

A new species of day gecko from high elevation in Sri Lanka, with a preliminary phylogeny of Sri Lankan *Cnemaspis* (Reptilia, Squamata, Gekkonidae)

Aaron M. Bauer^{*, 1}, Anslem de Silva², Eli Greenbaum¹ and Todd Jackman¹

¹ Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19085, USA

² 15/1 Dolosbage Road, Gampola, Sri Lanka

Received 23 October 2006, accepted 24 December 2006

Published online 5 April 2007

With 7 figures, 1 table

Key words: *Cnemaspis*, Gekkonidae, Sri Lanka, description, molecular phylogeny.

Abstract

A new species of *Cnemaspis* (Sauria, Gekkonidae) from the highlands of central Sri Lanka is described. The species is distinctive relative to all other recognized Sri Lankan congeners in possessing enlarged subcaudal scales that are pentagonal to hexagonal in shape, in having 12 femoral pores and no precloacal pores, and in its dorsal pattern of chevrons. The species is most similar to the Indian *C. jerdonii*. Molecular data support both the distinctiveness of this taxon with respect to other Sri Lankan day geckos and its affinities with *C. podihuna* and *C. scalpensis*. *Cnemaspis kandiana* and *C. tropidogaster* do not appear to be reciprocally monophyletic. *Cnemaspis modiglianii*, recently described from Pulau Enggano, near Sumatra, is also a member of the *C. kandiana* clade.

© 2007 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim

Introduction

Cnemaspis Strauch, 1887 is one of the most speciose Old World genera of geckos, and its composition has expanded rapidly in recent years as the result of the description of new species from across its range. The majority of the 50 recognized species occur in south and southeast Asia, from the Western Ghats of India to Timor (Das & Bauer 1998, 2000; Bauer & Das 1998; Kluge 2001; Das & Sengupta 2001; Das & Grismer 2003; Das & Leong 2004; Das 2005; Mukherjee et al. 2005), with 12 species occurring in equatorial Africa (Smith 1935; Perret 1986). Among the greatest areas of diversity for Asian *Cnemaspis* are the hill ranges of southern India (Western Ghats, Shevaroy Hills, southern Eastern Ghats) and the central hills of Sri Lanka (Smith 1935; Das & Bauer 2000; Bauer 2002). In recent decades a variety of new species of *Cnemaspis* have been described from the Indian states of Goa (Sharma 1976); Kerala (Inger et al. 1984),

Tamil Nadu (Das & Bauer 2000), and Assam (Das & Sengupta 2001), but diversity within the genus in India is almost certainly still underestimated. New species may also be expected from Sri Lanka, where recent intensive research has revealed spectacular diversity in frogs and reptiles (Pethiyagoda & Manamendra-Arachchi 1998a, 1998b; Meegaskumbura et al. 2002; Bossuyt et al. 2004; Manamendra-Arachchi & Pethiyagoda 2005; Meegaskumbura & Manamendra-Arachchi 2005; Batuwita & Bahir 2005).

The systematics of South Asian *Cnemaspis* in general is complicated by the morphological conservatism of many taxa, the poor condition of many older types, the absence of type localities for some species, and a history of taxonomic confusion (Boulenger 1885; Deraniyagala 1932; Inger et al. 1984). Until recently, four taxa of *Cnemaspis* have been recognized from Sri Lanka (Deraniyagala 1953; Wickramasinghe & Somaweera 2002) and a fifth species was described while this paper was in

* Corresponding author: e-mail: aaron.bauer@villanova.edu

review (Wickramasinghe 2006). Additional species have been identified and are in the process of description (K. Manamendra-Arachchi, pers. comm., November 2004; H. Rösler, pers. comm., October 2005). *Cnemaspis podihuna* Deraniyagala, 1944 is unambiguously endemic to Sri Lanka, where it occurs relatively broadly, although it is infrequently encountered relative to other species (Wickramasinghe & Somaweera 2002) and the newly described *C. ranwellai* Wickramasinghe 2006 is apparently endemic to the Gannoruwa area of the Kandy District. The other three taxa have been variously linked to taxa occurring in south India. *Cnemaspis scalpensis* (Ferguson 1877) has previously been considered as synonym of *C. jerdonii* (Theobald 1868), a species otherwise known from the southern Western Ghats of Tamil Nadu, India (Deraniyagala 1932; Smith 1935; Tikader & Sharma 1992; Sharma 2002), or as an endemic Sri Lankan subspecies of *C. jerdonii* (Deraniyagala 1953; de Silva 1996, 1998; Wickramasinghe & Somaweera 2002; Rathnayake 2004). Most recently Manamendra-Arachchi (1997) and Das & de Silva (2005) have accorded it full species rank, but without comment. *Cnemaspis kandiana* (Kelaart, 1852) has previously been considered to have a broad distribution, including Sri Lanka (type locality: Kandy), south India, the Andaman Islands, Thailand and parts of western Indonesia (Boulenger 1890; Annandale 1904; De Rooij 1915; Smith 1935; Taylor 1963). Although a complete revision of this taxon is still lacking, Manamendra-Arachchi (1997), Bauer (2002), Das (2005) and Das & de Silva (2005) concluded that *C. kandiana* sensu stricto should be considered as a Sri Lankan endemic. *Cnemaspis kandiana* reported from Thailand by Cox et al. (1998) has subsequently been described as *C. phuketensis* by Das & Leong (2004) and those from Indonesia are assignable to four new species (and perhaps one additional taxon as yet unnamed (Das 2005). *Cnemaspis tropidogaster* (Boulenger, 1885) was synonymized with *C. kandiana* by Smith (1935) but has been recognized by more recent authors (Taylor 1953; Inger et al. 1984) as specifically distinct, although there is no consensus as to whether Sri Lankan and southern Indian populations are taxonomically distinct (Manamendra-Arachchi 1997) or conspecific (Rathnayake 2004).

As part of a broader study of the systematics of the geckos of Sri Lanka, we have sampled *Cnemaspis* throughout much of their range on the island. Despite extensive intraspecific variation in color pattern and ecology, the majority of specimens we examined were unambiguously assignable, based on Deraniyagala's (1953) keys, to one of the species presently recognized from the country. However, two specimens from forested areas at high elevation (>1200 m) could not be allocated to any of these forms and are described here as a new species. We also take this opportunity to use mole-

cular data to evaluate their divergence of Sri Lankan members of the genus relative to one another and to examine their interrelationships (with the caveat that the monophyly of Sri Lankan *Cnemaspis* as a group cannot be established without complete sampling of their Indian congeners as well).

We take special pleasure in dedicating the species described herein to Rainer Günther on the occasion of his 65th birthday. Rainer has been an important contributor to many subfields within herpetology, not the least of which has been the systematics of tropical frogs and reptiles. We honor him for these contributions and, in the case of the senior author, for two decades of collaboration and friendship.

Methods

Morphology

The following measurements were taken with Brown and Sharpe Digit-cal Plus digital calipers (to the nearest 0.1 mm): snout-vent length (SVL; from tip of snout to vent), tibia length (TBL; from base of heel to knee); tail length (TL; from vent to tip of unregenerated tail), tail width (TW; measured at base of tail); head length (HL; distance between retroarticular process of jaw and snout-tip), head width (HW; measured at angle of jaws), head depth (HD; maximum height of head, from occiput to throat), ear length (EL; longest dimension of ear); forearm length (FA; from base of palm to elbow); eye diameter (ED; greatest diameter of orbit), eye to nostril distance (E-N; distance between anteriormost point of eye and nostril), eye to snout distance (E-S; distance between anteriormost point of eye and tip of snout), eye to ear distance (E-E; distance from anterior edge of ear opening to posterior corner of eye), internarial distance (IN; distance between nares), and interorbital distance (IO; shortest distance between medial rims of left and right orbits).

