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NATURAL HISTORY AND CONSERVATION STATUS OF *CALODACTYLODES ILLINGWORTHORUM* DERANIYAGALA, 1953 (SAURIA: GEKKONIDAE) IN SOUTH-EASTERN SRI LANKA

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Abstract: The endangered golden gecko, *Calodactylodes illingworthorum* is one of the largest geckos recorded in Sri Lanka. Populations of this species have been found from 23 dry mixed evergreen forest patches in Uva Province. During our surveys, we could identify 94 granite caves (elevation between about 125 to 800 m a.s.l.). Of these, 77 locations were represented as egg deposition sites for a total of 1010 eggs. Total number of individuals was counted as 197. Here we observed behaviour, ecology, and distribution, which may be important for future conservation studies on this species. However, those important forest patches are threatened by anthropogenic activities such as explosion granite boulders, illegal logging and man-made forest fires. Thus, urgent conservation measures are required to conserve this species.

Key words: Asia, Behaviour, Distribution, Ecology, Gekko, Reptilia.

Resumen: D.M.S.S. Karunarathna y A.A.T. Amarasinghe. "Historia natural y estatus de conservación de *Calodactylodes illingworthorum* **Deraniyagala, 1953 (Sauria: Gekkonidae) en el sureste de Sri Lanka"**. El amenazado geco dorado, *Calodactylodes illingworthorum*, es uno de los mayores gecos registrados en Sri Lanka. Poblaciones de esta especie han sido encontradas en 23 parches mixtos de bosque siempreverde seco en la Provincia Uva. Durante nuestros muestreos, pudimos identificar 94 cuevas graníticas (elevación entre cerca 125 a 800 m s.n.m.). De esas, 77 localidades fueron representadas como sitios de depositación de nidadas, para un total de 1010 huevos. El número total de individuos fue 197. Aquí observamos comportamiento, ecología, y distribución, que puede ser importante para futuros estudios de conservación de esta especie. No obstante, estos parches importantes de bosque están amenazados por actividades antropogénicas tales como explosión de rocas graníticas, tala ilegal e incendios forestales provocados por el hombre. Por consiguiente, se requiere medidas de conservación urgentes para preservar esta especie.

Palabras clave: Asia, Comportamiento, Distribución, Ecología, Geco, Reptilia.

INTRODUCTION

Geckos are found throughout the world and belong to one of the most species-rich lizard families, second only to the skinks (Daniel 2002; Das 1994, 2001; Pough *et al.* 2004), and are the smallest, active and most primitive, living saurians in Asia and other parts of the world (Deraniyagala 1953a, Halliday and Adler 2002, Somaweera and Somaweera 2009). In Sri Lanka, there are 42 species belonging to eight genera, and 33 (>78 %) of them are endemic to the island (de Silva 2006; Manamendra-Arachchi 1995; Manamendra-Arachchi *et al.* 2007; Somaweera and Somaweera, 2009; Wickramasinghe and Munindradasa 2007). The gecko fauna of the island is not well studied, except for a recent interest on their taxonomy; further studies on ecology and natural history are important. The Sri Lankan gecko fauna faces many threats, natural and anthropogenic impacts (de Silva *et al.* 2004a, Wickramasinghe 2006). The gekkonid lizard genus *Calodactylodes* Strand, 1926 is endemic to the peninsular India and Sri Lanka (Bauer and Das 2000, Daniel 2002, Das and de Silva 2005, de Silva 1994 and 1998, Javed *et al.* 2007).

