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Three more novel species of South Asian *Cnemaspis* Strauch, 1887 (Squamata, Gekkonidae) from Kalakad Mundanthurai Tiger Reserve, Tamil Nadu, India

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Abstract

We describe three distinct, small-bodied, scansorial species of south Asian *Cnemaspis* from Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu, India—*Cnemaspis azhagu* **sp. nov.** from Thirukurungudi forest range, *Cnemaspis mundanthuraiensis* **sp. nov.** from Mundanthurai forest range and *Cnemaspis kalakadensis* **sp. nov.** from Kalakad forest range. Phylogenetic analyses using a partial sequence of the mitochondrial ND2 gene and general morphology places each of the three new species in the *beddomei*, *gracilis* and *littoralis* clades, respectively. The three new species are diagnosed from all other described members of their respective clades by a suite of differing morphological characters including snout vent length, number of dorsal tubercle rows at mid-body, number of paravertebral tubercles, presence or absence of spine-like scales on flanks, number of ventral scales across belly at mid-body, number of ventral scales from mental to anterior border of cloaca, number of lamellae under digit IV of pes, number of femoral and/or precloacal pores and poreless scales separating these series, as well as subtle colouration differences. We also provide some novel characters of tail tuberculation of the three new species described herein. With the discovery of these three new species, eight species of geckos including five *Cnemaspis* are now known to be endemic to KMTR.

Keywords

Biodiversity hotspot, dwarf geckos, endemic species, southern India, taxonomy, Western Ghats

Introduction

The South Asian clade within the polyphyletic genus *Cnemaspis* Strauch, 1887 diversified from a Western Ghats origin during the Paleocene-Eocene and today includes over 100 species disjunctly distributed in peninsular India, Sri Lanka, parts of Southeast Asia, with a single species in northeast India (Iskandar et al. 2017; Lee et al. 2019; Agarwal et al. 2020c, 2021a; Amarasinghe et al. 2021; Pal et al. 2021; Uetz et al. 2022). A recent series of contributions on the taxonomy and biogeography of South Asian *Cnemaspis* have resulted in the placement of almost all described species from India and Sri Lanka into phylogenies, redescriptions of several poorly known species, and descriptions of a large number of new species (Sayyed et al. 2018, 2020, 2021; Cyriac et al. 2018, 2020; Khandekar et al. 2019a, 2019b, 2020a, 2020b, 2021a, 2021b, 2022; Murthy et al. 2019; Chandramouli, 2020; Agarwal et al. 2020a, 2020b, 2021a, 2021b; Sayyed and Sulakhe, 2020; Karunarathna et al. 2021; Pal et al. 2021).

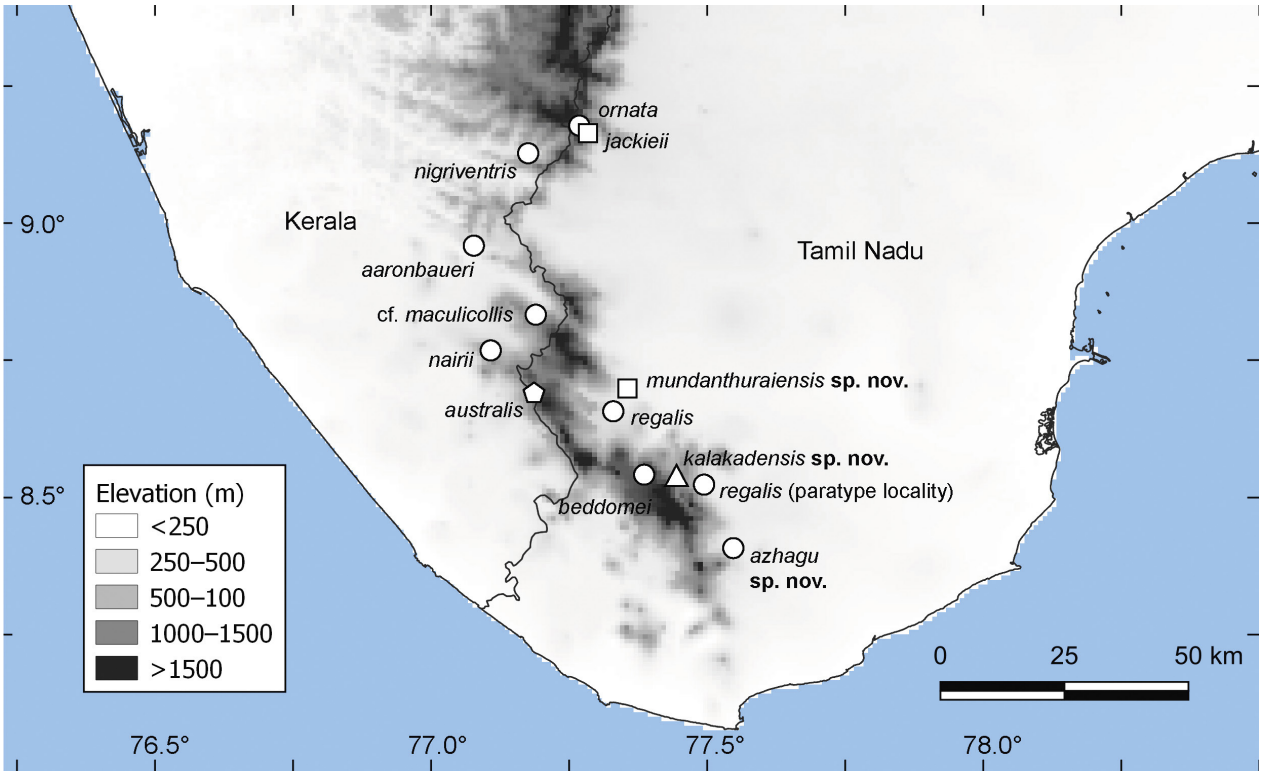

Figure 1. Elevation map of southern Kerala and Tamil Nadu showing the distribution of all known *Cnemaspis* species from the region: circles, *beddomei* clade; squares, *gracilis* clade; triangle, *littoralis* clade; pentagon, *australis* clade.

Ten well supported, broad clades are now recognised within South Asian *Cnemaspis* in peninsular India based on *ND2* and *16S* mitochondrial phylogenies (Sayyed et al. 2018; Khandekar et al. 2019a; Agarwal et al. 2020a, 2021b; Cyriac et al. 2020; Pal et al. 2021). Members of the *bangara* and *mysoriensis* clades are restricted to relatively arid, rocky landscapes on the Mysore Plateau; the *girii* clade to the northern Western Ghats, the *wynadensis* and *goaensis* clades to the central and northern Western Ghats, *beddomei* to the southern Western Ghats, and the *indica*, *littoralis*, and *monticola* clades are distributed in the southern and central Western Ghats (Pal et al. 2021; Khandekar et al. 2022). The *gracilis* clade is among the most widely distributed, found in the central and southern Western Ghats, the southern Eastern Ghats and the Mysore Plateau.

During a recent survey in Kalakad Mundanthurai Tiger Reserve, Tamil Nadu, India as part for an ongoing project on the systematics and taxonomy of peninsular Indian geckos, we collected multiple unidentified small-bodied *Cnemaspis* specimens from a few forest ranges in the Tiger reserve. Based on preliminary morphological examination, the specimens collected from Thirukurungudi, Mundanthurai, and Kalakad forest ranges represent three species that fall within the *beddomei*, *gracilis* and *littoralis* clades, respectively, as defined by Pal et al. (2021). Detailed taxonomic examination revealed that the three species differ from other members of their respective clades in a number of non-overlapping morphological characters and represent three undescribed species. Molecular analysis based on ND2 mitochondrial gene fragments of these samples confirmed their placements in respective clades as well as their distinctiveness. In this paper, we describe these three new species based on their distinctive morphology.

Materials and methods

Taxon sampling

Surveys were conducted in both day and night time, specimens were spotted on rocks, tree trunks and collected by hand and euthanized using isoflurane after taking colour photos in life. Liver/ tail tissues of at least three individuals of each new species were collected in molecular grade ethanol and subsequently stored at –20°C for genetic analysis. Specimens were fixed in 8% formalin for ~12 hours, washed and kept in tap water for ~12 hours, and transferred to 70% ethanol for long-term storage. Specimens are deposited in the museum and research collection facility at the National Centre for Biological Sciences, Bengaluru (NRC) and at the Bombay Natural History Society, Mumbai (BNHS).

Morphological and meristic data

Morphological data were collected from a total of 25 specimens of three new species. We restricted morphological comparisons to the clade each new species was assigned to (see Results). Comparative morphological

Table 1. List of *Cnemaspis* sequences used in this study. Museum abbreviations are as follows: AA, Rohan Pethiyagoda field series; AK/ AK-R, Akshay Khandekar field series; AMB; Aaron Bauer field series; BNHS, Bombay Natural History Society, Mumbai; CESL, CESG, Centre for Ecological Sciences, Bangalore; MVZ, Museum of Vertebrate Zoology. Berkeley; NRC-AA, National Centre for Biological Sciences, Bangalore; SB, Sayantan Biswas field series; VG, Varad Giri field series; ZM, Zeeshan Mirza field series; ZSI-WRC, Zoological Survey of India, Pune. Accession numbers with * indicate 16S sequences.