Scale counts and external observations of morphology were made using a Nikon SMZ-1000 dissecting microscope. Radiographic observations were made using a Faxitron closed cabinet x-ray system (20–30 s at 20–23 kV). Comparisons were made with museum material (see Das & Bauer 2000 for a partial list of specimens examined), as well as newly collected material (to be deposited in the National Museum, Colombo; Appendix I), original published descriptions and descriptions provided in broader faunal and taxonomic treatments (Smith 1935; Deraniyagala 1953; Inger et al. 1984; Murthy 1985, 1990; Tikader & Sharma 1992).

DNA sequencing and alignment

Tissue samples representing four recognized species of Sri Lankan *Cnemaspis*, as well as the new species and two extralimital taxa (*C. modiglianii* from Pulau Enggano, Indonesia and *C. limii* from Pulau Tioman, Malaysia) were collected by the authors (AMB and ADS specimens) or obtained from the Museum of Vertebrate Zoology, University of California, Berkeley (MVZ) or from L. Lee Grismer, La Sierra University, Riverside, California (LLG). Based on ongoing phylogenetic analyses of representatives of all gekkonid geckos, *C. limii* is known to be outside the South Asian *Cnemaspis* and was used as the outgroup in the analyses.

Genomic DNA was isolated from liver or tail tissue samples preserved in 95–100% ethanol using the Qiagen DNeasy tissue kit (Valencia, CA, USA). We used double-stranded PCR to amplify 1,740 bases from one mitochondrial

Table 1
Novel primers used in this study.

Primer	Gene	Sequence
CytbF700	cytochrome <i>b</i>	5'-CTTCCAACACCAYCAAACATCTCAGCATGATGAAA-3'
CytbR700	cytochrome <i>b</i>	5'-ACTGTAGCCCCTCAGAATGATATTTGTCTCA-3'
PHOF2	Phosducin	5'-AGATGAGCATGCAGGAGTATGA-3'
PHOR1	Phosducin	5'-TCCACATCCACAGCAAAAACTCCT-3'
RAG1 F700	RAG-1	5'-GGAGACATGGACACAATCCATCCTAC-3'
RAG1 R700	RAG-1	5'-TTTGTACTGAGATGGATCTTTTTGCA-3'

(*cytb*) and two nuclear (RAG-1 and phosducin) genes. Novel primers employed are presented in Table 1.

Amplification of 25 µl PCR reactions were done with an Eppendorf Mastercycler gradient thermocycler with gene-specific conditions, and products were visualized with 1.5% agarose gel electrophoresis. Target products were purified with AMPure magnetic bead solution (Agencourt Bioscience, Beverly, MA, USA) and sequenced with either the BigDye® Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems, Foster City, CA, USA) or the DYEnamic™ ET Dye Terminator Kit (GE Healthcare, Piscataway, NJ, USA). Sequencing reactions were purified with CleanSeq magnetic bead solution (Agencourt Bioscience) and analyzed with an ABI 3700 automated sequencer. The accuracy of sequences was ensured by incorporating negative controls and sequencing complementary strands. Sequences were aligned by eye in the computer program SeqMan (DNASTAR, Madison, WI) and all four protein-coding genes were translated to amino acids with MacClade (Maddison & Maddison, 1992) to confirm conservation of the amino acid reading frame and check for premature stop codons.

Phylogenetic analysis

Phylogenetic relationships among the samples were assessed with parsimony, likelihood, and Bayesian optimality criteria. Maximum parsimony (MP) analyses were conducted in PAUP*4.0b10 (Swofford 2002). The heuristic search algorithm was used with the following conditions: 25 random addition replicates, accelerated character transformation (AC-TRAN), tree bisection-reconnection (TBR) branch swapping, zero-length branches collapsed to yield polytomies, and gaps treated as missing data. Each base position was treated as an unordered character with four alternate states. We used nonparametric bootstraps (1000 pseudoreplicates) to assess node support in resulting topologies. Strict consensus trees were calculated when several equally parsimonious trees resulted from MP searches.

ModelTest 3.06 (Posada & Crandall 1998) was used to find the model of evolution that best fit the data for subsequent Maximum Likelihood (ML) and Bayesian inference (BI). All genes were pooled to determine the best model for ML analyses, but separate models for each gene were run for BI. The Akaike Information Criterion (AIC) was used to pick the best models of evolution in ModelTest. ML analyses with estimated base frequencies (based on the MP tree) were performed in PAUP* with a neighbor-joining starting tree. As with MP, the nonparametric bootstrap was used to assess the stability of internal nodes in the resulting phylogenies.

Partitioned Bayesian analyses were conducted with MrBayes 3.1.1 (Huelsenbeck & Ronquist, 2005; Ronquist & Huelsenbeck, 2003) with default priors. Analyses were initiated with random starting trees and run for 1,000,000 generations; Markov chains were sampled every 1000 generations. Convergence was checked by plotting likelihood scores against generation, and using a standard deviation of the split frequencies less than 0.01 as suggested in MrBayes. Two hundred and fifty trees were discarded as “burn in.”

Results and Discussion

Cnemaspis gemunu sp. nov.

Figures 1–5

Holotype. AMB 7495 (to be deposited in the National Museum, Colombo, Sri Lanka), adult male. 15 November 2002. Coll. A. M. Bauer, A. de Silva and C. A. Austin. Sri Lanka, Central Province, Nuwara Eliya District, Hakgala, Hakgala Botanic Gardens (6°55'30" N, 80°49'15" E), 1660 m. **Paratype.** AMB 7507 (to be deposited in the National Museum, Colombo, Sri Lanka), adult female. 17 November 2002. Coll. A. M. Bauer, A. de Silva and C. A. Austin. Sri Lanka, Province of Sabaragamuwa, Ratnapura District, Balangoda Rd., 2nd milepost from Borangamuwa, 25 km N Balangoda (6°44'39" N, 80°42'28" E), 1250 m.

Etymology. The specific epithet is a proper noun in apposition based on the name of Prince Gemunu (161–137 B.C.; also known as Gāmani and later as King Dutugemunu). This warrior king spent several years in hiding from the wrath of his father in the central hills of Sri Lanka. He subsequently succeeded his father as king and ultimately defeated the invading armies of the Indian King Elara, who had been based in Anuradhapura, and united all of Sri Lanka under his rule. The name refers to the new species, which was also “hidden” in the hills of central Sri Lanka. It also pays homage to our friend and colleague Rainer Günther whose given name is derived from Old German and may be variously translated as “deciding warrior” or “ruler” and who is sometimes known to his friends as “der Froschkönig.”

Diagnosis. A small *Cnemaspis*, snout-vent length at least 34 mm. One pair of slightly enlarged postmentals in contact behind mental. 20 scale rows across venter between lowest rows of tubercles. Six enlarged basal lamellae beneath fourth toe of pes. Irregular rows of tiny, conical tubercles along flanks; scales of body venter, throat, and limbs smooth, without keels. Preloacal pores lacking, 12 femoral pores on each thigh (holotype). Original tail with 2–4 rows of small dorsal tubercles; median subcaudal scales enlarged, pentagonal to hexagonal in shape. Dorsal pattern of dark chevrons, with a pale, broad, discontinuous vertebral stripe from

nape on to tail; venter of male yellow in life, with a white throat.