The first described species in the genus *Calodactylodes* came from Tripathy Hill, in India, and was named as *C. aureus* (Beddome 1870, Daniel *et al*. 1986). After 83 years of the discovery of this endemic lizard, Deraniyagala (1953b) described a second species, *Calodactylodes illingworthi* (now *C. illingworthorum)*, from the Nuwaragala area of Sri Lanka at the Eastern Province of the country. The specimen collected on 15 to 20 March 1953 from Pollebeddhe-Mahaoya (National Museum Sri Lanka – uncatalogued) is labeled as the holotype, but it is unmatched with the description (Amarasinghe *et al.* 2009). Both *C. aureus* and *C. illingworthorum* species inhabit restricted habitats in both countries, India and Sri Lanka (Deraniyagala 1953a, Daniel 2002, Russel and Bauer 1989, Wickramasinghe and Somaweera 2003). The natural history, distribution and ecological aspects of the Sri Lankan golden rock gecko, *C. illingworthorum*, have been documented by Bauer and Das (2000), Das and de Silva (2005), Deraniyagala (1953a), de Silva *et al.* (2004a, 2004b), Goonatilake and Peries (2001), Manamendra-Arachchi (1997), Rathnayake (2004), Somaweera and Somaweera (2009), and Wickramasinghe and Somaweera (2003). In this paper, we discuss the current status of *C. illingworthorum*, including its conservation, ecology, threats and recent distribution patterns.

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MATERIALS AND METHODS

This paper is mainly based on the data collected by authors from January 2002 to April 2008, during opportunistic field visits to South-Eastern Sri Lanka (Fig. 1). Surveys were conducted by both day and night. Flashlights were used during night sampling, and the surveys were carried out for nearly six years in both wet and dry seasons. We recorded details of eggs, individuals (males/females/juveniles/adults), egg laying sites and cave habitats. The individuals were captured alive. All the external measurements of the specimens were taken with a Tricle ® brand vernier caliper to the nearest 0.1mm, and animals were released to the places from where they were captured, after recording data at the original locations. Scale counts and morphological characters were taken by using a Triplet ® brand 18 mm X 10 hand lens. A non-parametric test (Mann-Whitney U-test) with a 5% significant level was used for comparison of independent samples to find the difference between number of eggs and *Calodactylodes illingworthorum* individuals. Species identification was based on Bauer and Das (2000) and Deraniyagala (1953a, 1953b).

RESULTS AND DISCUSSION

According to our observations *Calodactylodes illingworthorum* is restricted to eastern and south-eastern parts of the dry zones of Sri Lanka, between circa 125 to 800 m a.s.l. However, there is no relationship between the number of eggs or number of individuals and the elevation from 125 m to 800 m above sea level (Fig. 2).

During our surveys we could identify 94 important granite caves. Out of them, 77 locations were represented as egg deposition sites (breeding grounds/sites) (Fig. 3). In these egg-deposition sites we counted a total of 1010 eggs; 197 individuals were recorded during the whole study period. In Koslanda and Ul-hela areas we could identify minimal number of caves (1 each). The most numbers of