Species	Voucher	Locality	GenBank Accession number
C. adii	BNHS 2465	India, Karnataka, Bellary, Hampi	KX753654*
C. agarwali	AK 107	India, Tamil Nadu, Salem District, Sankari	MK792466
C. ajijae	AK 432	India, Maharashtra, Satara District, Mahabaleshwar	MK792499
C. ajijae	ZSI-WRC-R/1060	India, Maharashtra, Satara District, Mahabaleshwar	KX753649*
C. amba	NCBS-BH691 (VG408)	India, Tamil Nadu, Kolhapur District, Amba	MK792488
C. amboliensis	VG 394	India, Maharashtra, Sindhudurg District, Amboli	MK792481
C. amboliensis	BNHS2508	India, Maharashtra, Sindhudurg District, Amboli	MH174356*
C. anamudiensis	CESL 232	India, Kerala, Idukki District, Anamudi	MZ701805
C. anandani	CESL 297	India, Tamil Nadu, Nilgiris	MZ701811
C. cf. *assamensis*	BNHS 2808	India, Meghalaya, Ri Bhoi District, Saiden	MW3674
C. australis	ZM003	India, Kerala, Peppara	MZ701834
C. azhagu **sp. nov.**	NRC-AA-1172 (AK-R 671)	India, Tamil Nadu, Tirunelveli District, Thirukurungudi forest range	ON494554
C. balerion	CESL 415	India, Karnataka, Chikkmagaluru District, Kemmangudi	MZ701815
C. bangara	BNHS 2584 (AK 292)	India, Karnataka, Kolar District, Paparajanahalli	MT188143
C. beddomei	CESL 379	India, Tamil Nadu, Tirunelveli District, Kalakad Mundanthurai Tiger Reserve	MZ701814
C. chengodumalaensis	CESL 626	India, Kerala, Kozhikode District, Chengodumala	MT217043
C. flavigularis	CESL 247	India, Kerala, Idukki District, Mathikettan Shola National Park	MZ291585*
C. cf. *flavigularis*	ZM002	India, Kerala, Idukki District, Mathikettan Shola National Park	MZ291569/ MZ291569*
C. flaviventralis	VG 354	India, Maharashtra, Sindhudurg District, Amboli	MK792495
C. galaxia	CESL 511	India, Tamil Nadu, Virudhunagar District, Srivilliputhur	MZ701818
C. goaensis	AK 360	India, Goa, South Goa District, Canacona	MK792479
C. gracilis	CES G385	India, Kerala, Palakkad District, near Chittur River	MK792465
C. cf. *gracilis*	AK 209	India, Tamil Nadu, Salem District, Yercaud	MK792462
C. indica	CESL 291	India, Tamil Nadu, Nilgiris	MZ701810
C. jackieii	CESL 192	India, Tamil Nadu, Vairavankulam RF, near Karuppanadhi dam	MZ701804
C. kalakadensis **sp. nov.**	NRC-AA-1181 (AK-R 643)	India, Tamil Nadu, Tirunelveli District, Kalakadu forest range	ON494555/ ON521706*
C. kalakadensis **sp. nov.**	NRC-AA-1182 (AK-R 644)	India, Tamil Nadu, Tirunelveli District, Kalakadu forest range	ON494556/ ON521707*
C. kolhapurensis	unvouchered	India, Maharashtra, Kolhapur District, Dajipur	MK792501
C. koynaensis	CES G349	India, Maharashtra, Satara District, Humbarli	MK792490
C. krishnagiriensis	NRC-AA-1120 (AK 896)	India, Tamil Nadu, Krishnagiri District, Krishnagiri fort	MW580961
C. littoralis	AK 955	India, Kerala, Kozhikode District, Kozhikode	ON494557
C. littoralis	AK 956	India, Kerala, Kozhikode District, Kozhikode	ON494558
C. littoralis	AK 963	India, Kerala, Kozhikode District, Kozhikode	ON494559
C. littoralis	SB 151	India, Kerala, Thrissur District, Athirappilly Falls	KY038013
C. littoralis	ZM001	India	MZ701831
C. littoralis	BNHS 2517	India, Kerala, Kozhikode	MH174367*
C. littoralis	BNHS 2518	India, Kerala, Kozhikode	MH174368*
C. cf. *maculicollis*	CESL 709	India, Kerala, Kollam District, Shendurney Wildlife Sanctuary	MZ701825
C. magnifica	BNHS 2547 (AK855)	India, Karnataka, Hassan District, Sakleshpur	MT180437
C. modigliani	MVZ239314	Sumatra, Kecematan Enggano, Pulau Enggano, near Malakoni	KY037977
C. monticola	CESL 044	India, Kerala, Wayanad District, Manikunjmalai	MZ701803
C. mundanthuraiensis **sp. nov.**	NRC-AA-1176 (AK-R 443)	India, Tamil Nadu, Tirunelveli District, Mundanthurai forest range	ON494557
C. mundanthuraiensis **sp. nov.**	NRC-AA-1177 (AK-R 445)	India, Tamil Nadu, Tirunelveli District, Mundanthurai forest range	ON494558
C. mysoriensis	unvouchered	India, Karnataka, Bangalore Urban District, IISc Campus	MK792474
C. nigriventris	CESL 264	India, Kerala, Achankovil Reserve Forest	MZ701808

Species	Voucher	Locality	GenBank Accession number
C. nimbus	CESL 252	India, Kerala, Idukki District, Mathikettan Shola National Park	MZ701807
C. ornata	CESL 276	India, Tamil Nadu, Tirunelveli District, Vairavakulam Reserve Forest	MZ701809
C. palanica	CESL 341	India, Tamil Nadu, Dindigul District, Palani Hills	MZ701812/ MZ291614
C. palakkadensis	BNHS 2790	India, Kerala, Palakkad	MT762366*
C. cf. *palakkadensis*	CESL 221	India, Kerala, Palakkad	MZ291583*
C. phillipsi	AA81	Sri Lanka, Matale District, Gammaduwa, Rattota	KY038001
C. podihuna	58A	Sri Lanka, Moneragala District, Kukulagoda	KY038005
C. regalis	CESL 487/488	India, Tamil Nadu, Tirunelveli District, Kalakad Mundanthurai Tiger Reserve	MZ701816/ MZ701817
C. rubraoculus	CESL 114	India, Kerala, Periyar Tiger Reserve, Upper Manalar	ON494559
C. shevaroyensis	NCBS-BH 674 (AK 204)	India, Tamil Nadu, Salem District, Yercaud	MK792468
C. smaug	CESL 251	India, Kerala, Idukki District, Mathikettan Shola National Park	MZ701806
C. thackerayi	CESG 143	India, Tamil Nadu, Salem District, Yercaud	MK792471
C. tropidogaster	AMB 7505	Sri Lanka, Nuwara Eliya District, Upcot tea estate	KY037983
C. wallaceii	CESL 377	India, Tamil Nadu, Anamalai, Andiparai Shola	MZ701813
C. yercaudensis	CES G133	India, Tamil Nadu, Namakkal District, Kollimalai massif	MK792473

data of all other members of *beddomei*, *gracilis*, and *littoralis* clades were collected either from the type and/ or topotypic specimens listed in the Appendix 1 or obtained from Manamendra-Arachchi et al. (2007), Cyriac et al. (2018), Sayyed et al. (2019, 2020), and Pal et al. (2021) for some species. Meristic counts and measurements were taken under a ZEISS Stemi 305 stereo dissecting microscope and on the right side of the body where possible. Colour pattern was recorded from photographs taken in life. All measurements were taken with a Mitutoyo digital vernier calliper (to the nearest 0.1 mm). We follow Agarwal et al. (2020a) for body size categories for South Asian *Cnemaspis*; and Khandekar et al. (2019a, 2019b) for mensural, meristic and additional morphological character states: snout vent length (**SVL**), axilla to groin length (**AGL**), body height (**BH**), body width (**BW**), forearm length (**FL**), crus length (**CL**), tail length (**TL**), tail width (**TW**), head length (**HL**), head width (**HW**), head depth (**HD**), eye diameter (**ED**), eye to nares distance (**EN**), eye to snout distance (**ES**), eye to ear distance (**EE**), ear length (**EL**), internarial distance (**IN**), interorbital distance (**IO**); meristic data recorded for all specimens were number of supralabials (**SL**), infralabials (**IL**), supralabials at midorbital position (**SL M**), infralabials at midorbital position (**IL M**), dorsal tubercle rows including longitudinal rows of spine-like scales on lower flank (**DTR**), paravertebral tubercles (**PVT**), ventral scales (**VS**), mid-body scale rows across the belly (**MVSR**), precloacal pores (**PP**), femoral pores (**FP**), poreless scales between precloacal and femoral pores (**SB PP&FP**), poreless scales between precloacal pores (**SB PP**), poreless scales between femoral pores (**SB FP**), postcloacal tubercles (**PCT**), transverse subdigital lamellae on finger 1 (**LamF1**), finger 4 (**LamF4**), toe 1 (**LamT1**), toe 4 (**LamT4**), toe 5 (**LamT5**). Additionally, we recordeddata on tuberculation of original tail — paravertebral tubercles (**PVTT**), dorsolateral tubercles (**DLTT**), and lateral tubercles (**LTT**), which are the number of tubercles in paravertebral, dorsolateral, and lateral rows respectively, counted from tail base to tip.

Molecular data

We extracted genomic DNA from liver/ tail biopsies using the Qiagen DNeasy Blood & Tissue extraction kit for samples of the three new species as well as a few topotypical *Cnemaspis littoralis* (Jerdon, 1853) (Table 1). We targeted the protein coding mitochondrial ND2 gene using the primers L4437 & H5934 (Macey et al. 1997), with L4437 used for sequencing. PCR and sequencing were outsourced to Medauxin, Bangalore. These sequences were combined with published sequences including representatives of all clades of South Asian *Cnemaspis* and all known species of the *beddomei*, *gracilis* and *littoralis* clades (after Agarwal et al. 2020; Pal et al. 2021; Table 1). ND2 sequences were not available for *C. aaronbaueri* Sayyed, Grismer, Campbell and Dileepkumar, 2019 and *C. nairi* Inger, Marx and Koshy, 1984 of the *beddomei* clade, and *C. flavigularis* Pal, Mirza, Dsouza and Shanker, 2021 and *C. palakkadensis* Sayyed, Cyriac and Dileepkumar, 2020 of the *littoralis* clade. Additionally, we used a chimeric sequence for *C. regalis* Pal, Mirza, Dsouza and Shanker, 2021 as the two published sequences (that are of individuals from the same locality) have only 70 nucleotides of overlap. Sequences were aligned using default settings in ClustalW (Thompson et al. 1994) as implemented in MEGA 5.2 (Tamura et al. 2011). Uncorrected pairwise p-distance with the partial deletion option was calculated in MEGA and the best fit models of sequence evolution were picked using the Bayesian Information Criteria in Partitionfinder 2 (Lanfear et al. 2012). We reconstructed a Maximum Likelihood (ML) phylogeny using the GTR + G model for each codon partition in RAxML HPC 8.2.10 (Stamatakis, 2006) via the

