

DESCRIPTION OF A NEW GROUND-DWELLING *Cnemaspis* STRAUCH, 1887 (SQUAMATA: GEKKONIDAE), FROM KERALA, ALLIED TO *C. wynadensis* (BEDDOME, 1870)

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Submitted January 5, 2014.

A new species of ground dwelling gecko, *Cnemaspis kottiyooensis* sp. nov. is described from the hills of Kannur and Wayanad district of Kerala, India. This medium sized, robust *Cnemaspis* differs from all other Indian congeners in possessing heterogeneous dorsal scales composed of granular scales with more or less regularly arranged longitudinal rows of keeled, conical tubercles running down the back; two supranasals and a long internasal separating the nasal scales; subtriangular mental with two widely separated enlarged postmentals and 1 – 3 small median scales; 19 or 20 subdigital lamellae on finger IV and 20 or 21 on toe IV; 4 or 5 femoral pores on each thigh; no preanal pores; sub-cylindrical tail without whorls of enlarged tubercles on the dorsal aspects; uniform, hexagonal median subcaudals; six supralabials and six or seven infralabials. Morphological characters and natural history traits suggest the affinity of the new species is with *Cnemaspis wynadensis*. Characters useful in distinguishing the new species from *C. wynadensis* are also provided.

Keywords: ground-dwelling; *Cnemaspis kottiyooensis* sp. nov.; *Cnemaspis wynadensis*; Kerala; India.

INTRODUCTION

The genus *Cnemaspis* Strauch, 1887 is one among the most speciose Old World gekkotan genera of the family Gekkonidae, represented by over 100 species from South and Southeast Asia and also from tropical Africa (Mukherjee et al., 2005; Manamendra-Arachchi et al., 2007; Gamble et al., 2008; Giri et al., 2009; Grismer et al., 2010; Somaweera, 2009). In India, this genus is represented by 22 described species, which are recognized by their round pupils, slender digits and their predominantly diurnal habits. The Western Ghats has 16 species known so far, all of which are endemic to the region (Giri et al., 2009).

Cnemaspis wynadensis was described by Beddome in 1870a as *Gymnodactylus wynadensis* based on several specimens collected in Wayanad. Günther (1875) however, placed the species in the genus *Goniodactylus* and considered *Gymnodactylus maculatus*, described by Beddome in 1870b, to be a synonym of *Goniodactylus wynadensis*. On the contrary, Theobald (1876) considered both

species to be distinct and provided a replacement name for *Gymnodactylus maculatus*, collected by Beddome at the foot of the Sispar Ghat, as *Gymnodactylus sisparensis*. Later Boulenger (1885), based on examining specimens at the British Museum of Natural History (BMNH), assigned the species *G. wynadensis* and its other Indian Congeners under the genus *Ganatodes*. Boulenger also brought to notice several specimens of *G. wynadensis* collected by Beddome from the Anamalai Hills, Bolupputta Hills, Tirunelveli and Nellikuth. Annandale (1915), in the description of *Gonotodes bireticulatus* (now a synonym of *C. sisparensis*) from Kavalai of Cochin State, mentioned that the types were collected along with several specimens of *G. wynadensis*. Smith (1935) placed the species under the genus *Cnemaspis* and mentioned the distribution of this species as Wynaad and the hill ranges further south. More recent herpetofaunal explorations have reported the existence of this species from Wayanad district, Nilambur in Malapuram District, Silent Valley National Park and Siruvani in Palakkad district and Peechi Wildlife Sanctuary in Thrissur District of Kerala State (Easa, 1998; Thomas and Easa, 1997). Manamendra-Arachchi et al. (2007), in their revision of the genus *Cnemaspis* from South India and Sri Lanka, designated a lectotype for *C. wynadensis* from the type series collected by Beddome in Wayanad and provided a de-

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tailed description of the species. They also provided several diagnosable characters such as mid-dorsal scales smooth, homogeneous in nature with few isolated and scattered rounded scales; paired postmentals separated by three medial scales; spine-like tubercles absent on flank; no pre-cloacal pores; 4–6 femoral pores on each side; subcaudals on median series enlarged, regularly arranged; five supralabials to angle of jaw; subdigital lamellae on digit IV of pes, 18; that distinguish the species from other congeners.