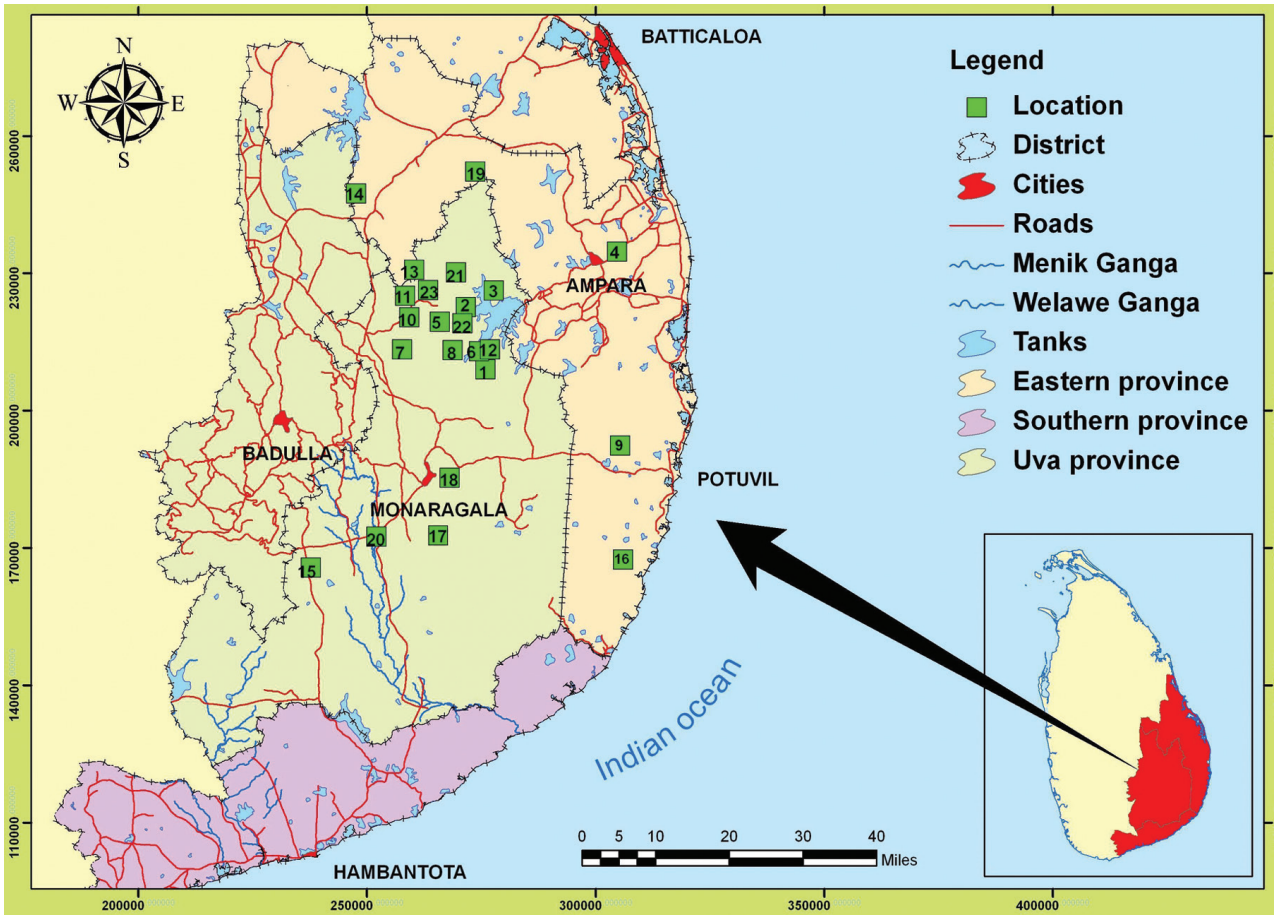

FIG. 1. Study locations of *Calodactylodes illingworthorum* within Sri Lanka. Locations numbers as follows: (1) Baduluwelakanda, (2) Bambarabeddegala, (3) Beddegala (4) Buddangala, (5) Bulupitiyahela, (6) Dambadeniyahela, (7) Godigamuwahela, (8) Guruhela, (9) Habuthagala, (10) Hamapolakanda, (11) Hangala, (12) Hewamedillahela, (13) Karandugala, (14) Kokagalakanda, (15) Koslanda, (16) Kudumbigala, (17) Maligathenna, (18) Maragalakanda, (19) Nuwaragala, (20) Rahathangala, (21) Rathugala, (22) Ulhela, (23) Yakunhela.

Localidades de estudio de Calodactylodes illingworthorum *en Sri Lanka. Numero de localidades como sigue: (1) Baduluwelakanda, (2) Bambarabeddegala, (3) Beddegala (4) Buddangala, (5) Bulupitiyahela, (6) Dambadeniyahela, (7) Godigamuwahela, (8) Guruhela, (9) Habuthagala, (10) Hamapolakanda, (11) Hangala, (12) Hewamedillahela, (13) Karandugala, (14) Kokagalakanda, (15) Koslanda, (16) Kudumbigala, (17) Maligathenna, (18) Maragalakanda, (19) Nuwaragala, (20) Rahathangala, (21) Rathugala, (22) Ulhela, (23) Yakunhela.*

