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RESEARCH ARTICLE

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Captive husbandry and breeding of the Nguru spiny pygmy chameleon *Rhampholeon acuminatus*

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ABSTRACT - The Nguru spiny pygmy chameleon (*Rhampholeon acuminatus*) is endemic to the Nguru mountains in Tanzania. It is assessed as Critically Endangered and is collected from the wild for the pet trade. An ex-situ population of this species was recently established at The Wild Planet Trust, Paignton Zoo, in the hope of learning more about the husbandry and biology of this species. We report on the captive husbandry of adults and the successful breeding, hatching and rearing of juveniles. Females carried four eggs but laid them in pairs. When eggs were incubated at 19.2-22.8 °C, hatchlings emerged roughly 180 days after laying. The hatchlings had a total length of about 30 mm and weighed 0.2-0.3 g. To our knowledge, this is the first published account of captive breeding for this species. The husbandry methods described could be used to establish populations of this and other *Rhampholeon* species in captivity, which in turn would reduce the demand for wild caught (*Rhampholeon*), as well as inform future conservation breeding programmes for this species.

INTRODUCTION

The genus *Rhampholeon* (family Chamaeleonidae) comprises 19 species (The Reptile database, 2021). These are distributed across West Africa (parts of Nigeria), Central Africa and East Africa in savannah, forests and woodland habitats usually restricted to highland areas. *Rhampholeon acuminatus* Mariaux & Tilbury 2006, commonly known as the Nguru spiny pygmy chameleon, occurs in the subtropical/tropical montane forest of the Nguru Mountains in the Morogoro region of Tanzania, at 1500-1600 m a.s.l. (Mariaux & Tilbury, 2006; Tilbury, 2010). The species is assessed as Critically Endangered by the IUCN (Tolley et al., 2014). It is also considered a global priority for conservation on account of its evolutionary distinctiveness and global endangerment (EDGE, 2020).

Rhampholeon acuminatus is a crepuscular chameleon living on the lower levels of the forest in leaf litter or perching on low vegetation between 50 cm and 700 cm high (Tilbury, 2010). They are sexually dimorphic; the males are more slender and longer than females, up to 63-71 mm total length with a longer tail that accounts for 25-30 % of this length, and when mature have a larger downward pointing rostral extension (Fig. 1) (Mariaux & Tilbury, 2006; Hildenhagen, 2007). Females have a shorter and more rounded body and when gravid are extremely round due to the large size of the eggs. The mating behaviour of this species is not documented but is likely to be similar to *Rhampholeon spinosus* in which males will chase the females. If the females are receptive then they will remain a light colour, while unreceptive females will change to darker colours and will display aggressive postures at approaching males. Gravid females *R. spinosus* carry 3-4 eggs (each 11 x 6 mm) and descend to the ground to lay them in leaf litter and soil; females may lay several clutches a year and once laying is finished the females' bloated shape will reduce significantly (Hildenhagen, 2007). Although *R. acuminatus* has been kept and bred by private breeders, the methods used to breed them and keep them successfully have not been reported.

Figure 1. Adult female (left) and adult male (right) *Rhampholeon acuminatus* showing the larger rostral extension of the male

MATERIALS & METHODS

Origin of captive specimens

On 25th October 2019, a group of 17 *R. acuminatus* were donated from a private collection in the United Kingdom that had held the founders of the group in captivity since 2016. The founder animals were acquired before CITES was in place for protecting this species; the species was added to CITES appendix II in 2017 (Species+, 2021). The group comprised one adult male, three large adult females, three subadult males and four small adult females, with the remaining six of undetermined sex. Two of the large adult females appeared to be gravid on arrival given their swollen abdomens and

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because they displayed aggressively when approached by the male. The largest female weighed 4.24 g on arrival and the male weighed 3.81 g. Within the adult group, one male and one female were of wild origin and came into captivity in 2016 as subadults.

Captive enclosure

To form a breeding group, the adult male, three large adult females and the largest two of smaller adult females were housed together in a 65 x 127 x 55 cm aluminium-framed mesh enclosure (Fig. 2) (Chameleon World Muji). To help maintain humidity, the ventilation rate was reduced by replacing the mesh on the left side of the enclosure with a solid foamex panel and the mesh at the back of the enclosure was pressed against a vinyl wall. The enclosure was placed on a shelf in a 20 cm-deep tray made of foamex to allow for a deep substrate of leaf litter, soil and moss. The soil was a mixture of coir and organic compost with a layer of sphagnum moss on top covered with a thin layer leaf litter. The enclosure was simply furnished with plants such as *Ficus microcarpa* and *Ficus benjamina* with lots of thin twigged branching and vines. A water dish was not provided as the enclosure was heavily sprayed once in the morning and again in the early evening (for roughly 10 minutes) with aged tap water. The water used to spray the chameleon enclosure was warm (19-23 °C), approximately neutral (pH 6.8-7), with carbonate hardness (KH: 3-6 °d) and general hardness (GH: 8 °d).

