

NOTES ON THE OVIPOSITIONAL BEHAVIOR OF *CALOTES CALOTES* (LINNAEUS, 1758) (REPTILIA: AGAMIDAE) IN SRI LANKA

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Abstract: This is the first completely described observation of the oviposition behavior of the common Green Garden Lizard *Calotes calotes* from Sri Lanka. This oviposition behaviour consisted of the digging of the nest hole to lay the eggs, the laying of the eggs (N: 5; mean 18.5 mm long, 8.8 mm wide), the scraping of the soil to bury the eggs, the filling of the spaces between the eggs, the compression of the soil, and the camouflage of the nest.

Key Words: Agamidae, *Calotes calotes*, Colombo, Ovipositional behaviour, Conservation, Sri Lanka.

Resumen: D.E. Gabadage, A.A.T. Amarasinghe y M.M. Bahir. "Notas sobre el comportamiento territorial de *Calotes calotes* (Linnaeus, 1758)(Reptilia: Agamidae) en Sri Lanka". Esta es la primera observación completamente descrita del comportamiento de oviposición en el lagarto verde común de jardín *Calotes calotes* de Sri Lanka. Este comportamiento de oviposición consistió en la excavación del hueco nido para depositar los huevos, la postura de los huevos (N:5; largo promedio 18.5 mm, ancho promedio 8.8 mm), la excavación del suelo para depositar los huevos, el llenado de los espacios entre los huevos, la compresión de suelo, y el camuflaje del nido.

Palabras Clave: Agamidae, *Calotes calotes*, Colombo, Comportamiento oviposicional, Conservación, Sri Lanka.

INTRODUCTION

Sri Lanka is a biodiversity hotspot together with the Western Ghats of Southern India and the area is rich in herpetofaunal assemblages (Bossuyt et al. 2004; Meegaskumbura et al. 2002; Myers et al. 2000). This region is also recognized as one of the most populous hotspots (Cincotta et al. 2000). Eighteen species of agamid lizards, family Agamidae, have been recognized from Sri Lanka and fifteen (83%) of them are endemic to the island (Bahir & Surasinghe 2005, de Silva 2006, Manamendra-Arachchi et al. 2006), representing a single subfamily, the Draconinae (Macey et al. 2000). The genus *Calotes* is represented by seven species (Bahir & Maduwage 2005). Five of them (*C. ceylonensis* Müller, 1887; *C. liocephalus* Günther, 1872; *C. liolepis* Boulenger, 1885; *C. nigrilabris* Peters, 1860; *C. desilvai* Bahir & Maduwage, 2005) are endemic. The remaining two, *Calotes calotes* (Linnaeus, 1758) and *C. versicolor* (Daudin, 1802) are probably widespread species throughout South and South East Asia (Taylor, 1953).

According to the published literature, *Calotes calotes* is the largest among Sri Lankan agamid lizards (Manamendra-Arachchi & Liyanage 1994). This species occurs throughout Sri Lanka in the plains and mid hills up to elevations of 1500 m (Das & de Silva 2005; Manamendra-Arachchi & Liyanage 1994). This species is more abundant in the wet zone than in the dry zone (Erdelen 1984), is largely arboreal and mainly found in man-made habitats and

evergreen forests. It inhabits shrubs as well as tree trunks, close to streams (Das & de Silva 2005; Erdelen 1978; Manamendra-Arachchi & Liyanage 1994).

According to Das & de Silva (2005) and Deraniyagala (1953), the female digs a hole nest in the ground about 70 mm deep, deposits 6-12 eggs in April- September, the eggs are 18-18.5 mm x 12-12.5 mm in size and the period of incubation is 79-84 days. However, the ovipositional behaviour has not been explained in detail so far. Accordingly, this note intends to highlight further details on the ovipositioning behaviour of this species in nature.

MATERIALS AND METHODS

Study area and habitat

Observations were made approximately 100 m from Maharagama Town in Colombo District, Western Province, Sri Lanka. The ground was a vegetable nursery that was covered with leaf litter. The soil was light, soft and with loosely-bound particles. The soil layer presented air cavities, also. There was approximately 75% canopy cover and the undergrowth consisted of manioc, chilli and other exotic plants. The air temperature was 27.0 °C and the humidity 70%. At that day, the weather was sunny and the cloud cover was 4/8 even when there was a rain during the previous day.

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Observations and measurements

Observations of the lizard were made by the naked eye from 2 m away from the lizards, between 12:40 and 16:20 hours. The animals were not disturbed during the observations. All measurements were taken to the nearest 0.1 mm using a Tricle brand® (Shanghai, China) dial vernier caliper. A digital thermometer and a digital hygrometer are used to measure air temperature and humidity. The collected specimen was examined carefully and measured before releasing it to the same habitat. The diagnostic keys given by Deraniyagala (1953), Smith (1935) and Taylor (1953) were used for species identification.