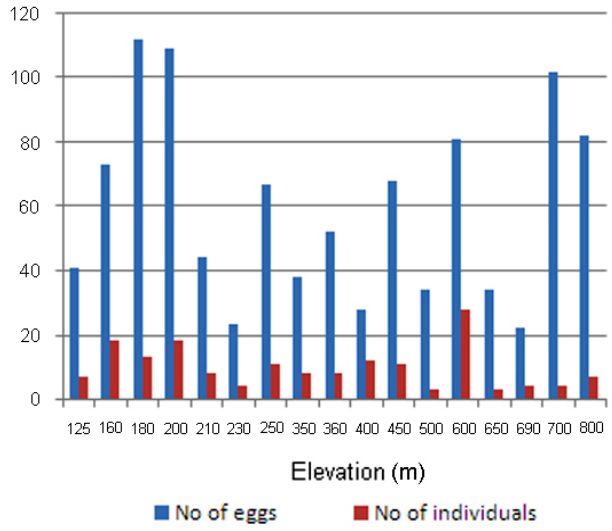

FIG. 2. Relationship between the number of eggs/individuals and the elevation.
Relación entre el número de huevos/ individuos y la elevación.

caves were recorded from Baduluwela-Kanda (6), Hewamadilla-hela (6), and Kudumbi-gala (7) and Yakun-hela (9) areas.

The least number of egg- deposition sites were documented from Bambarabadda-gala (1) and Koslanda (1), while Habutha-gala (6), Hewamadilla-hela (6), Yakun-hela (6) and Karandu-gala (7) evidenced the most. The smallest number of egg count in a deposition site represented Bambara-baddagala (13) and Han-gala (18) caves and the largest counts traced from Maragala-Kanda (82) and Yakun-hela (102) caves. We could trace highest number of individuals from Bulupitiya-hela (16) and Maligathenna (18) caves while least from Han-gala (2) and Nuwara-gala (2) caves. The average of the relative frequency of individuals in each habitat is 4.35 (Fig. 4). The number of eggs and the number of individuals found in those habitats do not show any relationship (Mann-Whitney U-test: Z = .76, n_1 = 23, n_2 = 23, 2-tailed P = <0.0001).

Of 197 individuals, 96 were found on granite caves, 51 on anthills associate with rock boulders, 39 on clay-walls and 11 on cement mixed-clay-walls (Fig. 5). Out of 77 egg deposition sites, 72 represented dark granite caves, and we could only locate 5 sites on anthills associated with rock boulders. Most of caves were enclosed with huge anthills. *Calodactylodes illingworthorum* use these anthills and granite caves for hunting their preys. We have never found any individual on tree trunks, but de Silva *et al.* (2004a) recorded the species from this habitat type. Only in hermitages we located some individuals from clay-walls rarely. Especially as these hermitages are in cool and shady places because of closed forest and many streams flows nearby them. Therefore, a considerable number of individuals inhabits in hermitages, associated with sacred groves. Within short time period these geckos adapt to clay-walls of abandoned buildings close to the forest. We observed a considerable competition for food among geckos that lives on clay-walls or abandoned buildings. All these egg deposition sites were well covered from the direct sunlight and heavy rain.

We have never observed more than one female laying eggs at the same time normally lays one to four eggs, even when de Silva *et al.* (2004a) and Somaweera and Somaweera (2009) recorded one to two eggs at one time. These geckos are very active from 1700 h to 2200 h. From 2300 h to 0400 h they are inactive. During the daytime, from 1100 h to 1400 h, they lie motionless on the interior surface of granite rock caves. At the same time we can observe a group of *C. illingworthorum* lying on the surface. We further observed six granite caves in Baduluwela Kanda; in that hill we located three egg- deposition sites with 38 eggs and eight mature adults. We observed once an *Oligodon sublineatus* feeding on *C. illingworthorum* eggs in one evening.