Cnemaspis gemunu is here compared with congeners from Sri Lanka and peninsular India (*C. boei* [Gray 1842] lacks specific locality but is assumed to be from peninsular India). Among Sri Lankan species *C. gemunu* can be distinguished from *C. tropidogaster* and *C. kandiana* by its lack of keeled scales, either on the body venter in general or the gular region, and by the presence of enlarged mid-ventral caudal scales. It further differs from these two species and from the much smaller (maximum SVL 26 mm) *C. podihuna* in lacking precloacal pores and in its much larger number of femoral pores (12 in the holotype versus 2–4 in *C. kandiana* and *C. tropidogaster* and 4–5 in *C. podihuna*). *Cnemaspis gemunu* shares with *C. scalpensis* and *C. ranwellai* the absence of precloacal pores and a large number of femoral pores (to 15 in *C. scalpensis* and *C. ranwellai*) but may be distinguished from the first species by its pentagonal to hexagonal midventral caudal scales (versus broad rectangular) and its larger number of enlarged basal subdigital lamellae (6 versus 2–3 under digit IV of pes) and from the second by its smaller number of ventral scale rows (20 versus 22), lack of internasal scales (versus 3 internasals), rostral-nostril contact, and lichenous grayish-green life color.

Among peninsular Indian forms, the lack of keeled scales on the venter or gular regions distinguishes *C. gemunu* from *C. beddomei* (Theobald, 1876) and *C. goaensis* Sharma, 1976, and the absence of keeled scales on the dorsum of the limbs serves to differentiate it from *C. yercaudensis* Das & Bauer, 2000. It differs from *C. sisparensis* (Theobald, 1876), *C. heteropholis* Bauer, 2002 and *C. anakattiensis* Mukherjee, Bhupathy & Nixon, 2005 in lacking strongly heterogeneous dorsal scalation and in a much smaller size (34 mm versus >60 mm SVL). The absence of precloacal pores and presence of femoral pores in males distinguishes *C. gemunu* from *C. mysoriensis* (Jerdon, 1853), *C. gracilis* (Beddome, 1870), and *C. otai* Das & Bauer, 2000, which have both precloacal and femoral pores, from *C. ornata* (Beddome 1870) and *C. nairi* Inger,

Marx & Koshy, 1984, which have precloacal pores only, and from *C. boei* (Gray 1842), which lacks pores all together. The absence of spine-like tubercles on the flanks and a lower number of femoral pores (4–6 versus 12) differentiates *C. indica* (Gray, 1846) and *C. wynadensis* (Beddome 1870) from the new species. *Cnemaspis gemunu* is most similar to the Indian taxa *C. littoralis* (Jerdon 1853), *C. jerdonii* (Theobald 1868), and *C. indraneildasii* Bauer, 2002. It differs from the first of these in having a larger number of enlarged basal lamellae (6 versus 3–5 under digit IV of pes), hexagonal or pentagonal (versus transversely widened rectangular) median subcaudal scales, and a different color pattern (darkish with well-defined chevrons versus pale grayish with dark-edged pale vertebral spots; Fig. 1). It differs from the last in possessing only a pair of tubercles per tail segment (four rows at tail base), versus six tubercles per whorl. Finally, the new species may be diagnosed from *C. jerdonii* on the basis of its greater number of enlarged basal lamellae (6 versus 3–5 under digit IV of pes) and more extensive dorsal tubercles (scattered over flanks versus restricted to ventrolateral margin of body).

Description (based on the adult male holotype, AMB 7495; features differing significantly in the female paratype are detailed at the end of the description). Snout-vent length 34.0 mm. Head elongate, large (HL/SVL = 0.29), moderately wide (HW/SVL = 0.19), depressed (HD/HL = 0.35), very distinct from neck. Snout short (E-S/HW = 0.61); longer than eye diameter (ED/E-S = 0.44); scales on snout and forehead granular, domed; scales on snout larger than those in interorbital region, much larger than those on occiput. Eye small (ED/HL = 0.18); orbits without extrabrillar fringes; pupil round with smooth margins; supraciliaries large, rectangular anterior to midpoint of orbit; smaller and granular posterior to midpoint; without elongate spines. Ear opening oval, small (EL/HL = 0.05), obliquely oriented; eye to ear distance greater than diameter of eyes (E-E/ED = 1.57). A small, white-tipped tubercle above each ear. Ros-



Fig. 1. Holotype (AMB 7495) of *Cnemaspis gemunu* from Hakgala Botanical Gardens, Nuwara Eliya District, Central Province, Sri Lanka. Note the relatively homogeneous dorsal scalation and small caudal tubercles. Scale bar = 5 mm.

tral less than half as deep as wide (rostral width = 1.6 mm; rostral depth = 0.6 mm); nearly completely divided by well developed rostral groove; in contact with first supralabial, and enlarged supranasals; supranasals in broad median contact; nostrils oval, each surrounded by one postnasal, supranasal, rostral, and first supralabial; 1–2 rows of scales separate orbit from supralabials. Mental subtriangular, wider (1.9 mm) than deep (1.4 mm); paired postmentals asymmetrically pentagonal (narrowest medially), much smaller than mental and in contact with one another; posteriorly, each postmental bounded by three juxtaposed, smooth scales, including a longitudinally-oriented median scale contacted by both postmentals, lateralmost of these scales largest; infralabials separated from hexagonal central chin shields by a row of slightly enlarged scales with rounded edges (Fig. 2). Supralabials (to midorbital position) 8; supralabials to angle of jaws 10; infralabials 9; interorbital scale rows between supraciliary rows 24, across narrowest point of frontal bone 6.

Body slender, relatively elongate (A–G/SVL = 0.39). Dorsal scales tiny, conical, with pointed, slightly enlarged tubercles (three times size of adjacent scales) scattered on the lateral and dorsolateral surfaces, where they form short spines; tubercles not in regular rows, each spinose tubercle taller than wide. Ventrally, scales decrease in size from chin to anterior gular region then enlarge across pectoral and abdominal regions; scales on dorsum at midbody much smaller than those on ventrum at same level; midbody scale rows across belly to lowest row of lateral granules 20. Pectoral and abdominal scales semicircular, strongly imbricate, smooth, without keels; no precloacal pores; femoral pores in uninterrupted row of 12 on each thigh (Fig. 3). Scales imbricating on preaxial surfaces of fore- and hindlimbs. Scales on palm and sole smooth, rounded, flattened; no keeled scales on dorsal or ventral aspects of limbs.

Forelimbs moderately long, slender; forearm short (FA/SVL = 0.14); hindlimbs relatively short,

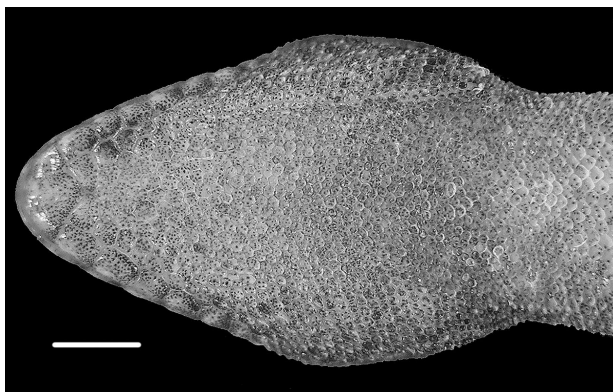


Fig. 2. Ventral view of head and neck of holotype of *C. gemunu* showing the configuration of the mental and postmentals and the absence of keeled gular scales. Scale bar = 2 mm.