RESULTS

Observations on digging the nest hole

A mature female *Calotes calotes* (snout to vent length: 98 mm and tail length: 385 mm) lying on the ground in a human habitation at Maharagama (6°50'54.73" N and 79°55'39.46" E) was observed on 28 January 2009 at about 12:40 h. First, the lizard was observed while resting on an exotic plant about one meter above ground. At this time, another *Calotes calotes*, a male, was sit on a Ceylon Olive/Veralu tree, *Eleocarpus serratus* (Family: Elaeocarpaceae) (DBH: 35 cm) at about one meter above the ground level. The female moved down from the exotic plant and came near to the Ceylon Olive tree. Then it looked around for about 30 seconds. During this time it repeatedly turned its head about 150° four times, without moving its body. At this time the lizard turned its body colour to dull green and the white coloured cross-bands disappeared, probably to camouflage with the background. Then the female started digging the ground while scraping the soil with its hands one after the other, without turning its body. In addition, it used hind limbs to pull the scraped soil away. During this time the above-mentioned male remained on the Ceylon Olive tree while observing the nest-making female.

The dug soil was thrown backwards through its raised hind limbs. While digging, it made the margin and inner wall of the nest hole by pressing the soil with the supra-ocular region, snout-tip and anterior half of its lower jaw, to avoid the collapsing. Then it stopped digging and looked around for approximately one minute while repeatedly turning its head about 90° ten times, without moving its body. After that, the female continued to dig the hole for another hour, stopping fifteen more times for about one minute each, to rest. The hole-nest was dug into the ground at a 35° angle. The hole-nest measured 60.5 mm deep and 35.0 mm in diameter. While digging the hole-nest, it placed its head totally inside the cavity. During the rest of the intervals, the tail was kept coiled.

Laying the eggs

After two hours of digging, it turned its body 180° clockwise; placing the posterior part of its body at the opening of the hole-nest and the tail was coiled at the outer margin of the hole. It then looked around, again. The significance of this egg laying behaviour was that the female laid eggs in the hole without lifting its limbs, while gripping well the ground and placing its limbs at the sides of the nest-hole. The

head and breast were gripping the ground during the whole period. Five eggs were laid at a rate of one every two minutes. The last two were laid outside the hole-nest, but the female kick them into the hole-nest using its snout-tip. The thin shelled eggs were pure white and elliptic, and measure an average length of 18.5 mm and a mean width of 8.5 mm. After the egg-laying process, the female stayed without any movement, looking around for about 6 minutes.

Burying the eggs and camouflaging the nest

After the resting time, the egg-laying female turned 180° clockwise and crept back into the hole-nest for about five minutes to pack and place the eggs below ground level using the anterior part of its lower jaw. Then it stayed without any movement looking around for about two minutes. Then it began to drag the soil towards the hole using its hands one after the other. After dragging the soil it turned 180° counterclockwise and started pressing the soil with the tip-of-snout and anterior half of its lower jaw for nearly half an hour.

The hole was completely filled up to the ground level. After looking around, it dragged the surrounding fallen leaves of Ceylon Olive tree over the nest for camouflage. It remained motionless for nearly five minutes and this time it changed its body color into light green and then moved slowly towards to the exotic plant where it was observed first.

Additional observations

The female climbed the exotic plant up to about one meter from the ground and rested on a horizontal branch. Then, the male lying on the Ceylon Olive tree suddenly ran down and climbed the plant where the female rested. Suddenly, the male caught the female and gripped the female's shoulders using its forelimbs. The female showed opposition to this action, but it had not enough energy to escape. And this time the female raised its tail from the base and then they copulated for nearly 10 minutes. After that, the male released its grip to escape away. However, the female lied on the plant motionless for nearly twelve minutes. After that, the specimen was caught for measurement, and then released to the same place with minimal disturbance to the animal.

DISCUSSION

Though the *Calotes calotes* is one of the most common agamid lizards in Sri Lanka, unfortunately its oviposition behavior has not been documented, even though it has been commonly seen by many naturalists and conservationists over the years. We believe this note will serve as useful information on the nesting behavior of the species. The recent interest on the oviposition behaviors of Sri Lankan Agamidae has documented the behaviors of most of the *Calotes* in Sri Lanka except *Calotes nigrilabris*, *Calotes desilvai* and the species described herein.