The human impact of this area is high and the forest fragmentation is increasing rapidly due to the deforestation for paddy cultivations. In addition, the granite rocks are demolished for building purposes. There is a small population of *C. illingworthorum* in the Bambarabadda-gala area. There, we observed a cannibalistic behavior of *C. illingworthorum* for the first time. In Badde-gala we detected 46 eggs in four egg-deposition sites, but the mature individual count is very low (*n*=2). The golden geckos engage in a variety of social behaviours, most conspicuously they vocalize very loudly (Werner *et al*. 2008). According to Somaweera and Somaweera (2009) "this species have a multiple chirp call like a high-pitched rapid chatter, loud enough to be heard at some distance, perhaps about as loud as average human conversational speech". This area has been fired regularly for chena cultivations. The local villagers recognize this gecko as Patha-Angili Hoona (= Giant-finger Gecko) (Fig. 6).

Buddhan-gala is a famous hermitage in Sri Lanka. There are numbers of suitable microhabitats for *C. illingworthorum*, but the mature individual count in each of them is very low (*n* = 3). In this location *C. illingworthorum* is sympatric with *Hemidactylus maculates hunae* and *H. depressus* geckos (de Silva *et al*. 2004a), and we also observed *C. illingworthorum* in sympatry with *Cnemaspis podihuna*.

FIG. 3. Egg deposition site of *Calodactylodes illingworthorum.*
Sitio de depositación de huevos de Calodactylodes illingworthorum.

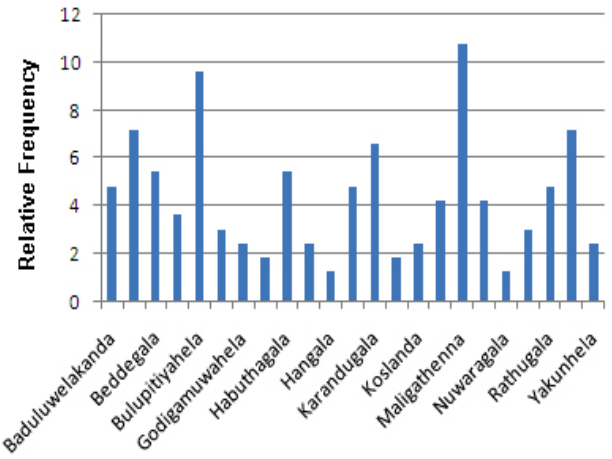

FIG. 4. Relative frequency of individuals in each habitat.
Frecuencia relativa de individuos en cada hábitat.

The Bulupitiya-hela is a deep-slope area and considerable numbers of individuals dwell in rocky cleavages, which are placed in the above slope area. This slope is very dry because it faces leeward. During our study we observed Land Monitors *(Varanus bengalensis*) feeding on *C. illingworthorum* egg-clutches. Ul-hela is also a deep-slope area and considerable numbers of individuals dwell in rocky cleavages. In this area, *Ptys mucosa* and *Duttaphrynus melanostictus* are recorded in high abundances. Dambadeni-hela is a fine-slope area and here also a considerable number of individuals dwell in rocky cleavages, which are located in the above slope area. At night visits we monitored a *Dryocalamus nympha* feeding on *C. illingworthorum*. The snake started to swallow the gecko head first, without making any noise. At Hewamadilla we could observe a tarantula, *Poecilotheria pedersoni* in the same habitat. But we have not seen any predatory behaviors.

At the Govinda-hela area we observed two mature *C. illingworthorum* individuals fighting for a centipede inside of a granite rock cave. They fought each other for approximately eight minutes and finally both geckos gave up their prey and threw it down. In "Guru-hela" we examined the cannibalistic behavior of *C. illingworthorum* for the second time. And also we observed some fast running behaviors of *C. illingworthorum* from one cave to another on ground. In Koka-gala we could locate *C. illingworthorum* from human habitations. However, there were a considerable number of caves and rocks near to these houses. The local villagers know this gecko as "Katusu Hoona" (= Agamid Lizard like Gecko). At Maligathenna area we observed a large numbers of corked, dark eggs in egg-deposition sites, and assume black ants inflicted these eggs. Sometimes these ants may feed on the eggs. At "Habutha-gala" area, we could observe a few small cave-arts depicting *C. illingworthorum*, a fact that de Silva *et al*. (2004a,b) and Goonatilake and Peries (2001) have already mentioned. This is amazing evidence that early tribal men had paid attention to these geckos as well.

