink mouse coated with egg yolk a week later and was accepted. H1 regurgitated its first two meals due to the pink mice being too large. Smaller pink mice were sourced preventing further regurgitation. Nine days after the last hatchling emerged in the enclosure, the nest was excavated. Eight eggs were located deep under the substrate (approx 30-35cm) and had been wedged under the crevice of a large rock. The substrate was of a damp consistency and when squeezed remained adhered together. There was also a high concentration of sphagnum moss in the nest chamber. Four eggs successfully hatched. One egg contained a dead hatchling that was found with over 50% of its body out of the egg. The egg was cut open to reveal the specimen had absorbed all yolk stores and separated from the umbilical cord. This specimen weighed 24 g. Three eggs were cut open to reveal one partially developed dead foetus and two were infertile (Fig. 3).

A digital min/max hygro-thermometer was used to ascertain the temperature and humidity of the incubating eggs. The probe was placed in the nest chamber and the area was returned to its original state. Temperature and humidity was recorded over a three-month period. The research showed that temperatures varied from 21.7-21.9°C during the first two weeks. From mid-April and May, the temperature incrementally increased in the nest chamber by 0.1°C over a 24-48 hour period. Occasionally, the temperature would remain constant for three-four days, with five days being the longest period recorded. The maximum temperature recorded was 28.8°C. Humidity was consistent throughout the study and was recorded between 87-94% RH. The higher RH recordings were observed when the temperature was above 26°C.

DISCUSSION

Although *H. exasperatum* has been previously bred in captivity (Draeby & Barte, 2006; Reisinger, 2006; Eidenmuller & Reisinger, 2011) the present paper would appear to be the first describing *H. exasperatum* eggs hatching in an enclosure/exhibit without using conventional incubation methods. The results therefore indicate that the husbandry methods used for the adults and the overall captive environment were sufficient for this breeding success to occur. Unfortunately, data on dates/times of copulation and oviposition are unknown but a subsequent clutch of eggs was laid on 04/08/13. The female was observed digging in all areas of the enclosure where the substrate was >20cm and a clutch of 10 eggs were deposited in the same nest site as the clutch described in this paper. The eggs were candled after two weeks and all were fertile but were not incubated due to zoo management protocols. The clutch of eggs were clumped together under a rock crevice and due to the nature of the incubation, eggs closest to the rock may have benefited from the extra warmth and hatched out sooner. An inquisitive interest between H4 and adult female *H. exasperatum* was observed but neither aggression nor antagonistic behaviour was recorded. *Heloderma spp* are more active during the rainy season (Draeby & Barten, 2006) therefore spraying the enclosure with warm water is a good enrichment as it increases activity levels. Specimens foraged and basked frequently during increased simulated rainfall.

Heloderma spp are prone to obesity in captivity due to their ferocious appetite (Draeby & Barte, 2006), large energy storage capacities and a low metabolic rate (Beck, 2005). In light of this, it is recommended that *Heloderma spp* should be fed sporadically throughout the year with a slight increase for gravid/post oviposition females. Spraying the enclosure daily with warm water was beneficial in maintaining high humidity within the nest chamber. Using sphagnum moss mixed in with a sand substrate absorbed excess water and possibly preventing it from flooding the nest chamber. Temperature in the nest chamber during egg collection was 21.7˚C and during the three-month study a maximum temperature of 28.8˚C was recorded. The slow incremental increase in temperature that occurred in the nest chamber may have allowed the growing foetuses to adapt to these changes. However, Eidenmuller & Reisinger (2011) mention that *Heloderma* eggs are not as sensitive to temperature fluctuations as other reptile eggs. A rapid change in temperature from the lowest to highest values recorded may have had an adverse effect on the foetuses (Eidenmuller & Reisinger, 2011).

There were a large number of rocks in the enclosure, the interior walls were all concrete themed and the substrate mainly consisted of sand. Due to the high heat conducting ability of these elements and substances, it may have caused a slow release of heat that was advantageous to the incubating eggs when temperatures dropped during the night. A long winter cooling (brumation) has often been cited as an essential mechanism for the entire *Heloderma* genus to produce fertile eggs (Reisinger, 2006; Seward, 2006; Eidenmuller & Reisinger, 2011). Although night temperatures in the main enclosure were recorded as low as 17°C, day temperatures were maintained above 25°C with basking temperatures rarely dropping below 30°C. The breeding pair were fed all year round with no instances of specimens failing to feed when offered food. Although hibernation has been effective in breeding *H. exasperatum* (Reisinger, 2006; Eidenmuller & Reisinger, 2011) this study suggests it is not essential. For example, Eidenmuller & Reisinger (2011) express the need for a six to seven week hibernation at 15-17°C to produce fertile eggs. Air temperatures in this study dropped to as low as 17°C during nocturnal hours and it is possible that this reduction in night temperature coupled with a changing photoperiod may have been necessary to produce fertile eggs. There is a lack of published data regarding the reproductive and incubation parameters of *H. exasperatum* and further studies are needed to enhance future ex-situ management and conservation of this species.

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