Examinations of this species from Kerala and from museum specimens in the Zoological Survey of India, Western Ghats Regional Centre (ZSI-WGRC) reveal the distributional range of *C. wynadensis*. Our evaluation also revealed a yet undescribed cryptic species from north Wayanad and Kannur district which very closely resembles *C. wynadensis*. We here describe this new species and provide notes on the distribution and natural history.

METHODS

Field sampling was carried out in the northern parts of Kerala state in Kannur, Wayanad, Malappuram, and Palakkad Districts. Representative specimens were collected, photographed in life, euthanized and fixed in 10% formalin. The following measurements were taken (to the nearest 0.1 mm): SVL, snout to vent length (distance from tip of snout to anterior margin of vent); AG, distance from axilla to groin; TW, trunk width (maximum width of the body); ED, eye diameter (horizontal diameter of the orbit); EN, distance between anterior point of the orbit to the posterior part of the nostril; ES, snout length (distance from anterior margin of the orbit to the tip of the snout); ET, distance from posterior margin of the orbit to the anterior margin of the ear opening; IN, internarial distance (least distance between the inner margins of the nostrils); TD, tympanum diameter (horizontal distance of from the anterior to posterior margin of the ear opening); HL, head length (distance from tip of snout to posterior edge of mandible); HW, head width (maximum width of the head); HD, head depth (maximum depth of the head); IO, interorbital distance (shortest distance between the superciliary scale rows); UAL, upper arm length (distance from axilla to elbow); LAL, lower arm length (distance from elbow to wrist); PAL, palm length (distance from wrist to the tip of the longest finger); FL, finger length (distance from the tip of the finger to the nearest fork); FEL, femur length (distance from groin to the knee); TBL, tibia length (distance from knee to heel); TOL, toe length (distance from tip of toe to the nearest

fork); TL, tail length (distance between posterior margin of vent to the tip of the tail); TBW, tail base width.

The pholidosis recorded included number of supralabials and infralabials up to the angle of the jaw on the left and right side; number of mid-ventral scale rows; subdigital lamellae on the digit IV of manus; subdigital lamellae on digit IV of pes and number of femoral pores on the left and right side. All the specimens were deposited at the Natural History Museum, Trivandrum (TNHM), India. Opportunistic observations were also made on the natural history.

RESULTS

Systematics

(Reptilia: Squamata: Gekkonidae)

Cnemaspis kottiyorensis sp. nov.

Holotype. TNHM (H) 13.7.06/80, Adult female collected under a stone in Perumalmudi (11°53'56" N 75°54'25.94" E), in the proposed Kottiyoor Wildlife Sanctuary, Kannur District, Kerala by Vivek Philip Cyriac, 13 May 2013.

Paratypes. TNHM (H) 13.7.06/81, adult male collected from the same locality as holotype, from under a log by Vivek Philip Cyriac, 13 May 2013; TNHM (H) 13.7.06/82, adult male collected from Chandanathodu (11°50'47.81" N 75°48'32.76" E), Periya Reserve Forest, Wayanad by Vivek Philip Cyriac and Umesh Pavukandy, June 2013; TNHM (H) 13.7.06/83, adult male collected from Makkimala Reserve Forest (11°52'10.91" N 75°57'02.51" E), Wayanad by Vivek Philip Cyriac, July 2013.