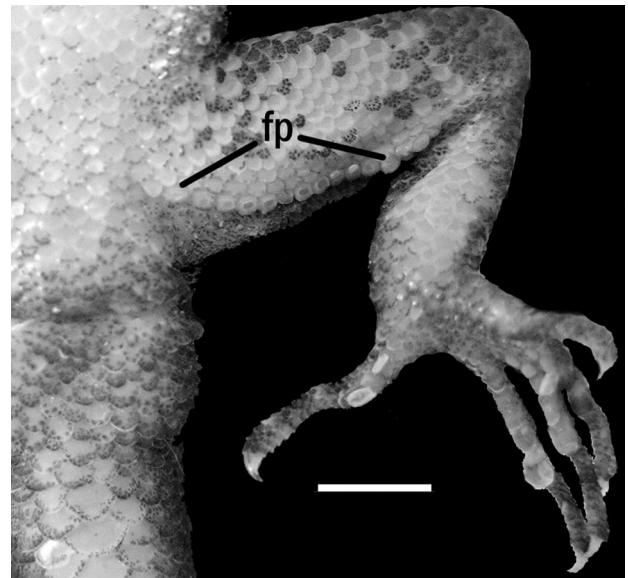


Fig. 3. Ventral view of left hindlimb and cloacal region of holotype of *C. gemunu* showing the uninterrupted series of 12 femoral pores (fp), absence of precloacal pores, and the large basal lamellae under the digits. Scale bar = 2 mm.

tibia short (TBL/SVL = 0.16); digits elongate, all bearing robust recurved claws; subdigital scansors entire; a series of greatly enlarged and elongate basal lamellae replaced distal to digital inflexion by much narrower lamellae; distalmost of basal series largest, distal one half to one third of basal lamellae darkly pigmented; basalmost lamellae of distal series sometimes fragmented; basal and distal series of lamellae separated (except in digit I of pes) by a single scale of intermediate width; interdigital webbing absent (Fig. 3). Total subdigital lamellae (basal/intermediate/distal, left:right) not including claw sheath: (manus) I (1/1/5:1/1/4), II (3/1/7:3/1/6), III (3/1/9:3/1/9), IV (4/1/9:4/1/9), V (4/1/7:4/1/7), (pes) I (2/0/7:2/0/7), II (4/1/8:4/1/8), III (4/1/11:4/1/10), IV (6/1/11:6/1/10), V (4/1/9:4/1/9). Relative length of digits (manus): IV > III > II > V > I; (pes): IV > V > III > II > I; digit IV of pes 4.1 mm.

Partially regenerated tail approximately same as snout-vent length (TL/SVL ratio 0.98); tail slender, squarish in cross section, tapering, with distinct whorls demarcated by a dorsolateral pair of enlarged, pointed, smooth-surfaced, recumbent tubercles (tail base with two additional pairs of tubercles, one separated by a single scale row from dorsolateral tubercles, the other in approximately midlateral position); each caudal tubercle separated by five to six smaller scales within a whorl; seven rows of smaller scales between each enlarged row (fewer distally); a single enlarged, smooth, thickened, conical postcloacal spur on each side of tail-base. Subcaudal scales smooth, much larger than dorsals; midventral scale row enlarged, scales pentagonal to hexagonal with rounded distal margins (Fig. 4); adjacent row on each side of enlarged mid-ventrals smaller, but much larger than all subse-

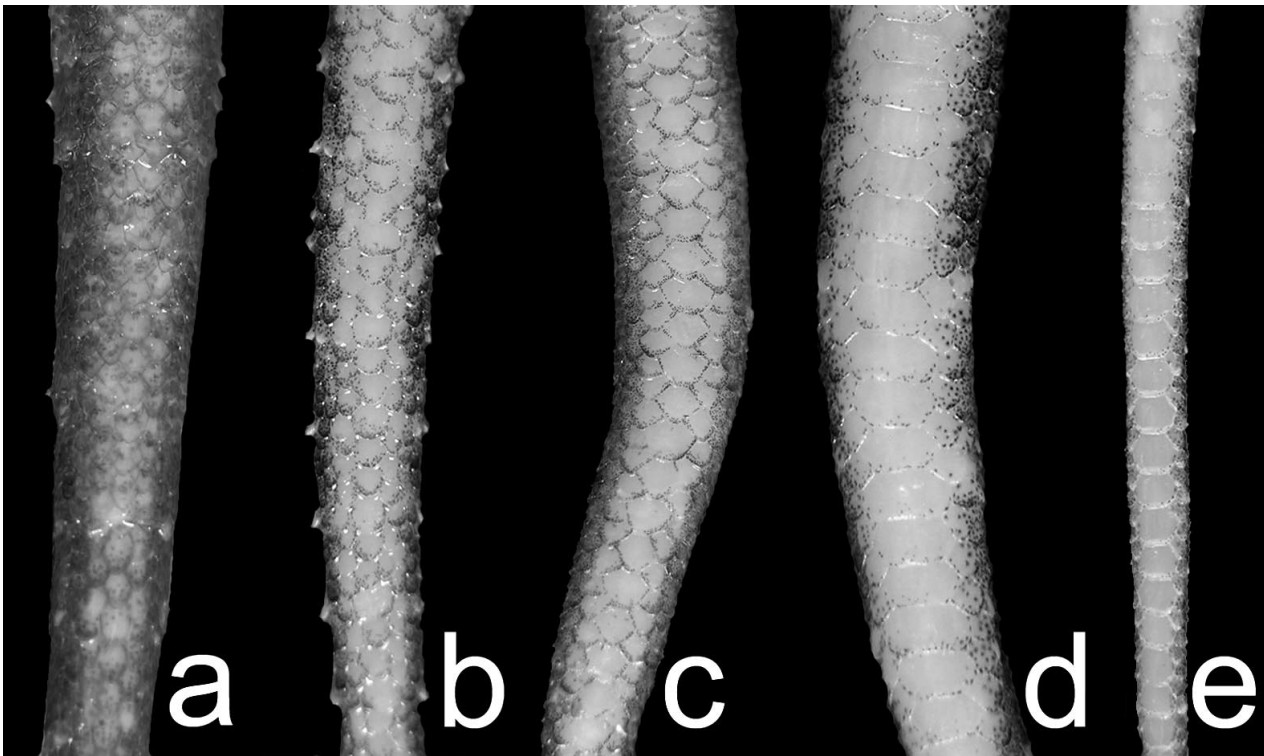


Fig. 4. Ventral views of the tails of the five species of Sri Lankan *Cnemaspis*. **a** – *C. tropidogaster* (AMB 7490), **b** – *C. kandiana* (ADS 51), **c** – *C. gemunu* (AMB 7495), **d** – *C. scalpensis* (ADS 60), **e** – *C. podihuna* (ADS 17). Note the relatively small median subcaudal scales in a and b, the transversely expanded scales in d and the enlarged pentagonal to hexagonal median subcaudals in c and e. Not to scale.

quent rows, which decrease in size, becoming granular on lateral surfaces of tail.

The adult female paratype (AMB 7507) differs from the male holotype in the following features: supranasals completely divided by a narrow internasal that contacts rostral groove anteriorly; first supralabial narrowly excluded from nostril, which is surrounded by rostral, supranasal and two postnasals; basal lamellae more completely pigmented than in holotype; no precloacal or femoral pores, but posterior row of thigh scales flattened and somewhat enlarged; cloacal spur single, very small.

Mensural features (holotype/paratype; in mm). SVL 34.0/33.8; FA 4.7/4.8; TBL 5.4/6.2; TL 33.6 (posterior 4.7 mm regenerated)/8.3; TW 2.7/2.8; A–G 13.1/15.6; HL 9.9/10.0; HW 6.6/5.2; HD 3.5/3.1; ED 1.8/1.7; E–E 2.7/2.7; E–S 4.0/3.8; E–N 2.8/2.7; IO (between supraciliary scales) 2.7/2.5; EL 0.5/0/4; IN 0.8/0.8.