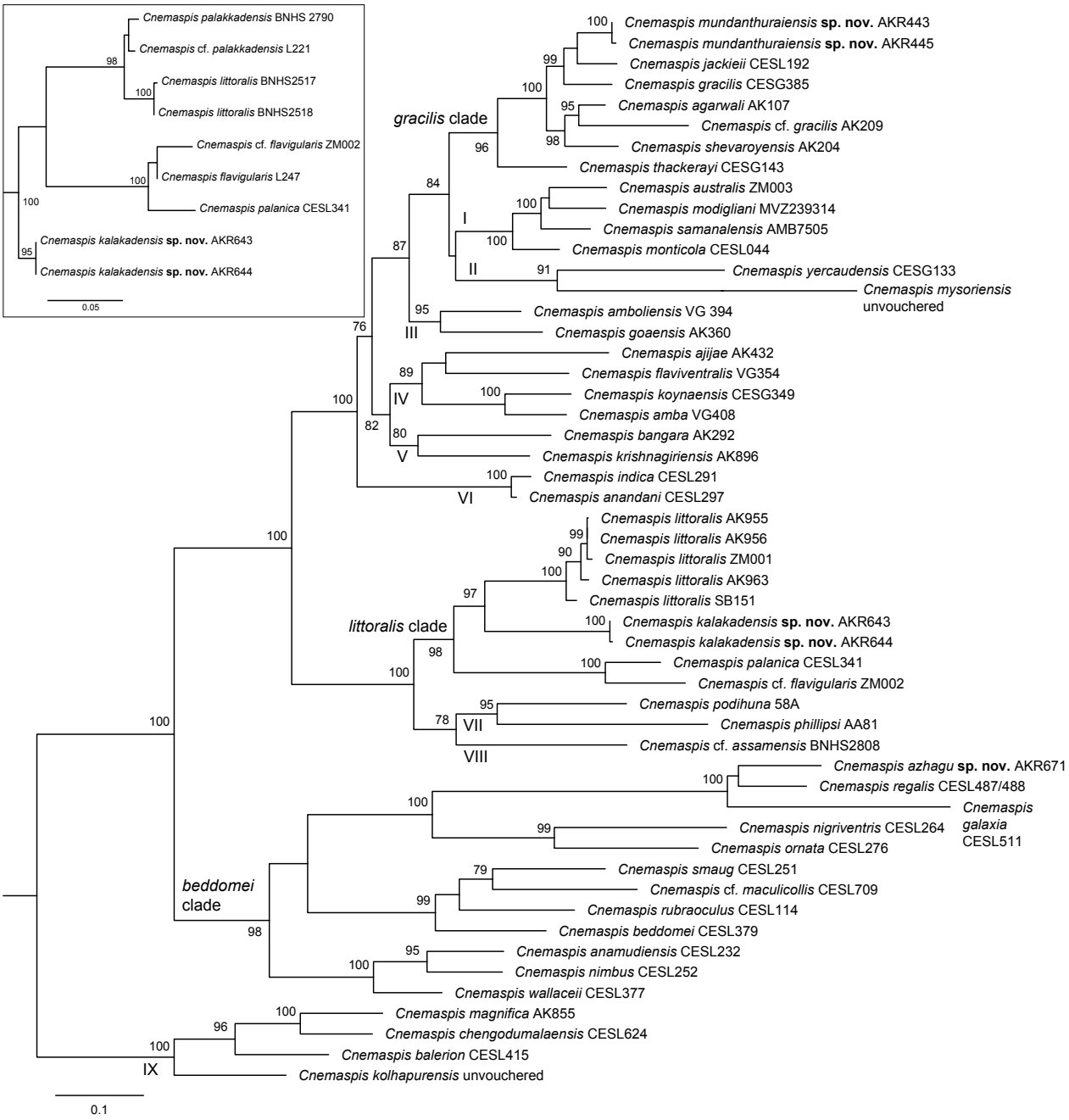

Figure 2. Maximum likelihood (ML) phylogeny of South Asian *Cnemaspis* based on the mitochondrial ND2 gene. Bootstrap support >70 shown at nodes; *beddomei*, *gracilis* and *littoralis* clades marked by text. Roman numerals indicate other broad clades: I, *australis*; II, *mysoriensis*; III, *goaensis*; IV, *girii*; V, *bangara*; VI, *indica*; VII, *podihuna*; VIII, *assamensis*; IX, *wynadensis*. Top left inset is a 16S ML phylogeny of the *littoralis* clade (outgroups not shown).

CIPRES Science Gateway (http://www.phylo.org/; Miller et al. 2010) with 10 independent ML runs and support assessed with 1000 non-parametric bootstraps. We also generated partial 16S sequences for the new species from the *Cnemaspis littoralis* clade using the primers 16SA and 16SB (Palumbi et al. 1991). These were added to published sequences of members of the *littoralis* clade, with *C. adii* Srinivasulu, Kumar & Srinivasulu, 2015, *C. ajijae* Sayyed, Pyron & Dileepkumar, 2018 and *C. amboliensis* Sayyed, Pyron & Dileepkumar, 2018 used as outgroups. The same settings as used above were applied for alignment and ML reconstruction with a single partition and the GTR + G model.

Results

Phylogenetic relationships

The ND2 sequences ranged in length from 490–1038 nucleotides and we translated these to amino acids to ensure that there were no erroneous internal stop codons. We recovered the same broad ten clades as Pal et al. (2021), within which we recognise the *littoralis* clade to be exclusive of the Sri Lankan species of the *podihuna* clade and *C. assamensis* (Fig. 2). *Cnemaspis kalakadensis* **sp. nov.** is the sister taxon to *C. littoralis* within the *littoralis*

clade, *Cnemaspis mundanthuraiensis* **sp. nov.** is sister to *C. jackieii* Pal, Mirza, Dsouza and Shanker, 2021 within the *gracilis* clade, and *Cnemaspis azhagu* **sp. nov.** is allied to *C. galaxia* Pal, Mirza, Dsouza and Shanker, 2021 and *C. regalis* from within the *beddomei* clade. The 16s phylogeny for the *littoralis* clade recovered a well-supported clade within which a basal split separates *Cnemaspis kalakadensis* **sp. nov.** from the remaining species of the group (Fig. 2) from which it is 6–11 % divergent. The three new species exhibit 6–14 % ND2 sequence divergence from other members of their respective clades (Table 2) and we describe them as new species below.

Systematics

Cnemaspis azhagu sp. nov.

Figs 3–8; Tables 3–5

http://zoobank.org/677D74B1-C4A9-4399-826F-E72F66-31E841

Holotype. NRC-AA-1170 (AK-R 678), adult male, from Thirukurungudi forest range (8.4069°N, 77.5485°E; *ca*. 200 m asl.), Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India; collected by Akshay Khandekar and team on 06 May 2021.

Paratypes. NRC-AA-1171 (AK-R 670), NRC-AA-1172 (AK-R 671), NRC-AA-1174 (AK-R 673), BNHS 2818 (AK-R 674), BNHS 2819 (AK-R 675), BNHS 2820 (AK-R 676), adult males; BNHS 2821 (AK-R 677), adult female; NRC-AA-1173 (AK-R 672), subadult female. AK-R 670 and AK-R 671 collected from the same locality as holotype; AK-R 673, AK-R 674, and AK-R 675 collected from 8.4049°N, 77.5376°E, *ca*. 280 m asl.; AK-R 676, AK-R 677, and AK-R 672 collected from 8.4142°N, 77.5323°E, ca. 400 m asl.; all localities from Thirukurungudi forest range, Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India; same collectors as holotype except collected on 07 May 2021.

Etymology. The specific epithet, azhagu (a-lha-gu, also sometimes transliterated as aḻaku), is the Tamil word for beauty (அழகு) and is used as a noun in apposition for this beautiful new species.

Suggested Common Name. Thirukurungudi dwarf gecko.

Diagnosis. A small-sized *Cnemaspis*, snout to vent length less than 38 mm (*n*=9). Dorsal pholidosis heterogeneous; smooth granular scales intermixed with a fairly regularly arranged row of enlarged, weakly keeled, conical tubercles on either side of flank; granular scales gradually increasing in size towards each flank, largest on mid-flank; spine-like scales absent on the flank; two (rarely three, *n*=1/9) rows of dorsal tubercles at mid-body, enlarged tubercles in paravertebral region absent (rarely a few present, *n*=2/9); ventral scales subcircular, smooth, subimbricate, and subequal from chest to vent, 34–44 scales across belly at mid-body, 151–171 longitudinal scales from mental to cloaca; subdigital scansors smooth, some divided and others entire; 13–16 lamellae under digit I of manus and 12–14 lamellae under digit I of pes, 20–25 lamellae under digit IV of manus and 24–27 lamellae under digit IV of pes; males (*n*=7/9) with a continuous series of 6–8 precloacal pores (*n*= 5/7), rarely divided medially by a single poreless scale (*n*=2/7), femoral pores absent; tail with enlarged, weakly keeled, pointed, and weakly conical tubercles forming four whorls only on anterior third; followed by a row of three paravertebral tubercles on either side; rest of tail without enlarged tubercles; a median row of subcaudals smooth, regularly arranged with condition of two slightly larger scales alternating with a large divided scale. Males with ochre head and grey body, females more uniform brown; single central black ocellus on occiput flanked by lighter markings, collar formed by thick black spots/streak flanked posteriorly by white band just anterior to forelimb insertions; tail without strong markings; iris red with light orange ring surrounding pupil.