Diagnosis. A medium sized robust *Cnemaspis* with a maximum snout-vent length of 41.65 mm. Dorsal scales heterogeneous consisting of granular scales interspersed with more or less regularly arranged longitudinal rows of keeled, conical tubercles running down the back. Nasals separated from each other by two supranasals and a long internasal. Nasals bordered posteriorly by four postnasals and in narrow contact with first supralabials. Mental scale subtriangular, bordered posteriorly by widely separated enlarged postmentals, separated from each other by 1–3 small median scales. Supralabials 6 and infralabials 6–7. Subdigital lamellae on digit IV of manus, 19–20 and on digit IV of pes, 20–21. Femoral pores ranging from 4–5 on each side. No pre-cloacal pores. Tail subcylindrical in cross-section and lacking whorls of enlarged tubercles on the dorsal aspects. Dorsal scales of tail granular and smooth. Ventral scales of tail smooth, larger than the dorsal scales. Median subcaudals larger than adjacent ventral scales of tail; anterior subcaudals



Fig. 1. Comparison of live coloration: a, *Cnemaspis kottiyooensis* sp. nov., holotype (TNHM (H) 13.7.06/80); b, *Cnemaspis wynadensis*.

uniformly arranged, subhexagonal; distal subcaudals irregular with a large hexagonal scale alternating with two rows of smaller scales.

Cnemaspis kottiyooensis sp. nov. differs from all other Indian congeners by the following characters: Absence of spine-like tubercles on flanks (vs. spine like tubercles present on flanks in *C. goaensis*, *C. littoralis*, *C. mysoriensis*, *C. jerdonii*, *C. indraneildasii*, *C. otai*, *C. yercaudensis*, *C. wicksii*, *C. andersonii*, *C. monticola*, and *C. nilagirica*); presence of 4–5 femoral pores and absence of pre-cloacal pores (vs. presence of only pre-cloacal pores in *C. beddomei*, *C. ornata*, and *C. nairi*; presence of both femoral and pre-cloacal pores in *C. goaensis*, *C. mysoriensis*, *C. indraneildasii*, *C. otai*, *C. yercaudensis*, *C. wicksii*, *C. andersonii*, and *C. australis*; presence of a continuous series of 24–28 precloacal-femoral pores in *C. kolhapurensis*; absence of both femoral and pre-cloacal pores in *C. boiei*); tail without caudal tubercles; no post-cloacal spur; median series of subcaudals enlarged, sub hexagonal and smooth (vs. median subcaudals not enlarged in *C. gracilis* and *C. andersoni*; post-cloacal spur present on either sides in *C. goaensis*, *C. mysoriensis*, *C. kolhapurensis*, *C. indraneildasii*, *C. otai*, *C. yercaudensis*, *C. andersonii*, *C. monticola*, *C. australis*, *C. beddomei*, *C. ornata*, and *C. nairi*; me-



Fig. 2. Dorsal pholidosis of *C. kottiyooensis* sp. nov. (a) showing series of conical tubercles down the back, *C. wynadensis* (b).

dian subcaudals enlarged, arranged as a single large scale alternating with two smaller scales in *C. sisparensis* and *C. heteropholis*).

Cnemaspis kottiyooensis sp. nov. closely resembles *C. wynadensis* in size, coloration, and general morphology (Fig. 1). However, *C. kottiyooensis* sp. nov. can be distinguished from the later by the presence of series of enlarged conical tubercles intermixed with the small conical dorsal scales on the body which is absent in *C. wynadensis* (Fig. 2). In *C. kottiyooensis* sp. nov. the supranasal scales are separated from each other by a long internasal scale while the internasal scale in *C. wynadensis* is significantly short. The sub-digital lamellae of the IV digit ranges from 19–20 on the manus and 20–21 on the pes in *C. kottiyooensis* sp. nov., but is slightly lesser in *C. wynadensis* and ranges from 15–16 on the manus and 18–19 on the pes.