Osteology. Phalangeal formulae 2-3-4-5-3 for manus and 2-3-4-5-4 for pes; presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 14.5 post pygal caudal vertebrae to point of regeneration; a single pair of crescentic cloacal bones present. Epiphyses of long bones fused, indicating that the type specimen is fully grown. Endolymphatic sacs enlarged extracranially in female paratype only.

Coloration (in preservative). Ground color mottled grayish brown with three forward pointing chevrons between axilla and groin, each with a thin (two granules wide) black margin enclosing a triangular area of orangish-brown; scattered dorsolateral and lateral tubercles whitish. Dorsal surfaces of limbs mottled with narrow, irregular, dark brown bands separating wider paler bands (grayish-brown on forelimbs, orangish-brown on hindlimbs); narrow white bands on the manus and pes. A bold black middorsal dash over midpoint of neck and a small, bright white spot at occiput. A small, orangish-brown chevron with weakly demarcated black border across sacrum; base of tail with well-defined chevron, remainder of tail with alternating narrow black bands and much wider orangish-brown markings. Vague dark canthal stripe extends through eye and above ear, terminating anterior to forelimb insertion. A series of faint, irregular, dark brown transverse bands on dorsum of head in midnasal, posterior nasal, and midfrontal positions. Labial scales with alternating light and dark markings; infralabials with bright white centers. Venter cream with dark brown speckling under digits, on palms and soles, and beneath limb and flank margins; chest, chin and throat heavily speckled, giving an overall grayish appearance. Tail base and cloacal lips heavily suffused with brown pigment; periphery of scales on abdomen and tail venter outlined in fine brown speckling. In life (Fig. 5) background



Fig. 5. Photograph of holotype of *Cnemaspis gemunu* in life. Photo courtesy of Christopher C. Austin.

color a lichenous grayish-green; pale vertebral, tail and limb markings pale yellow (e.g., nape) to peach (e.g., tail); chevron borders dark brown; dark ver-

tebral dash on nape black. Throat white; remainder of venter yellow.

Paratype similar in color to holotype, but with darker background coloration; white markings on labials smaller, both supra- and infralabials with thick dark brown margins; ventral pattern similar, but with central area of throat pale, with only scattered patches of brown speckles.

Distribution and natural history. The holotype of *C. gemunu* was one of several *Cnemaspis* seen active on a stone wall near buildings in the Botanic Gardens. Other amphibians and reptiles observed at this locality were *Calotes nigrilabris*, *Ceratophora stodartii*, *Polypedates eques* and *Phyllautus* sp. Edificarian habitat use has previously been noted in several other *Cnemaspis*, including *C. cf. kandiana* (Tikader & Sharma 1992), *C. indica* (pers. obs.), and *C. indraneildasii* (Bauer 2002). No other reptiles or amphibians were collected or noted at the paratype locality. Although we did not find other *Cnemaspis* sympatric with *C. gemunu*, its type locality falls within the known range of *C. tropidogaster* and *C. scalpensis*, and approaches that of *C. kandiana*, although it is higher than the maximum 1400 m elevation reported for the last species (Rathnayake 2004). Both known localities for the new species fall within the wet zone of Sri Lanka (Fig. 6) in areas now or formerly covered by submontane forest (Somasekaram 1997). The stomach

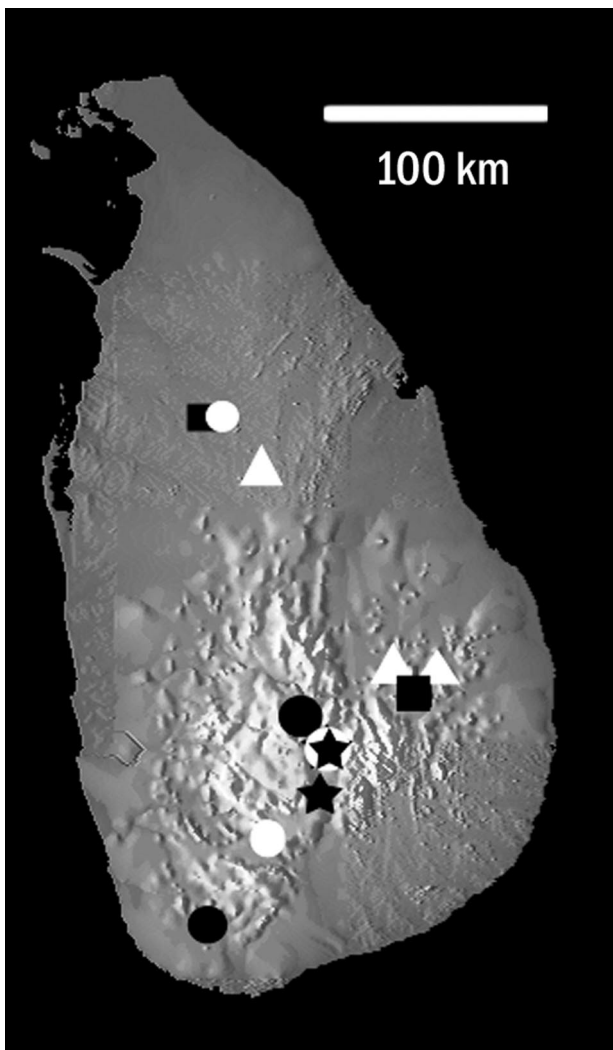


Fig. 6. Map of Sri Lanka showing the type (star in circle) and paratype (star) localities of *Cnemaspis gemunu* and the localities of the other specimens used in the phylogenetic analysis: *C. podihuna* (black squares), *C. scalpensis* (white triangles), *C. kandiana* (white circles), *C. tropidogaster* (black circles).

of the holotype contained a single spider as a prey item. The paratype contains two large oviductal eggs, suggesting that oviposition occurs in November or early December.

Conservation Status. If *Cnemaspis gemunu* is indeed limited to the sub-montane forest zone of the Sri Lankan wet zone, it may be assumed that it is threatened by human activity, most notably deforestation and conversion of land to tea growing and other agricultural uses. The wide use of pesticides and agrochemicals may also pose a threat to the species. On the other hand, because neither specimen was collected in pristine forest habitat, it is likely that this gecko is tolerant of some degree of disturbance. Current data are insufficient to assign an IUCN threat status to this species, but we suspect that it will eventually be found to be locally abundant within the central highlands of Sri Lanka. The Hakgala Botanic Gardens is a protected area and the much larger Peak Wilderness Sanctuary would also provide conserved habitat for the species within this region.

The conservation status of all *Cnemaspis* in Sri Lanka needs to be reassessed. Previous assessments were extremely conservative and resulted in vulnerable rankings for most species and a Critically Endangered ranking for *C. podihuna* (de Silva et al. 2000; Bambaradeniya 2001). However, the recent rediscovery of *C. podihuna* in many localities across Sri Lanka (Wickramasinghe 2000; Wickramasinghe & Somaweera 2002; de Silva et al. 2005; see Appendix I) and an increase in field work in Sri Lanka in general, has revealed that many species are not nearly so restricted or uncommon as previously believed.

Phylogeny

There are currently no explicit hypotheses of relationship for any species of *Cnemaspis*. However, differences in body size, scalation and behavior, as well as substantial geographic disjunctions, strongly suggest that the African and Asian members of the genus constitute reciprocally monophyletic groups. Further, our ongoing molecular studies of the Gekkonidae as a whole have revealed no close relationship between these two groups, suggesting that *Cnemaspis* as currently construed is polyphyletic. Within the South Asian taxa Das & Bauer (2000) identified the presence of both medial and lateral pairs of cloacal bones (versus the more widespread condition of medial bones only *vide* Smith 1933) in males of *Cnemaspis indica*, *C. otai*, and *C. yercaudensis* as a putative synapomorphy for this small cluster of species. Based on the strong phenetic similarities between some Indian and Sri Lankan taxa we suspect that Sri Lankan *Cnemaspis*, like other Sri Lankan lizards (Schulte et al. 2002) are

derived from within the Indian radiation. At present, however, we do not have the material to generate a taxon-complete phylogenetic hypothesis for the South Asian *Cnemaspis*.