Comparison with members of *C. beddomei* clade. *Cnemaspis azhagu* **sp. nov.** is a member of the *beddomei* clade and can be easily distinguished from all 13 members of the clade by a combination of the following differing or non-overlapping characters: two (rarely three) rows of dorsal tubercles at mid-body (*versus* 8–10 rows of dorsal tubercles at mid-body in *C. aaronbaueri*; 10–12 in *C. beddomei* (Theobald, 1876), eight in *C. galaxia*; 16–18 in *C. nairi*; 13 or 14 in *C. nigriventris* Pal, Mirza, Dsouza and Shanker, 2021; 12–14 in *C. nimbus* Pal, Mirza, Dsouza and Shanker, 2021; and *C. ornata* (Beddome, 1870); 7–9 in *C. regalis*; 8–10 in *C. rubraoculus* Pal, Mirza, Dsouza and Shanker, 2021; 19–22 in *C. smaug* Pal, Mirza, Dsouza and Shanker, 2021; and 14–15 in *C. wallaceii* Pal, Mirza, Dsouza and Shanker, 2021); paravertebral tubercle rows absent (*versus* paravertebral tubercle rows present in *C. aaronbaueri*, *C. beddomei*, *C. galaxia*, *C. nairi*, *C. nigriventris*, *C. nimbus*, *C. maculicollis*, *C. ornata*, *C. regalis*, *C. rubraoculus*, *C. smaug*, and *C. wallaceii*); A small-sized *Cnemaspis* SVL 38 mm (*versus* medium-sized *Cnemaspis* SVL 40–50 mm: *C. nairi*; *C. nimbus*; *C. ornata*; *C. rubraoculus*; and *C. wallaceii*; large-sized *Cnemaspis* SVL >50 mm: *C. anamudiensis* Cyriac, Johny, Umesh and Palot, 2018; *C. beddomei*; *C. maculicollis* Cyriac, Johny, Umesh and Palot, 2018; and *C. smaug*); 151–171 longitudinal ventral scales from mental to cloaca (*versus* 135–140 longitudinal ventral scales from mental to cloaca in *C. aaronbaueri*, 143–147 in *C. nairi*, 134–141 in *C. nimbus*, 148–154 in *C. regalis*, 122–133 in *C. rubraoculus*, and 142–150 in *C. smaug*); 34–44 ventral scales across belly at mid-body (*versus* 31–33 ventral scales across belly at mid-body in *C. aaronbaueri*, 30–34 in *C. beddomei* and *C. smaug*, 27–31 in *C. galaxia*, 32–33 in *C. nairi*, 26–27

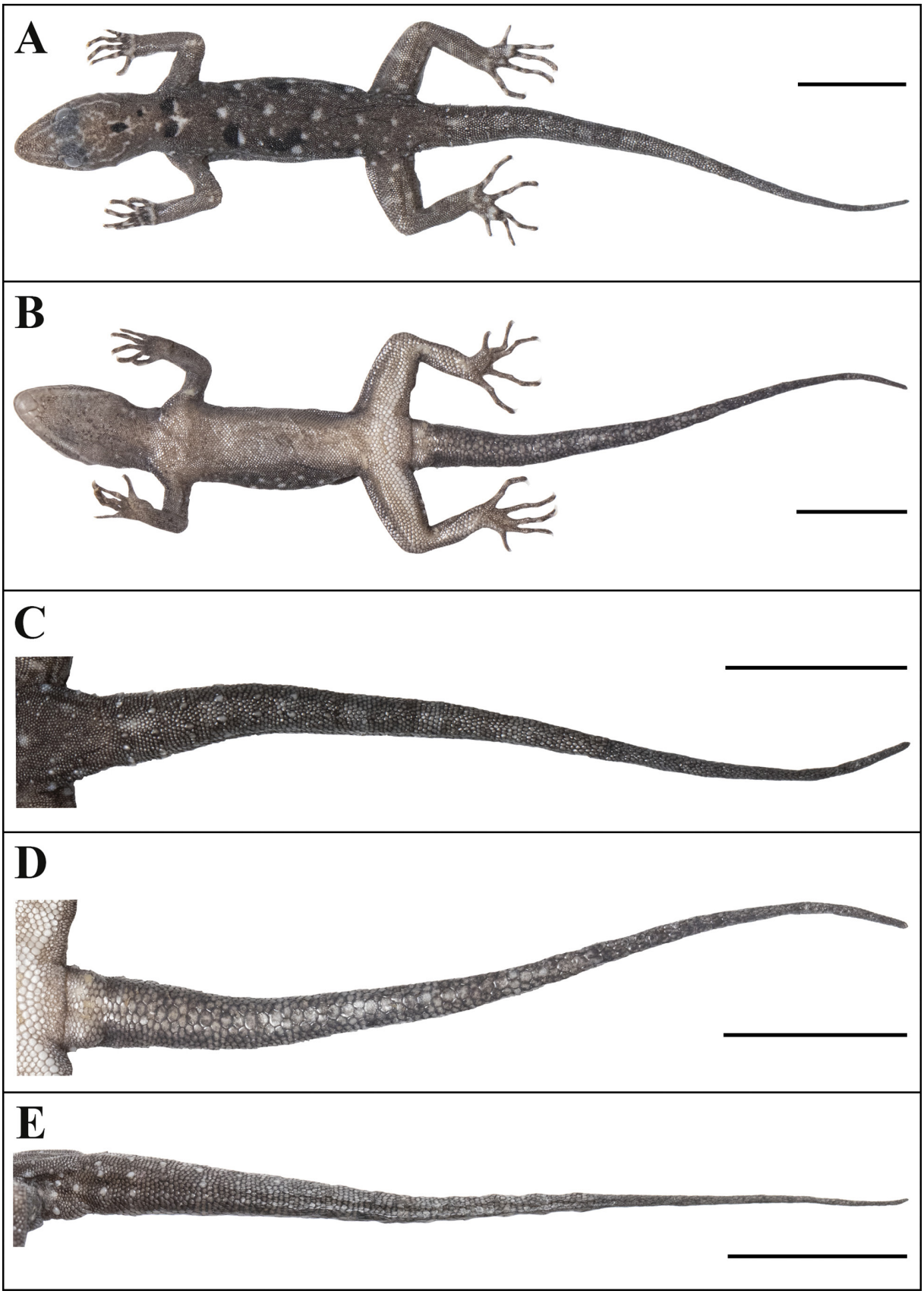

Figure 3. *Cnemaspis azhagu* **sp. nov.** (holotype, NRC-AA-1170): **A** dorsal aspect of body, **B** ventral aspect of body, **C** dorsal aspect of tail, **D** ventral aspect of tail, and **E** lateral aspect of tail. Scale bars 10 mm; photos by Akshay Khandekar and Satpal Gangalmale.

in *C. nimbus*, and 28–29 in *C. wallaceii*); 24–27 lamellae under digit IV of pes (*versus* 20–22 lamellae under digit IV of pes in *C. anamudiensis*, 21–23 in *C. beddomei*, 23–24 in *C. maculicollis*, 22 or 23 in *C. nimbus* and *C. wallaceii*, 28–31 in *C. ornata*, 18 or 19 in *C. rubraoculus*, 20–22 in *C. smaug*).

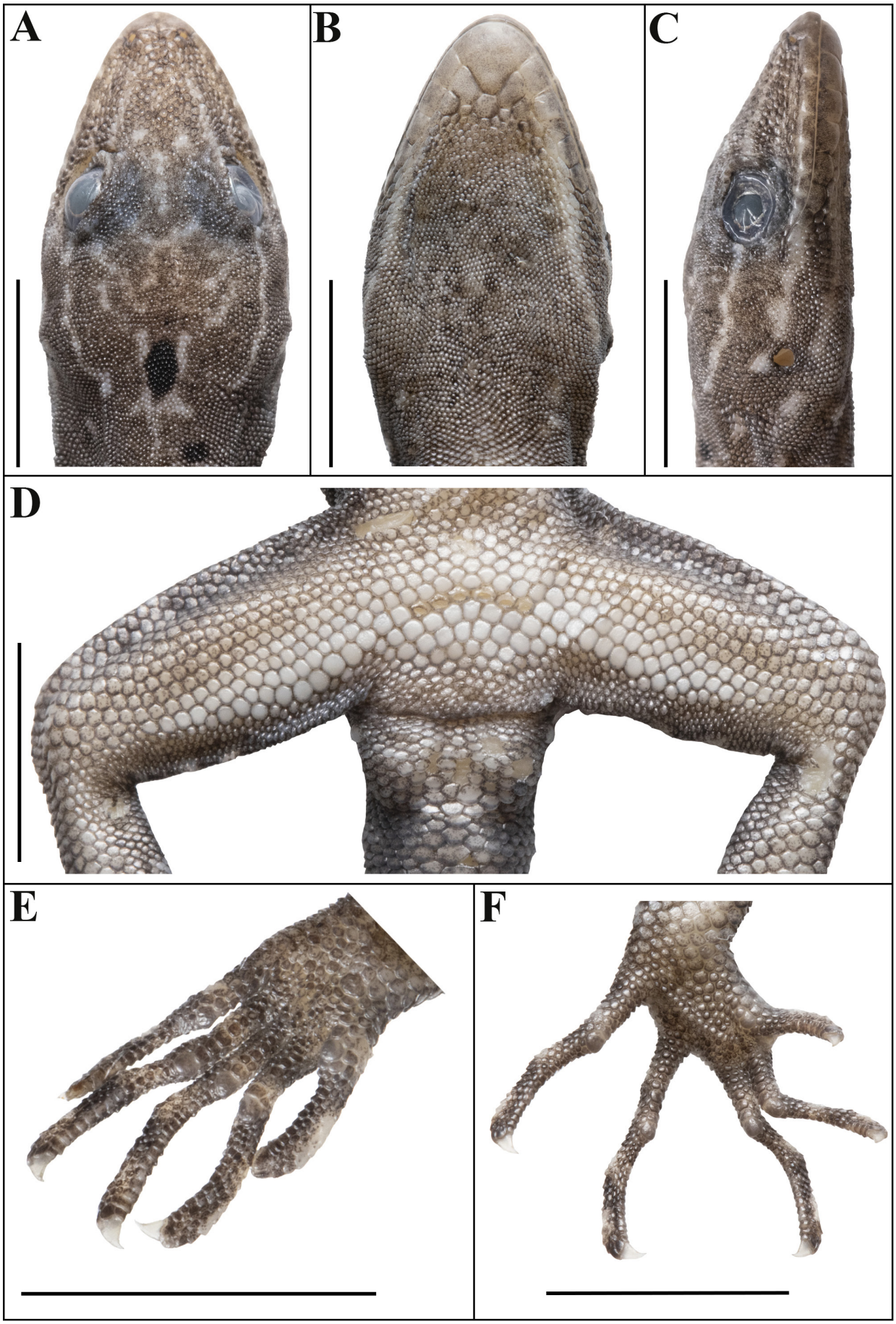

Figure 4. *Cnemaspis azhagu* **sp. nov.** (holotype, NRC-AA-1170): **A** dorsal aspect of head, **B** ventral aspect of head, **C** lateral aspect of right side head, **D** aspect of cloacal region showing precloacal pores, **E** ventral aspect of left manus, and **F** ventral aspect of left pes. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