Description of holotype (Fig. 1a and 3; Table 1). An adult female of SVL 41.65 mm. Head moderately long (HL 26.50% of SVL), broad (HW 73% of HL) and depressed (HD 45.65% of HL). Snout short (ES 40.85% of HL) and obtusely pointed; scales on snout smooth, larger than those on forehead and interorbital region. Eye relatively large (ED 30.25% of HL); pupils round; extra-brillar fringe scales large anteriorly, gradually becoming smaller posteriorly. Tympanum small (TD 10.60% of HL), oval and broader than long. Rostrum broader than long, with a partially dividing median groove. Nasals separated from each other by two supranasals and a long internasal scale; nasals bordered posteriorly by four post nasals and in slight contact with the first supralabials. Mental scale subtriangular bordered posteriorly with two widely separated postmentals and three smaller intermediate scales; post mental surrounded posteriorly by 5

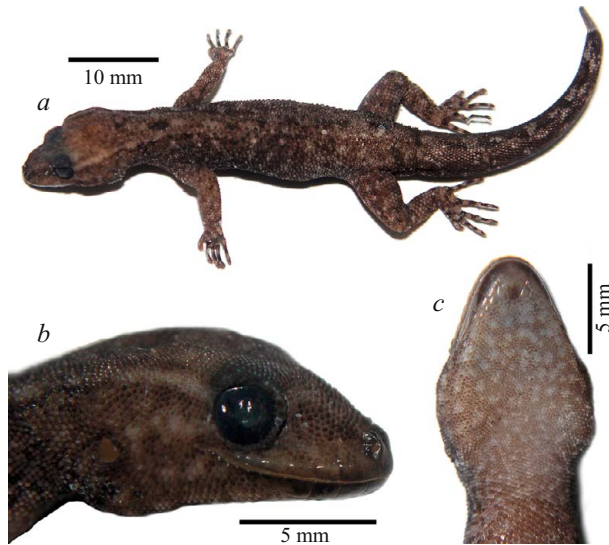


Fig. 3. Holotype (TNHM (H) 13.7.06/80) of *Cnemaspis kottiyooorensis* sp. nov.: a, dorsal aspects; b, lateral side of head; c, ventral side of head and neck.

scales. Supralabials to the angle of jaw, 6; Infralabials to the angle of the jaw, 7. Ventral scales of head and neck granular, smooth.

Body rather robust (TW 44.20% of AG) and elongate (AG 41.90% of SVL). Mid-dorsal scales heterogeneous, with small granular scales intermixed with regularly arranged longitudinal rows of enlarged, keeled, conical tubercles extending from the nape up to the base of the tail; scales on the lateral sides of the body heterogeneous. Ventral scales, smooth, sub-imbricate, rounded and larger than dorsal scales.

Forelimbs relatively short (UAL 9.8% of SVL; LAL 12.9% of SVL). Hindlimbs longer than forelimbs; femur slightly longer than tibia (FEL 15.72% of SVL; TBL 15.17% of SVL). Dorsal and ventral scales of forelimbs and hindlimbs smooth. Scales on manus and pes smooth. Subdigital lamellae entire, a few fragmented; lamellae on the basal phalanges larger. Interdigital webbing absent. Subdigital lamellae on finger I: 12, finger II: 15, finger III: 18, finger IV: 20, finger V: 18; toe I: 13, toe II: 17, toe III: 20, toe IV: 20 and toe V: 19. Relative length of digits, fingers: IV (3.55 mm) > III (3.33 mm) > V (3.25 mm) > II (3.15 mm) > I (2.64 mm); toes: IV (4.62 mm) > III (4.22 mm) > V (4.14 mm) > II (3.88 mm) > I (2.29 mm). Femoral and pre-cloacal pores absent.

Tail sub cylindrical in cross-section, regenerated at the tip, its length shorter than SVL (TL 78.40% of SVL). Tail base distinctly swollen and lacking a post-cloacal spur. Dorsal scales of tail, smooth, juxtaposed, without whorls of enlarged tubercles. Ventral scales larger than

TABLE 1. Measurements and polydosis of the type series of *Cnemaspis kottiyooorensis* sp. nov. (all measurements in mm).