Sri Lankan *Cnemaspis* fall into two well-supported clades (Fig. 7). *Cnemaspis gemunu* is the sister species to *C. scalpensis* + *C. podihuna* (*C. ranwellai* is presumably also a member of this clade). Divergences between these taxa are comparable to those among congeners in many other gecko genera. The second clade includes *C. kandiana* and *C. tropidogaster* as well as *C. modiglianii* from Pulau Enggano off the west coast of Sumatra. Specimens now referred to *C. modiglianii* were previously included within *C. kandiana*. Their relatively close relationship to Sri Lankan ("true") *C. kandiana* suggests that their superficial similarity is indicative of phylogenetic affinity rather than convergence. It may be that the other *kandiana*-like species: *C. jacobsoni* Das, 2005, *C. dezwaani* Das, 2005, *C. whittenorum* Das, 2005, all from the Mentawai Archipelago, *C. phuketensis* from Thailand, specimens from the Andaman Islands (to which the names *C. wicksii* and/or *C. andersonii* may apply) and those from Tamil Nadu and Kerala, Jog, Uttara Kannada, Karnataka (Smith 1935) and Mahabaleshwar, Maharashtra (Tiware & Sharma 1970) are also members of this clade.

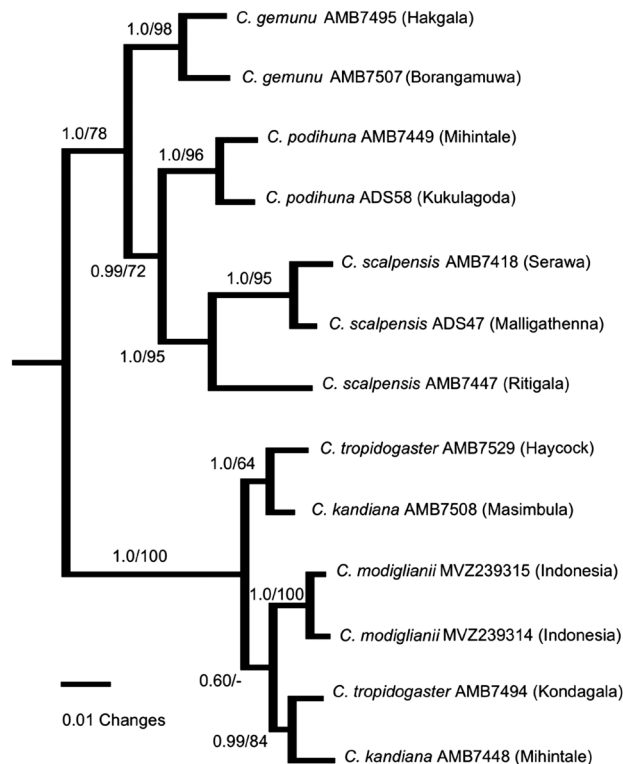


Fig. 7. Phylogeny of Sri Lankan *Cnemaspis*. Tree shows maximum likelihood branch lengths. Branches are subtended by Bayesian posterior probabilities (left of slash) and maximum likelihood bootstraps (right of slash). The southeast Asian species *C. limii* was used as the outgroup.

Interestingly, our results suggest that *C. kandiana* and *C. tropidogaster* are not reciprocally monophyletic (Fig. 7). There was strong support for the clustering of *C. kandiana* from Masimbula with *C. tropidogaster* from Haycock, both in the southwest of the country, and for *C. kandiana* from Mihintale in the northcentral region with *C. tropidogaster* from Kondagala in the central region. Indeed, the second grouping is supported by a uniquely derived two amino acid deletion. In his description of *C. kandianus tropidogaster*, Boulenger (1885) was only able to diagnose his new subspecies from the typical form on the basis of its keeled ventral scales. Deraniyagala (1932) found both keeled and unkeeled forms in the same general area and proposed that *C. k. tropidogaster* and *C. k. kandiana* were lowland and highland forms, respectively, of a single species. More recently, Inger et al. (1984) reported no polymorphism in keeling in a sample of 137 *C. tropidogaster* from across a broad elevational range at a single locality in Kerala, India and argued, on this basis, that Boulenger's (1885) character should be considered diagnostic. They recommended recognition of *C. tropidogaster* as a full species, although they considered the issue as unresolved pending additional data. If anything, the situation seems even more complex than previously assumed. Our data demonstrate that the current allocation of specimens to the two taxa *C. kandiana* and *C. tropidogaster* is inappropriate, as neither species, as recognized on morphological grounds, is monophyletic. Further, we cannot confirm the monophyly of Sri Lankan *C. kandiana* + *C. tropidogaster* with respect to extralimital *kandiana*-like taxa, such as *C. modiglianii*. Most significantly, the relationship between Indian and Sri Lankan populations currently assigned to *C. kandiana* and *C. tropidogaster* remains unresolved. Untangling this difficult taxonomic problem will ultimately require a comprehensive revision of South Asian *Cnemaspis* incorporating a molecular phylogeny with near complete taxon sampling from both countries, or potentially all of Asia. Although much of the Sri Lankan herpetofauna has been demonstrated to represent endemic radiations ultimately derived from India (Schulte et al. 2002; Pethiyagoda 2005), it is unclear if this is true for Sri Lankan *Cnemaspis*. While *C. gemunu*, which appears limited to cooler, higher elevations, may have been separated from its probable close Indian relative, *C. jerdonii*, for long periods, other species, which occur at lower elevations may have had contact with Indian relatives across the Palk Strait very recently. During the last glacial maximum (~20,000 ybp) sea levels were approximately 120 m lower than today. This would have yielded a 140 km wide land bridge. Dry land connections existed for at least half of the last half million years and were present as recently as 10,000 years ago (Rohling et al. 1998).

Acknowledgments

We are grateful to Panduka de Silva, G. Vajira, and Sudesh Batuwita amongst others for technical assistance during the collection of the specimens reported on here. Permission to conduct research in Sri Lanka and to export specimens and tissues for study was kindly provided by the Director General, Department of Wildlife Conservation. We also thank the Conservator General of Forests for his approval. Comparative material was examined in the collections of the Natural History Museum, London (BMNH), the Colombo Museum, the Museum of Comparative Zoology, Harvard University (MCZ), the California Academy of Sciences (CAS), and the Field Museum of Natural History (FMNH). We thank the curators and collections managers of these institutions for providing access to their collections and loans of relevant material. A. M. Bauer, T. Jackman and E. Greenbaum were supported by grant DEB 0515909 from the National Science Foundation of the United States and by Villanova University.