In Maligathenna area, the tribal men, the Veddas as well as villagers, are afraid of these geckos. They believe that if this species touches the body or falls onto the body or craps the body, it causes many indiscernible diseases. Therefore, tribal men, especially, kill these species whenever seen. At Kudumbi-gala (Fig. 7) we could locate a significant number of individuals from the caves. The Maraga-kanda area is cultivated with Rubber and Cocoa plantations. In this area we located a small population of *C. illingworthorum*, while *H. maculates hunae* were recorded in large population sizes. From Nuwara-gala (type locality) we could record only two individuals with two egg-deposition sites. In Rahathan-gala area we could trace many egg deposition sites without any corked eggs even darkened. The restricted areas of *C. illingworthorum* are frequently affected by fires. After considering facts, we identified some critical areas to be protected. Those areas are Maragala Kanda, Bulupitiya-hela, Karandu-gala and Maligathenna.

Conservation

The villagers that live in the above areas believe in mythical stories about this gecko. As all the above villages occur in the vicinity of Buddhist hermitages (Das and de Silva 2005; de Silva *et al*. 2004a), these temples could be made the centers for conducting awareness programs aimed at dispelling these myths. The microhabitats as well as macro habitats of this species are granite rocks. Most of the people destroy large rocks and boulders in those areas (de Silva *et al*. 2004b; Karunarathna and Amarasinghe 2008). Consequently, the authorized government establishments should minimize demolishing granite rocks as well as illegal forest clearances, chena cultivations and man-made fires. According to our observations, there is a considerable isolated but stable population of *Calodactylodes illingworthorum*. Since this species is the only one member representing the genus in Sri Lanka (Deraniyagala 1953b, Bauer and Das 2000), this taxon categorized as Endangered (IUCNSL & MENR, 2007) should deserve much more attention on conservation matters.

FIG. 5. A live *Calodactylodes illingworthorum* on cement mixed-clay-walls.
Un ejemplar vivo de Calodactylodes illingworthorum *sobre paredes con mezcla de arcilla y cemento.*

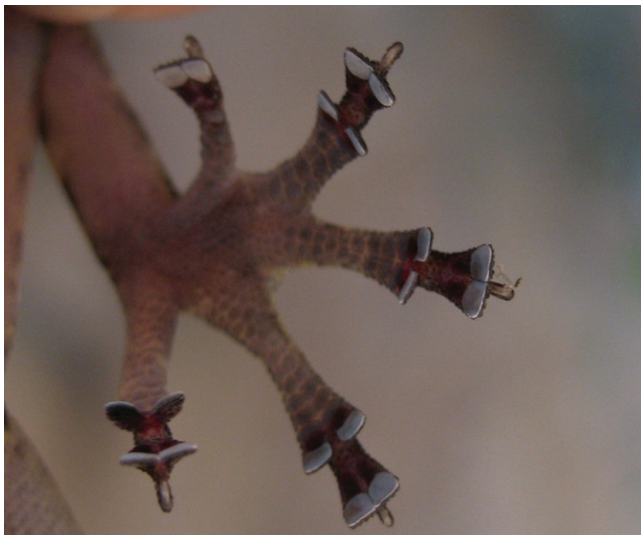

FIG. 6. Ventral view of the fingers of *Calodactylodes illingworthorum*
Vista ventral de los dedos de Calodactylodes illingworthorum.

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FIG. 7. Kudumbi-gala place used for meditation by ascetics.
Kudumbi-gala, lugar de meditación de ascetas.

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