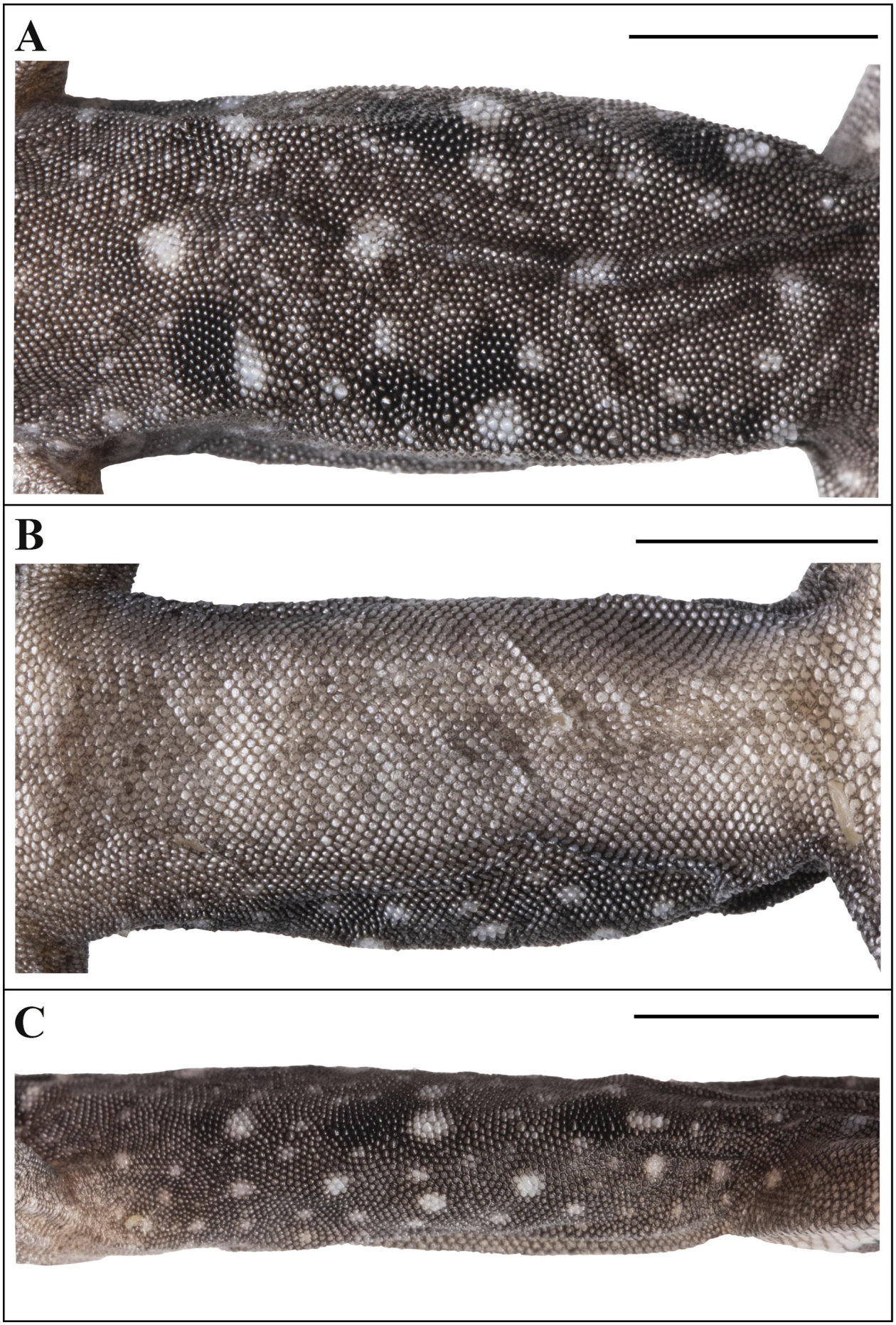

Figure 5. *Cnemaspis azhagu* **sp. nov.** (holotype, NRC-AA-1170): **A** dorsal aspect of mid-body, **B** ventral aspect of mid-body, and **C** right side lateral aspect of mid-body. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

Figure 6. Colouration in life of *Cnemaspis azhagu* **sp. nov.**: **A** adult male (holotype, NRC-AA-1170), and **B** adult female (paratype, BNHS 2821). Photos by Akshay Khandekar and Satpal Gangalmale.

Description of the holotype. Adult male in good state of preservation except head marginally bent towards left and tail tip towards right (Fig. 3A, B); SVL 37.5 mm, head short (HL/SVL 0.25), wide (HW/HL 0.64), not strongly depressed (HD/HL 0.42), distinct from neck. Loreal region marginally inflated, canthus rostralis indistinct. Snout half of head length (ES/HL 0.48), ~2.5 times eye diameter (ES/ED 2.47); scales on snout and canthus rostralis subcircular, subequal, smooth, much larger than those on forehead and interorbital region; scales on forehead similar to those on snout and canthus rostralis except much smaller and weakly conical; scales on interorbital region, occipital, and temporal region even smaller, granular (Fig. 4A). Eye small (ED/HL 0.19); with round pupil; supraciliaries short, larger anteriorly; nine interorbital scale rows across narrowest point of frontal bone;

Figure 7. Paratype series of *Cnemaspis azhagu* **sp. nov.** from left to right, NRC-AA-1171, NRC-AA-1172, NRC-AA-1173, NRC-AA-1174, BNHS 2818, BNHS 2819, BNHS 2820, and BNHS 2821. Scale bar 10 mm; photo by Akshay Khandekar and Satpal Gangalmale.

29–31 scale rows between left and right supraciliaries at mid-orbit (Fig. 4A). Ear-opening deep, oval, small (EL/HL 0.04); eye to ear distance greater than diameter of eye (EE/ED 1.47) (Fig. 4C). Rostral slightly more than twice as wide (1.8 mm) as high (0.8 mm), incompletely divided dorsally by a strongly developed rostral groove for more than half of its height; a single enlarged supranasal on each side, slightly larger than upper postnasal and strongly in contact with each other on snout; rostral in contact with supralabial I, nostril, and supranasal on either side; nostrils oval, surrounded by two postnasals, supranasal, rostral and supralabial I on either side; a single row of scales separate orbit from supralabials (Fig. 4C). Mental enlarged, subtriangular, marginally wider (2.1 mm) than high (1.9 mm); two pairs of postmentals, inner pair roughly rectangular, shorter (1.0 mm) than mental, separated from each other below mental by a single enlarged median chin shield; inner pair bordered by mental, infralabial I, outer postmental and two enlarged chin shields on either side; outer postmentals roughly rectangular, half the size (0.5 mm) than inner pair, bordered by inner postmentals, infralabial I and II, and four enlarged chin shields on either side; five enlarged gular scales between left and right outer postmentals; all chin scales bordering postmentals flat, subcircular, smooth, and smaller than outermost postmentals, except the one separating inner pair (median) below mental as large as outer postmentals; scales on rest of throat granular, small, smooth (Fig. 4B). Infralabials bordered below by a row or two of slightly enlarged, much elongated scales, decreasing in size posteriorly. Eight supralabials up to angle of jaw and six at midorbital position on each side; supralabial I largest,

Figure 8. Habitat at the type locality of *Cnemaspis azhagu* **sp. nov.**: **A** general habitat showing the dry scrub forest dominated by rocks, and **B** & **C** microhabitat showing the rock and its base from where the type series were collected. Photos by Akshay Khandekar.

gradually decreasing in size posteriorly; seven infralabials up to angle of jaw, six at midorbital position on left and five on right side; infralabial I largest, gradually decreasing in size posteriorly (Fig. 4C).

Body relatively slender (BW/AGL 0.44), trunk less than half of SVL (AGL/SVL 0.40) without ventrolateral folds and spine-like scales on flank (Fig. 5B, C). Dorsal pholidosis heterogeneous; smooth granular scales intermixed with a fairly regularly arranged row of enlarged, weakly keeled, conical tubercles on either side of flank; granular scales gradually increasing in size towards each flank, largest on mid-flank; granular scales on occiput and nape slightly smaller than paravertebral granules (Fig. 5A). Ventral scales much larger than granular scales

Table 2. Pairwise uncorrected ND2 sequence divergence within the *beddomei* (only four closest species included), *gracilis* and *littoralis* clades of South Asian *Cnemaspis*.

	Species	**1**	**2**	**3**	**4**			
1	*azhagu*							
2	*galaxia*	11.1						***beddomei* clade**
3	*nigriventris*	32.2	28.8					
4	*ornata*	28.3	26.6	18.5				
5	*regalis*	19.6	20.0	32.1	29.0			
	Species	**1**	**2**	**3**	**4**	**5**	**6**	
1	*mundanthuraiensis*							
2	*agarwali*	8.8						
3	*gracilis*	7.6	8.8					***gracilis* clade**
4	cf. *gracilis*	13.9	11.3	13.9				
5	*jackieii*	6.1	9.0	7.7	11.3			
6	*shevaroyensis*	10.3	7.9	10.3	13.4	9.7		
7	*thackerayi*	13.3	13.1	13.1	16.7	12.3	13.5	
	Species	**1**	**2**	**3**				
1	*kalakadensis*							
2	cf. *flavigularis*	19.5						***littoralis* clade**
3	*littoralis*	14.4	19.9					
4	*palanica*	19.3	11.7	20.2				

Table 3. Mensural (mm) data for the type series of *Cnemaspis azhagu* **sp. nov.**. Abbreviations are listed in Materials and Methods.