References

- Annandale, N. 1904. Contributions to Oriental herpetology I. – The lizards of the Andamans, with the description of a new gecko and a note on the reproduced tail in *Ptychozoon homalocephalum*. – Journal of the Asiatic Society of Bengal **73**, Part II, Supplement: 12–22.
- Bambaradeniya, C. N. B. 2001. Threatened herpetofauna of Sri Lanka. In: Bambaradeniya, C. N. B. & Samarasekera, V. N. (eds). An Overview of the Threatened Herpetofauna of South Asia: 91–101. Colombo (IUCN Sri Lanka and Asia Regional Biodiversity Programme).
- Batuwita, S. & Bahir, M. M. 2005. Description of five new species of *Cyrtodactylus* (Reptilia: Gekkonidae) from Sri Lanka. – Raffles Bulletin of Zoology, Supplement **12**: 351–380.
- Bauer, A. M. 2002. Two new species of *Cnemaspis* (Reptilia: Squamata: Gekkonidae) from Gund, Uttara Kannada, India. – Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut **99**: 155–167.
- Bauer, A. M. & Das, I. 1998. A new *Cnemaspis* (Reptilia: Gekkonidae) from Southeastern Thailand. – Copeia **1998**: 439–444.
- Bossuyt, F., Meegaskumbura, M., Beenaerts, N., Gower, D. J., Pethiyagoda, R., Roelants, K., Mannaert, A., Wilkinson, M., Bahir, M. M., Manamendra-Arachchi, K., Ng, P. K. L., Schneider, C. J., Oommen, O. V. & Milinkovitch, M. C. 2004. Sri Lanka: a center of faunal endemism in Biodiversity Hotspot 21. – Science **306**: 479–481.
- Boulenger, G. A. 1885. Catalogue of the Lizards in the British Museum (Natural History), Second Edition. Vol. 1. Gekkonidae, Eublepharidae, Uroplatidae, Pygopodidae, Agamidae. – London (British Museum (Natural History)). xii + 436 pp., pls. 1–32.
- 1890. A list of the reptiles and batrachians collected by Dr. E. Modigliani on Sereinu (Sipora), Mentawai Islands. – Annali del Museo Civico di Storia Naturale de Genova, serie 2. **14**: 613–618.
- Cox, M. J., Van Dijk, P. P., Nabhitabhata, J. & Thirakhupt, K. 1998. A Photographic Guide to Snakes and Other Reptiles of Peninsular Malaysia, Singapore and Thailand. – London (New Holland Publishers). 144 pp.
- Das, I. 2005. Revision of the genus *Cnemaspis* Strauch, 1887 (Sauria: Gekkonidae), from the Mentawai and adjacent archipelagos off western Sumatra, Indonesia, with the description of four new species. – Journal of Herpetology **39**: 233–247.
- Das, I. & Bauer, A. M. 1998. Systematics and biogeography of Bornean geckos of the genus *Cnemaspis* Strauch, 1887 (Sauria: Gekkonidae), with the description of a new species. – Raffles Bulletin of Zoology **46**: 11–28.

- 2000. Two new species of *Cnemaspis* (Sauria: Gekkonidae) from Tamil Nadu, southern India. – *Russian Journal of Herpetology* **7**: 17–28.
- Das, I. & de Silva, A. 2005. A Photographic Guide to Snakes and Other Reptiles of Sri Lanka. – London (New Holland Publishers). 144 pp.
- Das, I. & Grismer, L. L. 2003. Two new species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from the Seribaut Archipelago, Pahang and Johor States, West Malaysia. – *Herpetologica* **59**: 546–554.
- Das, I. & Leong, T.-M. 2004. A new species of *Cnemaspis* (Sauria: Gekkonidae) from southern Thailand. – *Current Herpetology* **23**: 63–71.
- Das, I. & Sengupta, S. 2001. A new species of *Cnemaspis* (Sauria: Gekkonidae) from Assam, north-eastern India. – *Journal of South Asian Natural History* **5**: 17–24.
- Deraniyagala, P. E. P. 1932. The Gekkonidae of Ceylon. – *Spolia Zeylanica* **16**: 291–310, pls. LVIII–LXIV.
- 1953. A Colored Atlas of Some Vertebrates from Ceylon. Volume Two. Tatrapiod Reptilia. – Colombo (Ceylon National Museums). [ix], pls. I–XI, [1], colored pls. 1–35, [i–iv], 101 pp.
- De Rooij, N. 1915. The Reptiles of the Indo-Australian Archipelago. I. Lacertilia, Chelonia, Emydosauria. – Leiden (E. J. Brill). xiv + 384 pp.
- de Silva, A. 1996. The Herpetofauna of Sri Lanka: A Brief Review. – Gampola (Published by the author). 99 pp., 15 pls.
- 1998. Sauria (Lizards and Varanids) of Sri Lanka: A Checklist and an Annotated Bibliography. – Colombo (Department of Wildlife Conservation/GEF/UNDP/FAO). 52 pp.
- de Silva, A., Molur, S. & Walker, S. 2000. Conservation Assessment and Management Plan CAMP Report for Amphibians and Selected Taxa of Reptiles of Sri Lanka. – Colombo (Conservation Breeding Specialist Group, Sri Lanka). [1] + iii + 212 + [15] pp.
- de Silva, A., Bauer, A. M., Goonewardene, S., Drake, J., Nathaniel, S. & de Silva, P. 2005. Some observations on the geckos inhabiting the Knuckles Massif. *In*: de Silva, A. (ed.). *The Diversity of the Dumbara Mountains* (Lyriocephalus, Special Issue, Vol. 6, Numbers 1 & 2): pp. 125–133. Gampola (Amphibia and Reptile Research Organization of Sri Lanka).
- Huelsensbeck, J. P. & Ronquist, F. 2005. Bayesian analysis of molecular evolution using MrBayes. *In*: Nielsen, R. (ed.). *Statistical Methods in Molecular Evolution*. New York (Springer). 183–232.
- Inger, R. F., Marx, H. & Koshy, M. 1984. An undescribed species of gekkonid lizard (*Cnemaspis*) from India with comments on the status of *C. tropidogaster*. – *Herpetologica* **40**: 149–154.
- Kluge, A. G. 2001. Gekkotan lizard taxonomy. – *Hamadryad* **26**: 1–209.
- Maddison, W. P. & Maddison, D. R. 1992. *MacClade version 3: Analysis of Phylogeny and Character Evolution*. – Sunderland, Massachusetts (Sinauer Associates).
- Manamendra-Arachchi, K. 1997. Gecko – Sri Lanka Nature **1** (1): 45–55.
- Manamendra-Arachchi, K. & Pethiyagoda, R. 2005. The Sri Lankan shrub-frogs of the genus *Philautus* Gistel, 1848 (Ranidae: Rhacophorinae), with description of 27 new species. – *Raffles Bulletin of Zoology, Supplement* **12**: 163–303.
- Meegaskumbura, M., Bossuyt, F., Pethiyagoda, K., Manamendra-Arachchi, K., Bahir, M., Milinkovitch, M. C. & Schneider, C. J. 2002. Sri Lanka: an amphibian hotspot. – *Science* **298**: 379.
- Meegaskumbura, M. & Manamendra-Arachchi, K. 2005. Description of eight new species of shrub-frogs (Ranidae: Rhacophoridae: *Philautus*) from Sri Lanka. – *Raffles Bulletin of Zoology, Supplement* **12**: 305–338.
- Mukherjee, D., Bhupathy, S. & Nixon, A. M. A. 2005. A new species of day gecko (Squamata, Gekkonidae, *Cnemaspis*) from the Anaikatti Hills, Western Ghats, Tamil Nadu, India. – *Current Science* **89**: 1326–1328.
- Murthy, T. S. N. 1985. A field guide to the lizards of Western Ghats. – *Records of the Zoological Survey of India Occasional Papers* **72**: 1–51, pls. I–XIV.
- 1990. A field book of the lizards of India. – *Records of the Zoological Survey of India Occasional Papers* **115**: i–vii, 1–116, 8 pp. pls.
- Perret, J.-L. 1986. Révision des espèces africaines du genre *Cnemaspis* Strauch, sous-genre *Ancyrodactylus* Müller (Lacertilia, Gekkonidae), avec la description de quatre espèces nouvelles. – *Revue Suisse de Zoologie* **93**: 457–505.
- Pethiyagoda, R. 2005. Exploring Sri Lanka's biodiversity. – *Raffles Bulletin of Zoology, Supplement* **12**: 1–4.
- Pethiyagoda, R. & Manamendra-Arachchi, K. 1998a. Evaluating Sri Lanka's amphibian diversity. – *Occasional Papers of the Wildlife Heritage Trust* **2**: 1–12.
- 1998b. A revision of the endemic Sri Lankan agamid lizard genus *Ceratophora*, Gray, 1835, with description of two new species. – *Journal of South Asian Natural History* **3**: 1–50.
- Posada D. & Crandall K. A. 1998. Modeltest: testing the model of DNA substitution. – *Bioinformatics* **14**: 817–818.
- Rathnayake, N. D. 2004. The Sri Lankan day-geckos of the genus *Cnemaspis*. – *Gekko* **4** (1): 39–44.
- Rohling, E. J., Fenton, M., Jorissen, F. J., Bertrand, P., Ganssen, G. & Cautlet, J. P. 1998. Magnitudes of sea-level lowstands of the past 500,000 years. – *Nature* **394**: 162–165.
- Ronquist F. & Huelsenbeck J. P. 2003. MRBAYES 3: Bayesian phylogenetic inference under mixed models. – *Bioinformatics* **19**: 1572–1574.
- Schulte, J. A., III, Macey, J. R., Pethiyagoda, R. & Larson, A. 2002. Rostral horn evolution among agamid lizards of the genus *Ceratophora* endemic to Sri Lanka. – *Molecular Phylogenetics and Evolution* **22**: 111–117.
- Sharma, R. C. 1976. Records of the reptiles of Goa. – *Records of the Zoological Survey of India* **71**: 149–167.
- 2002. *The Fauna of India and the Adjacent Countries. Reptilia, Volume II (Sauria)*. – Kolkata (Zoological Survey of India). xxv + 430 pp.
- Smith, M. A. 1933. Remarks on some Old World geckoes. – *Records of the Indian Museum* **35**: 9–19.
- 1935. *The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia. Vol. II.- Sauria*. – London (Taylor and Francis). xiii + 440 pp + 1 pl.
- Somasekaram, T. (Chief ed.). 1997. *Arjuna's Atlas of Sri Lanka*. – Dehiwala (Arjuna Consulting Co., Ltd.). viii + 200 pp.
- Swofford, D. L. 2002. PAUP*. *Phylogenetic Analysis Using Parsimony (* and Other Methods)*. – Sunderland, Massachusetts (Sinauer Associates).
- Taylor, E. H. 1953. A review of the lizards of Ceylon. – *University of Kansas Science Bulletin* **35**: 1525–1585.
- 1963. *The lizards of Thailand*. – *University of Kansas Science Bulletin* **44**: 687–1077.
- Tikader, B. K. & Sharma, R. C. 1992. *Handbook: Indian Lizards*. – Calcutta (Zoological Survey of India). xv + 250 pp., 42 pls.
- Tiwari, K. K. & Sharma, R. C. 1970 [1971]. Reptiles of western Maharashtra. – *Journal of the Zoological Society of India* **22**: 101–115.
- Wickramasinghe, L. J. M. 2000. A new record of *Cnemaspis podihuna* from Badulla district. – *Sri Lanka Naturalist, Young Zoologists Association of Sri Lanka* **3**: 3–6.
- 2006. A new species of *Cnemaspis* (Sauria: Gekkonidae) from Sri Lanka. – *Zootaxa* **1369**: 19–33.
- Wickramasinghe, L. J. & Somaweera, R. 2002. Distribution and current status of the endemic geckos of Sri Lanka. – *Gekko* **3** (1): 2–13.