Parameters	Holotype		Paratype	
	TNHM (H) 13.7.06/80	TNHM (H) 13.7.06/81	TNHM (H) 13.7.06/82	TNHM (H) 13.7.06/83
SVL	41.65	34.63	41.2	36.86
AG	17.48	12.01	18.63	18.55
TW	7.73	5.55	7.39	7.48
ED	3.34	1.74	2.53	1.79
EN	3.47	2.45	3.44	3.37
ES	4.51	4.01	4.77	4.51
ET	3.23	3.19	3.45	3.21
IN	1.38	1.16	1.02	1.1
TD	1.17	0.71	1.1	0.84
HL	11.04	9.53	10.71	10.35
HW	8.06	6.51	7.6	7.39
HD	5.04	4.24	4.42	4.51
IO	1.86	1.86	1.81	3.52
UAL	4.08	4.35	4.18	4.47
LAL	5.37	5.08	5.1	5.16
PAL	4.61	4.3	4.72	4.62
FL1	2.64	2.09	2.56	2.12
FL2	3.15	2.61	3.16	3.13
FL3	3.33	3.12	3.44	3.71
FL4	3.55	3.32	3.56	3.64
FL5	3.25	3.08	3.27	3.36
FEL	6.55	5.3	6.79	6.7
TBL	6.32	5.05	6.52	6.55
TOL1	2.29	1.83	2.25	1.79
TOL2	3.88	3.44	3.73	3.26
TOL3	4.22	4.03	4.14	4.09
TOL4	4.62	4.33	4.42	4.32
TOL5	4.14	4.01	4.04	4.07
TL	32.65	42.21	36.75	15.37
TBW	4.57	3.67	3.98	3.92
Supralabials(R/L)	6/6	6/6	6/6	6/6
Infralabials(R/L)	7/7	7/7	6/6	7/7
Femoral pores	0	5/5	5/4	6/6
Lam IV manus	20	19	19	19
Lam IV pes	20	21	21	21

dorsal scales of tail; subcaudals large, subhexagonal and smooth.

Coloration in preservatives (Fig. 3a). Head grayish brown, with a faint, light brown line extending from the posterior corner of the canthus to the nape; lateral sides of the head brown with a faint line extending from the posterior of the eye to the tympanum; nape with a black spot; gular scales brown, mottled with grayish white spots. Dorsum of body and limbs dark brown in color, variegated with grayish white and black markings; ventral scales of body and limbs dark brown. Dorsal side of tail, dark brown with irregular black and white markings;