Type	**Holotype**	**Paratypes**							
Specimen no.	NRC-AA-1170	NRC-AA-1171	NRC-AA-1172	NRC-AA-1173	NRC-AA-1174	BNHS 2818	BNHS 2819	BNHS 2820	BNHS 2821
Sex	Male	Male	Male	Female	Male	Male	Male	Male	Female
SVL	37.5	37.3	34.9	27.4	37.2	37.0	35.4	34.3	38.0
TL	48.8	42.5	42.0	35.4	40.7	49.5	49.4	38.0	46.7
TW	3.9	4.1	3.4	2.5	3.5	3.7	4.0	3.5	3.7
LAL	5.9	5.5	6.1	4.7	6.1	5.9	5.5	5.6	5.8
CL	7.0	7.1	7.2	5.3	7.8	7.1	6.5	6.6	7.0
AGL	15.2	14.3	12.7	11.2	16.0	15.8	14.9	14.5	16.0
BH	3.7	4.0	3.9	2.6	4.6	5.5	4.7	4.4	3.8
BW	6.8	6.9	6.0	5.0	7.9	8.2	7.7	7.1	7.4
HL	9.6	9.8	9.4	7.1	10.2	9.5	9.0	8.7	10.7
HW	6.2	6.2	6.1	5.0	6.5	6.5	6.3	5.9	6.7
HD	4.1	4.0	3.9	3.1	4.3	4.2	4.2	4.0	4.2
ED	1.9	1.9	1.9	1.5	2.1	1.9	1.9	1.8	2.0
EE	2.8	3.0	2.7	2.1	3.3	2.8	2.9	2.7	2.8
ES	4.7	4.5	4.4	3.4	4.7	4.4	4.3	4.4	4.9
EN	3.6	3.5	3.4	2.7	3.7	3.5	3.4	3.4	3.9
IN	1.0	1.2	1.0	1.0	1.3	1.1	1.1	1.1	1.2
IO	2.3	2.3	2.3	1.5	2.6	2.4	1.3	2.2	2.8
EL	0.4	0.5	0.5	0.4	0.8	0.6	0.7	0.5	0.7

on dorsum, subcircular, smooth, subimbricate, subequal from chest to vent; scales on precloacal region and on last two or three rows on femur distinctly enlarged; mid-body scale rows across belly 40; 159 scales from mental to anterior border of cloaca (Fig. 3B). Scales on base of neck similar to those on belly, marginally smaller; gular region with much smaller, smooth, granular scales, those bordering postmentals enlarged, smooth, subcircular, and flattened (Fig. 4B). A continuous series of six precloacal pores, femoral pores absent (Fig. 4D). Scales on palm and soles granular, smooth, rounded, and flattened; scales on dorsal aspects of limbs heterogeneous in shape and size; mixture of small granules, slightly larger than body dorsum and flattened, smooth (few weakly keeled), subimbricate scales which are twice the size of granules on the body dorsum, largest on anterolateral aspect of the hands and feet; posterolateral aspect of limbs with small granular scales; ventral aspect of forelimbs with small granular scales, slightly larger on lower arm than upper arm; ventral aspect of hindlimb with enlarged, smooth, flattened,

Table 4. Meristic data for the type series of *Cnemaspis azhagu* **sp. nov.**. Abbreviations are listed in Materials and Methods except for: L&R = Left & Right; irr = irregular; * = ventral scales, precloacal pores, lamellae, and tail tuberculation incomplete; abs. = absent.

Type	Holotype	Paratypes							
Specimen no.	NRC-AA-1170	NRC-AA-1171	NRC-AA-1172	NRC-AA-1173	NRC-AA-1174	BNHS 2818	BNHS 2819	BNHS 2820	BNHS 2821
Sex	Male	Male	Male	Female	Male	Male	Male	Male	Female
SL (L&R)	8&8	8&8	10&10	9&8	10&10	9&8	9&9	9&9	9&9
IL (L&R)	7&7	8&7	8&9	8&8	8&8	8&7	8&8	8&8	9&8
SL M (L&R)	6&6	7&6	6&6	6&6	5&6	7&6	6&6	6&6	6&6
IL M (L&R)	6&5	6&5	5&5	6&6	5&5	6&5	6&5	5&5	6&5
PVT (L&R)	abs.	abs.	irr	abs.	irr	abs.	abs.	abs.	abs.
DTR	2	2	2	2	3	2	2	2	2
MVSR	40	39	38	40	37	44	38	34	43
VS	159	162	168	95*	151	171	169	168	169
LamF1 (L&R)	15&15	15&14	15&15	14&14	14&13	16&15	15&14	14&16	13&13
LamF4 (L&R)	21&21*	20&22	25&23	25&24	24&24	23&22	24&24	22&23	22&24
LamT1 (L&R)	13&14	13&14	14&14	13&13	12&12	12&13	13&14	14&14	13&12
LamT4 (L&R)	25&25	24&24	25&25	26&25	27&26	26&26	26&27	24&24	25&24
LamT5 (L&R)	21&22	21&20	22&22	23&20	21&24	21&20	20&20	20&20	20&19
PP (L&R)	6	8	3&3	abs.	3&3	8	7	6*	abs.
SBPP	abs.	abs.	1	abs.	1	abs.	abs.	abs.	abs.
PCT (L&R)	1&1	1&1	1&1	1&1	1&1	1&1	1&1	1&1	1&1
PVTT (L&R)	8&7	7&8	10&9	6&7	1*&1*	8&9	7&6	6&7*	7&8
LTT (L&R)	4&4	6&5	6&5	3&3	1*&1*	3&2	4&4	4&5	4&5
VLTT (L&R)	3&3	2&2	3&3	2&2	1*&1*	2&2	3&3	3&3	3&4

subimbricate scales, much larger than body ventrals (Fig. 3A, B).

Forelimbs and hindlimbs slightly long, slender (LAL/SVL 0.15); (CL/SVL 0.18); digits long, with a strong, recurved claw, distinctly inflected, distal portions laterally compressed conspicuously. Digits with both paired and unpaired lamellae, separated into a basal and narrower distal series by single enlarged lamella at inflection; 1–7 most basal paired on basal series and 1–5 paired lamellae above the inflection; basal lamellae series: (2-6-6-6-4 right manus, 2-7-7-8-4 right pes), (2-6-6-6-4 left manus, Fig. 4E; 2-7-7-8-4 left pes, Fig. 4F); distal lamellae series: (13-14-16-15-14 right manus, 12-14-17-17-18 right pes), (13-14-17-15-15 left manus, Fig. 4E; 11-14-18-17-17 left pes, Fig. 4F). Relative length of digits (measurements in mm in parentheses): IV (4.1) > III (3.7) > V (3.5) > II (3.3) > I (2.1) (left manus); IV (4.6) > V (4.2) = III (4.2) > II (3.4) > I (1.9) (left pes).

Tail original, entire, subcylindrical, slender, slightly longer than snout-vent length (TL/SVL 1.30; Fig. 3C–E). Dorsal pholidosis on tail heterogeneous; small, smooth, subcircular, flattened, subimbricate scales intermixed on anterior one third portion with enlarged, weakly keeled, and weakly conical tubercles forming four whorls; eight tubercles on first whorl, six tubercles on second, five tubercles on third and four tubercles on fourth; followed by a row of three paravertebral tubercles on either side; rest of the tail lacking enlarged tubercles (Fig. 3C, E). Scales on tail venter much larger than those on dorsal aspect, smooth, roughly subcircular, flattened, sub-imbricate; median series slightly larger than rest, regularly arranged with condition of two slightly larger scales alternating with a large divided scale (Fig. 3D). Scales on tail base slightly smaller, smooth, imbricate; a single enlarged, smooth, subcircular, and weakly conical postcloacal spur on each side (Fig. 3D, E).

Colouration in life (Fig. 6A). Dorsal ground colour of body, limbs and tail grey; entire head and region anterior to forelimb insertions ochre. Indistinct light preorbital streak runs from nostril to orbit; three light postorbital streaks, uppermost terminating in parietal region, middle at occiput and lowermost continuing until ear opening. A single large central black ocellus on occiput enclosed within a U-shaped light marking and in between uppermost and middle postorbital streaks; a single smaller black ocellus on the right side anterior to forelimb insertions; an incomplete collar at anterior edge of forelimb insertions consisting of a pair of dark blotches flanked posteriorly by a narrower white band on centre of back and small black spot flanked by white band at anterior base of forelimb insertion. Five white spots on vertebral region between forelimbs and tail base, scattered white spots of similar or smaller size on dorsum and femur, larger irregular black blotches scattered on dorsolateral aspect of back (two on left side and one on right). Original tail with indistinct lighter bands, digits with numerous light grey bands. Ventral surfaces of body, limbs and tail light grey with some scattered darker scales especially in centre of belly, throat and underside of neck ochre with scattered darker scales. Pupil black, iris reddish with a light orange ring lining pupil.

Table 5. Additional morphological character states evaluation for the type series of *Cnemaspis azhagu* **sp. nov.**. abs. = absent; / = data unavailable.