Figure 2. Enclosure used to house the breeding group of *Rhampholeon acuminatus*

Lighting and heating arrangements

Rhampholeon acuminatus is reported to occur in forests with canopy cover and in the wild hides in low vegetation under the canopy (Tilbury, 2010). We provided full spectrum lighting, including UV, with plenty of plant cover to create dappled light. UV light was provided by using a 55 cm lamp (Arcadia T5 D3 6 % Reptile Lamp 24watt) with a reflector, placed directly on the mesh top of the enclosure, covering around 50 % of the top with a gradient extending to the enclosure floor. The lamp was set to turn on at 10:00 h and off at 19:00 h. The UV index was measured monthly with a Solarmeter 6.5 UV index meter (Solartech Inc., Harrison Township, MI); UVI gradients were measured through the mesh and ranged 0-3 UVI at the level of the branches where the chameleons were perched. An Exo Terra Daylight Basking Spot (25 W in a 14 cm Arcadia Ceramic Reflector Dome Clamp Lamp) was used to create a small basking zone and temperature gradient giving a surface temperature of up to 29 °C. Temperature was measured using a mini RayTemp infrared thermometer (Electronic Temperature Instruments Ltd, Sussex, UK). The basking lamp was placed as close to the UV lamps as possible so the lights overlapped in the enclosure. The basking lamp was controlled by a dial timer set to turn on at 10:00 h and off at 19:00 h. Ambient full colour lighting was provided by a GroBeam 800 ND Natural Daylight LED (Tropical Marine Centre Ltd, Rickmansworth, UK) placed above the UV light, controlled by a AquaRay SmartControl 8 (Tropical Marine Centre Ltd, Rickmansworth, UK) so that the light came on at 07:30 h, ramping up from 1 % to 100 % in 20 minutes to give a 'dawn', and vice versa to give a dusk that finished at 20:00 h. Photoperiod was the same throughout October-April and set according to data from Tanzania on the season's day length and sunlight hours (Time and Date, 2019). Ambient temperature in the room where the enclosure was maintained was controlled by a wall mounted air-conditioning unit set to 19 °C which gave a temperature range in the room of 19-23 °C and relative humidity range of 30-50 %. Two thermometers were installed in the breeding enclosure, one at substrate level the other at the top of the enclosure. In a 24-hour period, the night / day temperature range at substrate level was 16.7-21.4 °C while the top of the enclosure was 19.0-29.0 °C. These temperature ranges were not altered by changes to air conditioning unit settings or the installation of additional heating or cooling equipment from the time of the chameleons' arrival to the hatching of young, between October-April. There was a night time temperature drop of 2-3 °C degrees as a result of lighting going off at night.

Feeding arrangements

The diet consisted of crickets (*Gryllus assimilis* and *Gryllus bimaculatus*), fruit flies (*Drosophila melanogaster* and *Drosophila hydei*), bean weevils (*Callosobruchus maculatus*), grain weevils (*Sitophilus granarius*) and hatchling hoppers (*Schistocerca gregaria*). Chameleons were fed three to four times a week. The food was dusted 1-2 times/week with Repashy Calcium Plus, vitamin and calcium supplement (Repashy Ventures, Inc., 4135 Avenida, De La Plata, Oceanside, USA).

RESULTS

Four days after arrival, the two smallest adult females were removed from the breeding enclosure and moved to an enclosure with the other two smaller adult females, as we noticed that they were showing signs of stress, indicated by a change in colour and black lateral stripes on the body (Fig. 3).

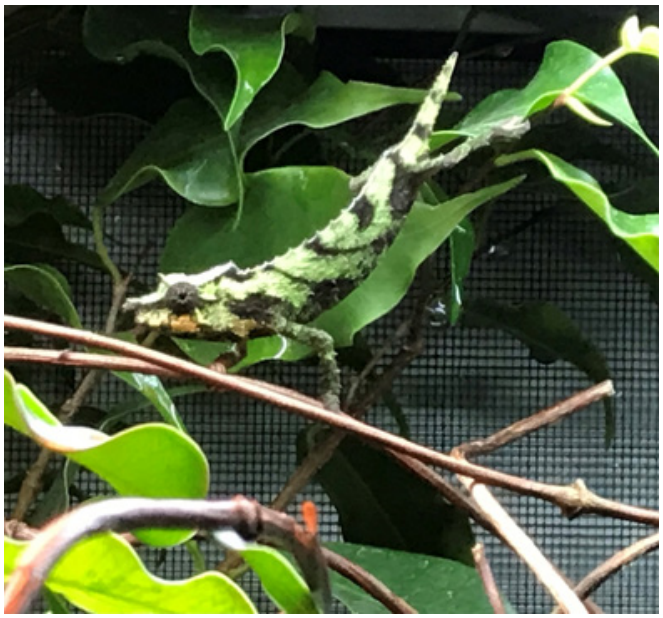

Figure 3. Adult female *Rhampholeon acuminatus* showing dark lateral markings to warn off a pursuing male