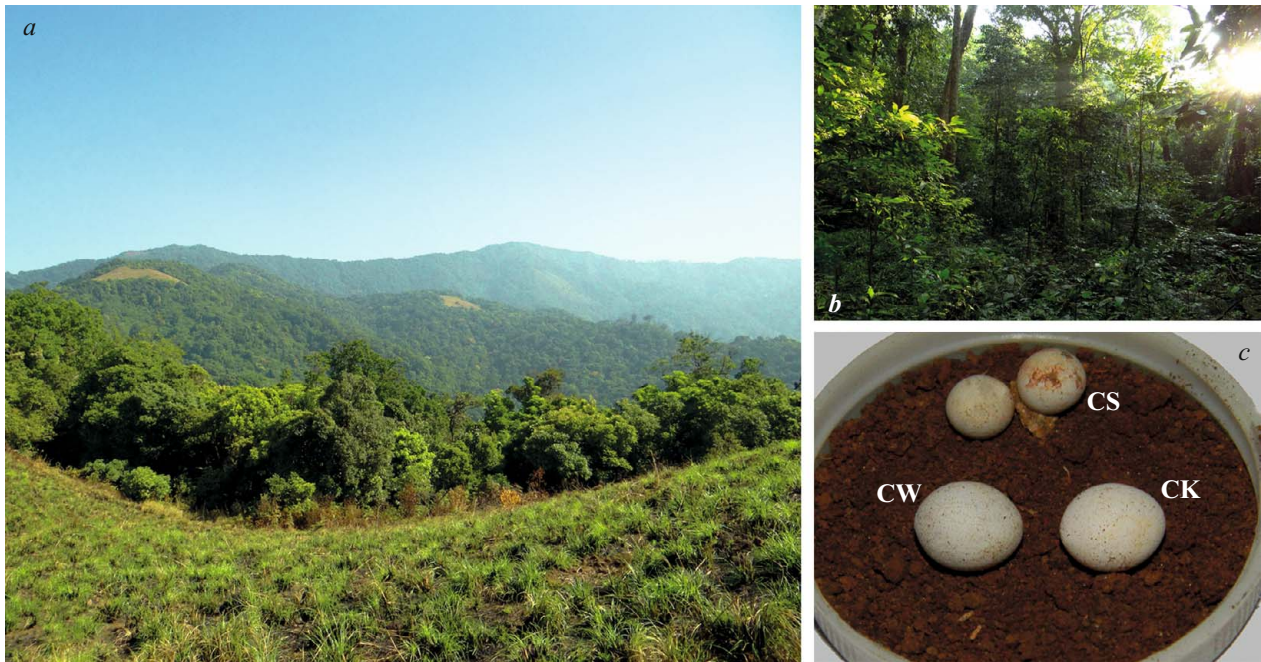


Fig. 4. Evergreen forests of Kottiyoor Reserve Forest which is the type locality of *C. kottiyorensis* sp. nov. (a); habitat of *C. kottiyorensis* sp. nov. from which the holotype and paratype (TNHM (H) 13.7.06/80 and TNHM (H) 13.7.06/81) were collected (b); compression of eggs size and structure of different species of *Cnemaspis* (c); CW, an elliptical egg *C. wynadensis*; CK, egg of *C. kottiyorensis*; CS, a pair of round eggs usually observed in most small sized *Cnemaspis*.

ventral side of tail, dark brown with few scattered whitish dots.

Coloration in life (Fig. 1a). Head overall light brown in color; lateral sides of head light brown with a black bordered, cream-brown lines extending from the posterior of the eye to the back; the upper border line is short and extends to the sides of the head while the lower black band extends up to the sides of the nape. Iris brown with a thin orange line bordering the round pupils; superciliaries yellowish. Ventral sides of the head grayish, mottled with white and yellowish spots. Dorsum grayish brown mottled with dark and light markings; mid-dorsum lighter in color with a dark black spot on the nape and a series of faint blackish vertebral spots on the back. Dorsal side of limbs, brown with light and dark markings; digits cross barred with black and yellowish brown bands. Ventral sides of body and limbs light gray in color. Dorsal side of tail light brown in color with irregular whitish spots, which form whitish bands towards the posterior region of the tail; ventral side of tail light gray in color with irregularly arranged, white spots.

Variations. Morphometric data of the holotype and the range of the type series are provided in Table 1. Infralabials usually 7, but 6 in TNHM (H) 13.7.06/82. Lamellae on digit IV of manus, 19 in TNHM (H) 13.7.06/82 and TNHM (H) 13.7.06/83 and 20 in TNHM

(H) 13.7.06/81; lamellae on digit IV of pes 21 in TNHM (H) 13.7.06/81 and TNHM (H) 13.7.06/82 and 22 in TNHM (H) 13.7.06/83. Femoral pores in males 5 or 6 on each side (TNHM (H) 13.7.06/81; TNHM (H) 13.7.06/83). In TNHM (H) 13.7.06/82, femoral pores were 5 and 4 on the right and left side respectively. In TNHM (H) 13.7.06/81, with the original tail, the anterior median subcaudal scales were long and sub-hexagonal while in the posterior regions, each long hexagonal scale alternated with two rows of smaller scales.

Etymology. The specific epithet is named after its type locality, Kottiyoor, which is a Reserve Forest in Kannur district of Kerala State. The area is proposed to be elevated to the status of a Wildlife Sanctuary.

Distribution. At present, *C. kottiyorensis* sp. nov. is known to occur in Perumalmudi (11°53'56" N 75°54'25.94" E), which is in the proposed sanctuary limits of Kottiyoor Reserve Forest in Kannur district and in Periya Reserve Forest and Makkimala Reserve Forest in the northern part of Wayanad district of Kerala between an elevation range of 800 – 1000 m a.s.l. (Fig. 5).