Type	**Holotype**	**Paratypes**							
Specimen no.	NRC-AA-1170	NRC-AA-1171	NRC-AA-1172	NRC-AA-1173	NRC-AA-1174	BNHS 2818	BNHS 2819	BNHS 2820	BNHS 2821
Sex	Male	Male	Male	Female	Male	Male	Male	Male	Female
Anterior extra-brillar fringe scales enlarged (1) or not enlarged (0)	1	1	1	1	1	1	1	1	1
Ventral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Gular scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Pectoral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Precloacal pores continuous (1) or separated (0)	1	1	0	abs.	0	1	1	1	abs.
Precloacal pores elongate (1) or round (0)	1	1	1	abs.	1	0	1	1	abs.
Dorsal pholidosis homogeneous (1) or heterogeneous (0)	0	0	0	0	0	0	0	0	0
Dorsal tubercles keeled (1) or not keeled (0)	1	1	1	1	1	1	1	1	1
Tubercles linearly arranged (1) or more random (0)	1	1	1	1	1	1	1	1	1
Spine-like tubercles on flank present (1) or absent (0)	0	0	0	0	0	0	0	0	0
Lateral caudal furrows present (1) or absent (0)	0	0	0	0	/	0	0	0	0
Subcaudals keeled (1) or smooth (0)	0	0	0	0	/	0	0	0	0
Single median row of subcaudals keeled (1) or smooth (0)	0	0	0	0	/	0	0	0	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0	/	0	0	0	0
Slightly enlarged median subcaudal scale row (1) or not (0)	1	1	1	1	/	1	1	1	1
Enlarged femoral scales present (1) or absent (0)	1	1	1	1	1	1	1	1	1
Subtibial scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0

Variation and additional information from type series. Mensural, meristic and additional character state data for the type series is given in Tables 3, 4 & 5 respectively. There are six adult males, an adult female and a subadult female ranging in size from 27.4–38.3 mm (Fig. 7). All paratypes resemble the holotype except as follows: a single internasal scale between supranasals on snout in BNHS 2819. Upper postmentals bordered by infralabial I on right and infralabials I & II on left in BNHS 2818, upper postmental bordered by infralabials I & II on either side in BNHS 2819. Outer postmental bordered by infralabials I & II on right and infralabial II on left in BNHS 2818, outer postmental bordered by infralabial II on either side in BNHS 2819; outer postmental bordered by four enlarged chin scales on right and three on left side in BNHS 2818; outer postmental bordered by three enlarged chin scales on right and five on left side in BNHS 2820. Three paratypes — NRC-AA-1174, BNHS 2819, and BNHS 2821 with original and complete tails, slightly longer than body (TL/SVL 1.29 and 1.39 respectively), partial tail detached from the body in BNHS 2821; NRC-AA-1171, NRC-AA-1172, BNHS 2818 and BNHS 2820 with partially regenerated but complete tails, slightly longer than body (TL/SVL 1.13, 1.20, 1.33, and 1.10 respectively); NRC-AA-1174 with complete but fully renegaded tail, marginally longer than body (TL/SVL 1.09). Sub-adult female (NRC-AA-1173) with damaged skin around the neck; four paratype males (NRC-AA-1174, BNHS 2818, BNHS 2819, and BNHS 2820) with partially or fully everted hemipenis. The new species is strongly sexually dimorphic in colour pattern (Fig. 6A, B), both female paratypes (NRC-AA-1173, BNHS 2821) brown with a slightly lighter head, ventrally dirty white with faint ochre on the edge of throat base; collar more complete in all paratypes except damaged in NRC-AA-1173; 1–4 dark ocelli on each side of back; head with numerous lighter lines in all paratypes except for BNHS 2821 (Fig. 7).

Distribution and natural history. *Cnemaspis azhagu* **sp. nov.** is currently known only from around its type locality (Thirukurungudi forest range *ca*. 200–400 m asl.), Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu (Fig. 1). Individuals of the new species were observed active during the daytime (morning to afternoon, 0930–1300 hrs) on rocks (< 2 m high from the base) inside dry deciduous forest patches (Fig. 8A–C). A large number of individuals (*n* = >30) were observed at all three locations indicating high abundance. The species moved inside rock crevices rapidly when approached. The holotype and two paratypes were collected during the day from rock crevices, while the rest of the type series were collected at night-time (1930–2100 hrs) from the other two closely spaced localities. All the paratypes collected at night were observed inactive, located openly on the rocks and did not try to escape when approached. *Hemidactylus* cf. *acanthopholis* and *H.* cf. *frenatus* were the only two gecko species we found sympatric with the new species.

Cnemaspis mundanthuraiensis sp. nov.

Figs 9–14; Tables 6–8

https://zoobank.org/FEC25F0C-6A0B-41C7-A6F9-A5AE777-EFF4E

Holotype. NRC-AA-1175 (AK-R 451), adult male, from Papanasam reserve forest, Mundanthurai forest range (8.6980°N, 77.3561°E; *ca*. 200 m asl.), Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India; collected by Akshay Khandekar and team on 21 April 2021.

Paratypes. NRC-AA-1176 (AK-R 443), NRC-AA-1177 (AK-R 445), NRC-AA-1178 (AK-R 446), BNHS 2822 (AK-R 448), BNHS 2824 (AK-R 450), and BNHS 2825 (AK-R 452), adult males; BNHS 2823 (AK-R 449), adult female; NRC-AA-1179 (AK-R 447), subadult female. AK-R 443 and AK-R 445 collected from the same locality and other details as holotype; AK-R 446, AK-R 448, and AK-R 450 collected from 8.7038°N, 77.3492°E, *ca*. 350 m asl.; AK-R 447, AK-R 449, and AK-R 452 collected from 8.7096°N, 77.3622°E; *ca*. 150 m asl.; all from Papanasam reserve forest, Mundanthurai forest range, Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India; same collectors as holotype except collected on 22 April 2021.

Etymology. The specific epithet is a toponym for the Mundanthurai forest range of Kalakad-Mundanthurai Tiger Reserve in Tirunelveli district of Tamil Nadu, the type and currently only known locality for this species.

Suggested Common Name. Mundanthurai dwarf gecko.

Diagnosis. A small-sized *Cnemaspis*, snout to vent length less than 33 mm (*n*=9). Dorsal pholidosis heterogeneous; weakly keeled, weakly conical, granular scales intermixed with irregularly arranged rows of enlarged, strongly keeled, conical tubercles which are gradually increasing in size towards flank; last two rows of enlarged tubercles on flank largest, spine-like; 6–8 rows of dorsal tubercles at mid-body, tubercles in paravertebral region irregular; ventral scales subcircular, smooth, subequal from chest to vent, 30–34 scales across belly at mid-body, 115–128 longitudinal scales from mental to cloaca; subdigital scansors smooth, unpaired, unnotched; 10 or 11 lamellae under digit I of manus and 9–12 lamellae under digit I of pes, 14–18 lamellae under digit IV of manus and 18–22 lamellae under digit IV of pes; males (*n*=7/9) with 3–5 femoral pores on each thigh separated by 9–11 poreless scales from two precloacal pores, precloacal pores separated medially by 2–4 poreless scales (*n*=4/7), precloacal pores sometimes absent entirely and femoral pores on each thigh separated by 23–25 poreless scales (*n*=3/7); tail with enlarged, strongly keeled, pointed, and spine-like tubercles forming whorls; six tubercles on first six whorl, five tubercles on seventh, and four on eighth whorl; rest of the tail with tubercles present only on the paravertebral rows; median row of subcaudals smooth, roughly pentagonal, and distinctly enlarged. Dorsum pale brown with numerous light blotches and red patches (more prominent in males); single small central black ocellus on occiput and larger one anterior to forelimb insertions; original tail with 8–10 alternating black and light grey bands; ventral surfaces off-white, dark streaks on posterior margin of throat and sternal region (males with underside of hindlimbs and margin of belly suffused with yellow).

Comparison with members of *C. gracilis* clade. *Cnemaspis mundanthuraiensis* **sp. nov.** is a member of the *gracilis* clade and can be easily distinguished from all five members of the clade by a combination of the following differing or non-overlapping characters: 6–8 rows of dorsal tubercles at mid-body (*versus* 9–11 rows of dorsal tubercles at mid-body in *C. agarwali* Khandekar, 2019; 11–14 in *C. gracilis* (Beddome, 1870) and *C. thackerayi* Khandekar, Gaitonde and Agarwal, 2019; 10–14 in *C. shevaroyensis* Khandekar, Gaitonde and Agarwal, 2019); only a few irregularly arranged tubercles in paravertebral region (*versus* 12–17 tubercles in paravertebral rows in *C. agarwali*; 9–12 in *C. gracilis*; 11–12 in *C. jackieii*; 13–17 in *C. shevaroyensis*; and 12–14 in *C. thackerayi*); spine-like tubercles present on flanks (*versus* spine-like tubercles absent on flanks in *C. agarwali*, *C. jackieii*, *C. shevaroyensis*, and *C. thackerayi*); 30–34 ventral scales across belly at mid-body (*versus* 24–26 ventral scales across belly at mid-body in *C. agarwali*, 23–25 in *C. gracilis*, 21–24 in *C. shevaroyensis*, and 22–25 in *C. thackerayi*).

Description of the holotype. Adult male in good state of preservation except tail tip marginally bent towards right (Fig. 9A, B); SVL 31.2 mm, head short (HL/SVL 0.24), wide (HW/HL 0.68), not strongly depressed (HD/HL 0.42), distinct from neck. Loreal region marginally inflated, canthus rostralis indistinct. Snout marginally larg-