The ovipositional behavior of *Calotes calotes* varies from the ovipositional behavior of *C. versicolor*, *C. ceylonensis* and *C. liocephalus*. According to Amarasinghe & Karunarathna (2007 and 2008), Karunarathna et al. (2009) and Pradeep & Amarasinghe (2009), *C. versicolor* places its cloacal aperture over the opening

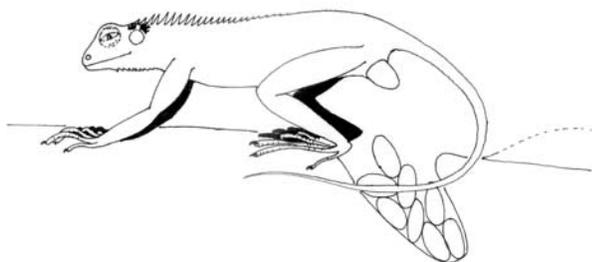


FIG. 1. Egg laying of *C. versicolor* (Daudin, 1802).
Postura de huevos de C. versicolor (Daudin, 1802).

of the hole while laying its eggs lifting its hind limbs (Figure 1); *C. liocephalus* places the posterior part of the body inside the hole while laying eggs (Figure 2), but *C. calotes* places the posterior part of the body at the opening of the hole and the tail remains coiled at the outer margin of the hole, while eggs are laid to the hole without lifting the hind limbs (Figure 3), somewhat similar to *C. liolepis* and *C. ceylonensis* (Figure 4). The *C. versicolor* lifts the anterior part of the body with its forelimbs, while turning its head to look around (Amarasinghe & Karunarathna, 2007), *C. liocephalus* coils its entire body inside the hole while bending the anterior part of its body to look around (Amarasinghe & Karunarathna, 2008), *C. liolepis* coils the tail inside the hole with the head bent at an angle of 90° to looking around (Karunarathna *et al.* 2009), but *C. calotes* and *C. ceylonensis* only turn the head at an angle of 90° to look around (Pradeep & Amarasinghe 2009).

The *C. liocephalus* places the eggs softly without making any noise (Amarasinghe & Karunarathna 2008) but *C. liolepis* does not show any packing behavior after laying eggs, but it makes a knocking noise while hitting to press the soil in the hole using its lower jaw (Karunarathna *et al.* 2009). *Calotes calotes* makes a knocking noise while packing and placing the eggs in the hole using its lower jaw similar to *C. ceylonensis* and *C. versicolor* (see Pradeep & Amarasinghe 2009 and Amarasinghe & Karunarathna 2007).

Calotes versicolor, *C. liocephalus* and *C. calotes* do not mark the body pit to dig the hole nest (Amarasinghe & Karunarathna 2007 and 2008) as has been reported for *C. liolepis* and *C. ceylonensis*, and they do not use hind limbs to pull the soil into the hole (Karunarathna *et al.* 2009; Pradeep & Amarasinghe 2009). Also, *C. calotes* throws the soil backward under its body through its raised

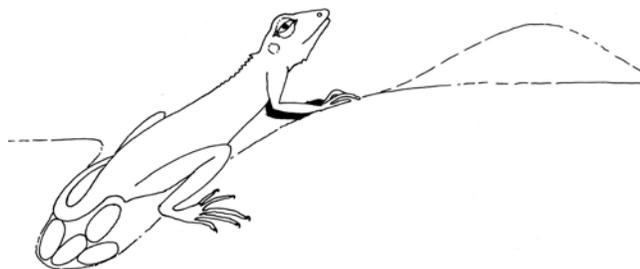


FIG. 2. Egg laying of *C. liocephalus* Günther, 1872.
Postura de huevos de C. liocephalus Günther, 1872.



FIG. 3. Egg laying of *C. calotes* (Linnaeus, 1758).
Postura de huevos de C. calotes (Linnaeus, 1758).

hind limbs, in a way similar to *C. versicolor*, *C. liocephalus* and *C. ceylonensis* (Amarasinghe & Karunarathna 2007 and 2008; Pradeep & Amarasinghe 2009), but *C. liolepis* throws the soil backwards alongside its body (Karunarathna *et al.* 2009). *C. liolepis* dug the hole straight inward to the ground (Karunarathna *et al.* 2009) while *C. versicolor*, *C. ceylonensis* and *C. liocephalus* (Amarasinghe & Karunarathna 2007 and 2008; Pradeep & Amarasinghe 2009) dug the hole into the ground at a 45° angle. However, *C. calotes* dug the hole into the ground at a 35° angle.

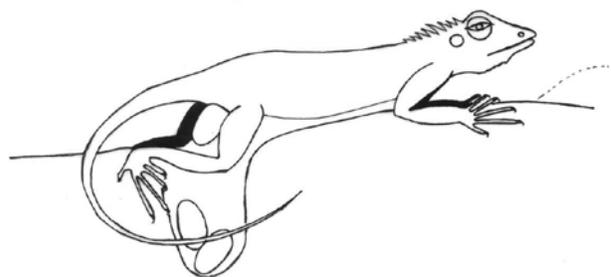


FIG. 4. Egg laying of *C. ceylonensis* Müller, 1887.
Postura de huevos de C. ceylonensis Müller, 1887.

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