Since receiving the chameleons, we have never observed copulation in our breeding group. The first hatchling was discovered on 17th April 2020 in the breeding enclosure, with a second found in the afternoon on the same day. They both weighed 0.3 g and measured 30 mm total length (Fig. 4). The hatchlings were left in with the adults for the first three days before they were transferred to a smaller enclosure, setup in the same way as the adults, so they could be monitored during rearing. All subsequent hatchlings were also moved to smaller enclosures. On 23rd April 2020, a hatchling was found in the single sex group of the four young adult females, this individual was only 0.2 g and unfortunately only survived for two days. All eggs were incubated and hatched naturally within the enclosure so we are unable to determine the exact length of incubation. However, given that two of the adult females appeared to be gravid on arrival and that the two smaller adult females spent four days with the male before being separated (and had previously never been housed with a male) we would estimate an incubation period of no longer than 180 days.

Figure 4. Recently hatched young *Rhampholeon acuminatus* (left) and a specimen that is about 2-weeks older (right)

Since the 23rd April 2020 we have successfully raised 12 juveniles from the three large adult females and the four small adult females (that previously had been considered to be sub-adult). When finding juveniles in the enclosure we almost always found them in pairs. Newly laid eggs measured 10 mm whilst more developed eggs measured 14 mm and the young all hatched weighing about 0.3 g and measuring 30 mm total length. Females laid eggs beneath moss and leaf litter in the first 1 cm of soil; they favoured certain locations laying several clutches in the same spot (Fig. 5). Remnant egg shells were found just below the surface of some moss which had a probed temperature of 19.2-22.8 °C. Clutch sizes are assumed to be four eggs but are possibly laid two at a time as juveniles hatched in pairs. However, when searching through the substrate we sometimes found up to 8 eggs laid in the same location. This suggests that females shared laying sites.

Figure 5. Several eggs of *Rhampholeon acuminatus* found under moss, at varied developmental stages

DISCUSSION

As anticipated, the breeding activities of *R. acuminatus* were similar to those described for *R. spinosus* (Necas & Schmidt, 2004). During courtship, male *R. acuminatus* will chase the females, which if receptive will remain a light colour. If unreceptive, females will change colour, adopt darker markings, and will display aggressive postures; similar responses have been reported for *R. spinosus* (Hildenhagen, 2007). Female *R. acuminatus* also appear to show signs of swelling when gravid (Hildenhagen, 2007). We assume that copulation in *R. acuminatus* occurs during dawn / dusk as we did not observe this behaviour between 08:00 h and 18:00 h. The females lay eggs in leaf litter and soil on the ground and appear to be able to lay several clutches a year (Necas & Schmidt, 2004). Based on our findings, *R. acuminatus* has a similar incubation period to *Rhampholeon spinosus* (Necas & Schmidt, 2004). Our recommendation is that breeding adults

are housed together in small groups with three females housed per one male as this reduces the stress on them. The male can then be removed periodically for a couple of months to give the females a break.

At emergence, hatchlings weigh only 0.3 g and are 30 mm long; they reach sexual maturity after 8-9 months. This is comparable to reports for *Rhampholeon spinosus* which also measure 30 mm at hatching and reaching sexual maturity at 9 months (Hildenhagen, 2007). Eggs can be left in situ to develop and do not need to be removed and placed in an incubator. Hatchlings should be removed from the adult enclosure as soon as they are found, as this makes them easier to monitor closely and keep track of their development. They can be reared in small mesh enclosures with cork bark covering the sides to increase humidity. We housed up to 8 hatchlings in a 38 x 51 x 38 cm aluminium framed mesh enclosure (Chameleon World Muji). The enclosures were setup with lots of thin branching and vegetation to create visual barriers and hiding places for them. They should be fed every other day on small food items such as fruit flies (*D. melanogaster*) and springtails (*Entognatha*). Juveniles can be reared in groups and separated once males and females can be identified then raised in single sexed groups. We have had no obvious issues raising males together however once they were fully mature, we house them individually.

The methods described here can be used for ex-situ management for species conservation to increase the captive population of this species. Given the similarities between *R. acuminatus* and *R. spinosus* it seems likely that the approach we have taken to captive breeding may well be suitable for other threatened species within the same genus.

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