Appendix I

Comparative Sri Lankan specimens examined:

Cnemaspis podihuna. North Central Province, Anuradhapura District: Mihintale (8°21'08" N, 80°30'48" E), 160 m, AMB 7449; Province of Uva, Monaragala District: Kukulagoda (07°11'28.7" N, 81°18'47.1" E), 288 m, ADS 58; Province of Uva, Badulla District: Kuruwekotha (07°05'54.8" N, 81°13'3.4" E), 460 m, ADS 70–71.

Cnemaspis scalpensis: North Central Province, Anuradhapura District: Ritigala (08°07'06" N, 80°39'51" E), 200 m, AMB 7446–47; Province of Uva, Monaragala District: Serawa, Pitakumbura (07°15'50" N, 81°21'25" E), 260 m, AMB 7417–18; Maligathenna (07°15'38.7" N, 81°14'45.4" E), 231 m, ADS 47–48; Mahahela, Vilaoya (06°50'24.8" N, 81°29'16.9" E), 165 m, ADS 60.

Cnemaspis kandiana: North Central Province, Anuradhapura District: Mihintale (8°21'08" N, 80°30'48" E), 160 m, ADS 51, AMB 7448, 7450–51; Central Province, Kandy District: VRR X site (07°19'55.2" N, 80°54'06.2" E), 850 m, ADS 55; Kandy (07°15'36" N, 80°37'11" E), 700–755 m, AMB 7471–73; Gampola (07°09'05" N, 80°33'05" E), 590 m, AMB 7486; Helboda (07°05'37" N, 80°39'26" E), 980 m, AMB 7491; Central Province, Matale District: Lucky Grove Spice Garden, Matale (07°31'48" N, 80°37'39" E), 350 m, AMB 7476–79, 7484; Kabaragala (07°27'52.6" N, 80°42'32.7" E), 1096 m, ADS 54; Province of Uva, Monaragala District: Dehikindagama (06°56'00" N, 81°17'17" E), AMB 7422–23; Rathatakanda Butlele (06°46'00" N,

81°15'43" E), 205 m, AMB 7431; Hamapola (07°09'57.0" N, 81°18'12.4" E), 304 m, ADS 42; Province of Uva, Badulla District: Galindakapolla, Lunugala (07°04'18.8" N, 81°10'31.9" E), 1166 m, ADS 65–66; Pissa Falls (06°58'50.7" N, 81°13'05.0" E), 577 m, ADS 64; Province of Sabaragamuwa, Ratnapura District: Masimbula, Godakawela (06°30'04" N, 80°38'19" E), 270 m, AMB 7508.

Cnemaspis tropidogaster: Central Province, Kandy District: Kandy (07°15'36" N, 80°37'11" E), 700–755 m, AMB 7470; Gampola (07°09'05" N, 80°33'05" E), 590 m, AMB 7487; Helboda (07°05'37" N, 80°39'26" E), 980 m, AMB 7488–90, 7492–93; Central Province, Nuwara Eliya District: Kondagala, Labookellie (07°02'12" N, 80°42'29" E), 1365 m, AMB 7494; Stockholm Tea Estate, Upcot (06°47'07" N, 80°36'22" E), 1330 m, AMB 7496–501, 7505; Fairlawn Tea Estate (06°46'10" N, 80°37'18" E), 1395 m, AMB 7502; Province of Sabaragamuwa, Ratnapura District: Rakwana-Deniya Rd. (A17) km post 122 (06°27'04" N, 80°37'37" E), 700 m, AMB 7510–14; Southern Province, Galle District: Haycock (Hinidumakanda) (06°19'51.3" N, 80°18'02.06" E), AMB 7529; Udugama, Galle (06°12'53" N, 80°20'23" E), AMB 7526; Kottawa (06°05'52" N, 80°18'40" E), 40 m, CCA 2460–62; Oil Palm Plantation btwn. Kottawa and Galle, ~5 km S Kottawa (06°04'48.12" N, 80°17'36.54" E), CCA 2463; Kitulampitiya, Galle (06°04'00" N, 80°13'00" E) AMB 7524–25; Bataganwilla, Galle (approx. 06°02'20" N, 80°13'17" E), AMB 7522.