Natural history. The holotype was found under a rock in an evergreen forest adjoining a stream at the top of Perumalmudi in Kottiyoor reserve forest (Fig. 4a, b). All the remaining specimens were found to be inactive during the day and were observed under rocks or under

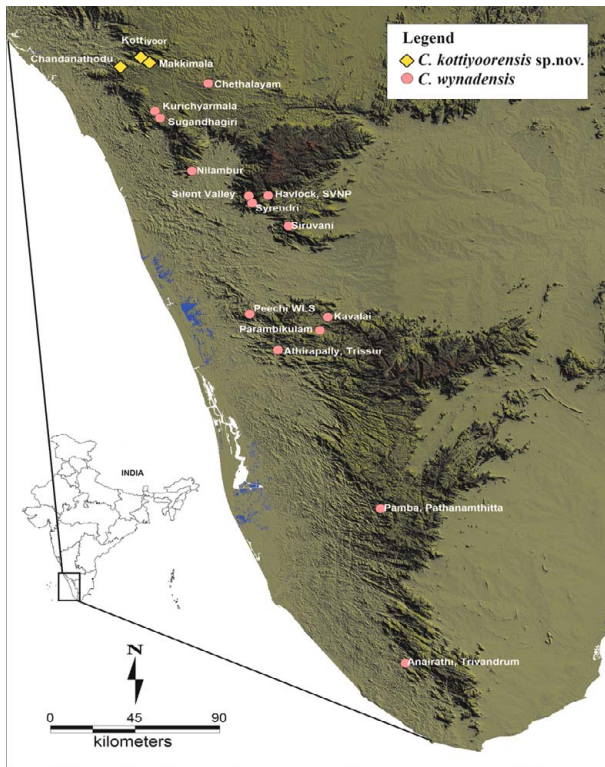


Fig. 5. Map showing the distribution of *Cnemaspis kottiyooensis* sp. nov. and *C. wynadensis* based on field samplings and museum specimens.

fallen logs on the ground. When disturbed, *C. kottiyooensis* actively escape into the surrounding leaf litter and remain still making them hard to detect. A similar behavior was observed in *C. kolhapurensis*, which is another ground dwelling *Cnemaspis* described from semi-evergreen forests of Maharashtra (Giri et al., 2009). Eggs of this species were observed during February under rock boulders on the ground. Eggs are dirty white in color and slightly elliptical (Fig. 4c). Two eggs that were collected measured 7.63×7.08 mm and 7.82×7.15 mm.

DISCUSSION

Cnemaspis kottiyooensis sp. nov. closely resembles *C. wynadensis* in morphology and natural history. The latter are found under rocks and near cave openings and inhabit evergreen and semi-evergreen forests adjoining streams, which is similar to the habitats used by *C. kottiyooensis*. Beddome (1870a) in the description of *C. wynadensis* mentioned that the species is found under stones during the day. Moreover, eggs of both species are laid under rocks in the ground, unlike most other members of this genus. Egg size and dimensions of both species are

also very similar (Fig. 4c) (egg size of *C. wynadensis* — 7.97×7.11 mm; Cyriac, personal observation). The resemblance between *C. kottiyooensis* and *C. wynadensis* in their morphology, coloration and natural history traits suggest that the two species are closely related.

Field sampling and examination of the specimens in ZSI-WGRC, suggests that the dorsal pholidosis in *C. wynadensis* is highly variable among individuals from being homogenous to more or less heterogeneous with irregularly arranged, large, rounded scales among the small granular scales (Fig. 2b). Boulenger (1885), in his description of *C. wynadensis*, also noted the inconsistency in dorsal pholidosis in this species and stated that “Upper surface of body with large round granules, each with a raised central point or short keel, largest on the sides; these tubercles are either homogeneous, or intermixed with much smaller ones, and as there are specimens which are intermediate in this respect, no great importance can be attached to this difference.” On the other hand, the arrangement of dorsal pholidosis of *C. kottiyooensis* is consistent among all individuals in its range and is a reliable character to distinguish it from *C. wynadensis*. Our observations also suggest that *C. wynadensis* has a wide range. Its distribution within Wayanad is to the southern hills of the Banasura hills, the Kuruchiarmala hills and the Camels Hump Hills, and the north-eastern parts of the Wayanad plateau. *C. wynadensis* is also distributed further south extending along the western slopes of the Nilgiris, hills on the western side of the Anamalai and Cardamom hill complex (Peechi, Parambikulam, Athirapally, and Pamba), and in the lower elevations of Agasthyamalai hills in the south (Anairathi) between an elevation range of 300 – 1000 m a.s.l. (Fig. 5). Contrasting to *C. wynadensis*, the distribution of *C. kottiyooensis* is to the western slopes of the hill ridges to the north-west of Wayanad. Since this ridge is continuous with Aaralam wildlife sanctuary and Brahmagiri Sanctuary of Karnataka, it is highly probable that the range of this species may extend further northwards and further expeditions may reveal the exact range of this species.

Classification of biodiversity is the usual measure used to explain the importance and value of different protected areas and forests (Cook et al., 2008). Such classification is fundamental for conservation and for effective management of our forested areas. Cryptic species pose a major problem in accurately assessing the biotic richness and distinctiveness of an area (Cook et al., 2008). The genus *Cnemaspis* poses a major challenge as the striking similarities and morphological conservatism among its members often make it difficult in delimiting species boundaries (Bauer and Das, 1998; Grismer et al., 2008). Although the genus has received considerable attention in South East Asia and Sri Lanka and several new species

have been described in recent years (Chan et al., 2010; Grismer and Chan, 2009; Grismer, 2010; Grismer et al., 2010; Manamendra-Arachchi et al., 2007; Wickramasinghe and Munindradasa, 2007), no substantial effort has been made in South India and its diversity remains largely underestimated (Das and Bauer, 2000; Bauer et al., 2007; Giri et al., 2009; Cyriac and Umesh, 2013). The present description of a new species which is very similar to *C. wynadensis* indicates a largely hidden diversity among the south Indian members of this genus and detailed examinations of museum specimens and field collections will help solve several long lasting taxonomic confusions.

Acknowledgments: We thank the Kerala Forest Department, especially V. Gopinathan, Principle Chief Conservator of Forest, for providing collection and study permits (Permit No. WL 10-7451/2013) to the first author and for their support during field work. We would also like to thank the Periyar Foundation, especially Mr. Balasubramaniam for organizing and providing logistic support during the Kottiyoor herpetofaunal survey; Dr. Anil Zachariah for his constant support and encouragement; to Robin Abraham for his constructive criticisms and for commenting on an earlier draft of the manuscript; Ansil B. R. for his assistance in field; Mr. Shaji Martin and Mr. Babu for providing stay and assisting us during our field visits in Wayanad; Paul Freed for sharing his observations on *Cnemaspis wynadensis*; Muhammad Jafar Palote for allowing us to study the specimens at ZSI-Western Ghat Regional Center, Kozhikode; Dr. George Chandy (Centre for Wildlife Studies, Pookode) for his support; Ashok Kumar (Centre for Wildlife Studies, Pookode) for preparing the map and commenting on an earlier draft of the Manuscript.

APPENDIX

Specimens examined: *Cnemaspis wynadensis* (Beddome, 1870), ZSI/WGRC/IR/V/8708, collected from Athirapally, Thrissur District, Kerala; ZSI/WGRC/IR/V/10180, collected from Pamba, Pathanamthitta District, Kerala; ZSI/WGRC/IR/V/19611, collected from Silent Valley National Park, Palakkad District, Kerala; ZSI/WGRC/IR/V/19615, collected from Sirandry, Silent Valley National Park, Pallakad District, Kerala; ZSI/WGRC/IR/V/19327, collected from Anairathi, Trivandrum District, Kerala; TNHM (H) 13.7.06/84, from Sugandhagiri, Wayanad District, Kerala.

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