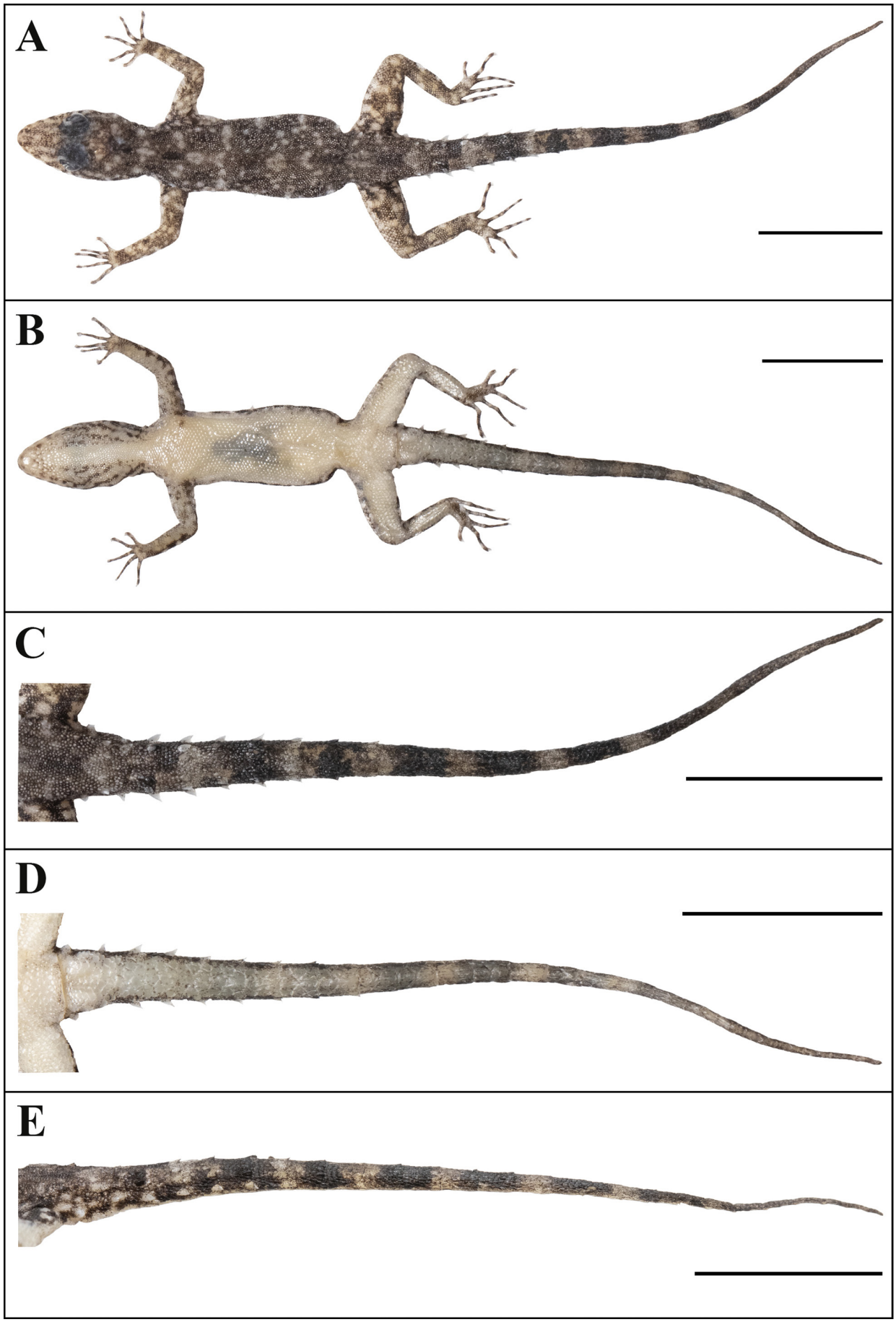

Figure 9. *Cnemaspis mundanthuraiensis* **sp. nov.** (holotype, NRC-AA-1175): **A** dorsal aspect of body, **B** ventral aspect of body, **C** dorsal aspect of tail, **D** ventral aspect of tail, and **E** lateral aspect of tail. Scale bars 10 mm; photos by Akshay Khandekar and Satpal Gangalmale.

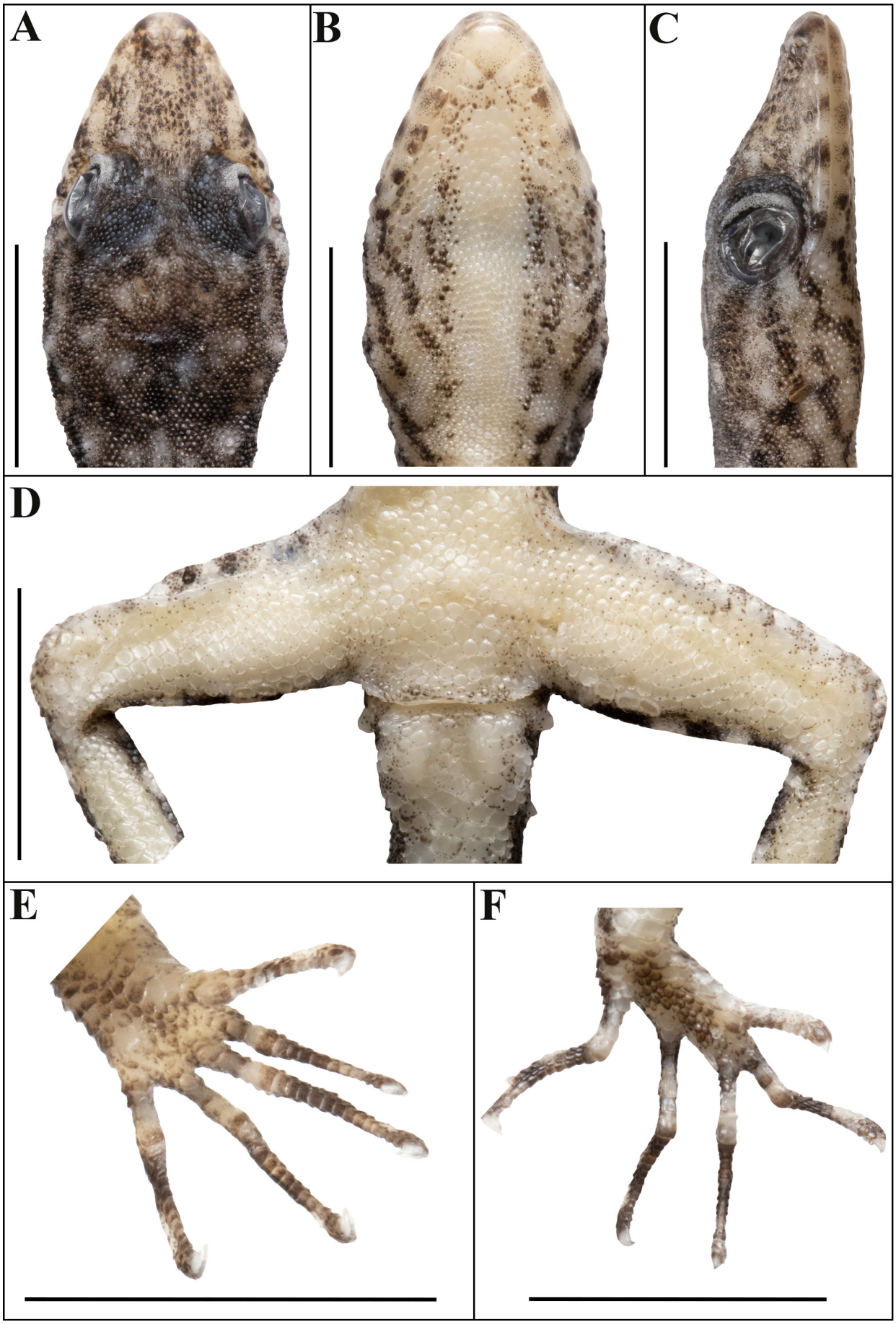

Figure 10. *Cnemaspis mundanthuraiensis* **sp. nov.** (holotype, NRC-AA-1175): **A** dorsal aspect of head, **B** ventral aspect of head, **C** lateral aspect of right side head, **D** aspect of cloacal region showing precloacal and femoral pores, **E** ventral aspect of left manus, and **F** ventral aspect of left pes. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

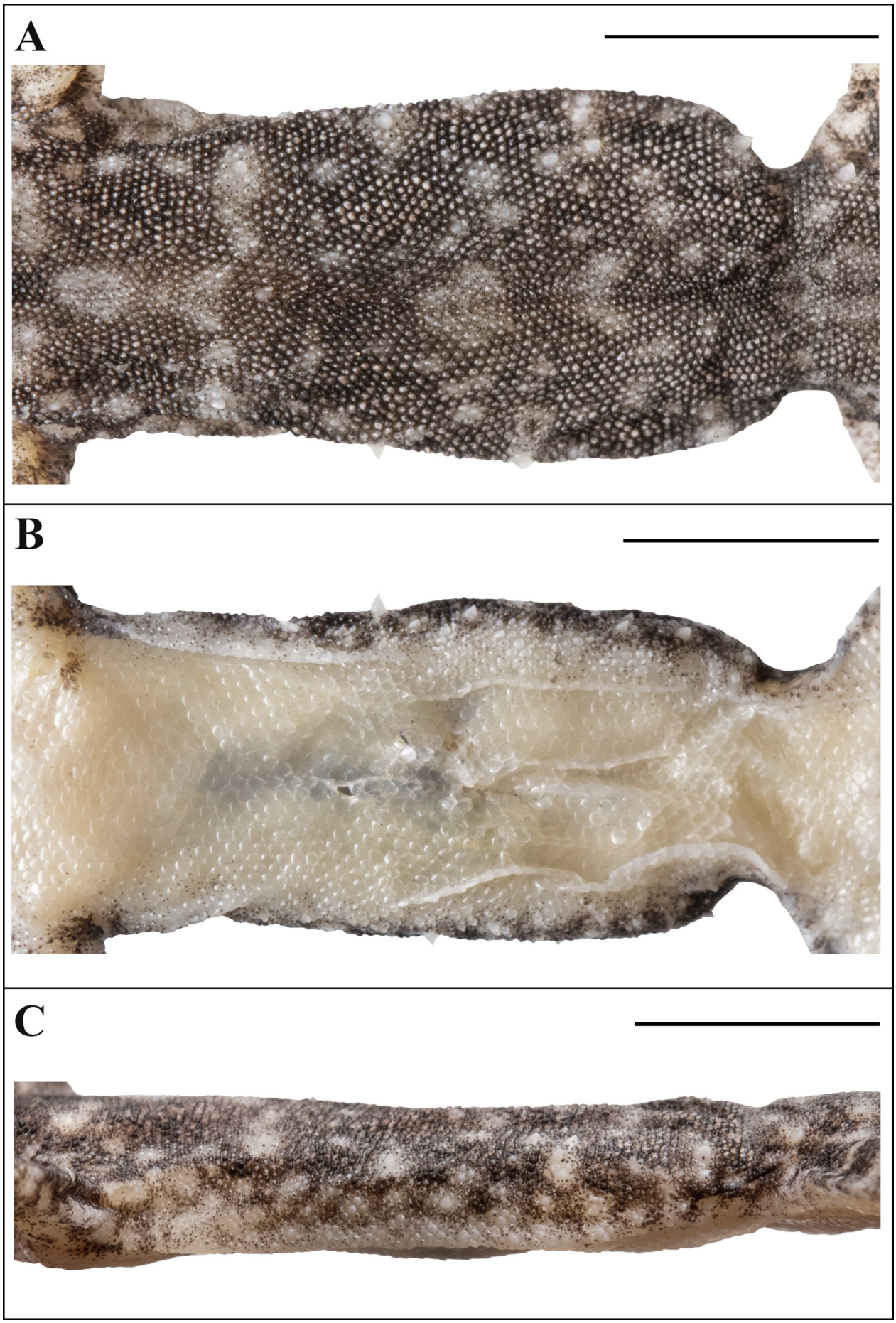

Figure 11. *Cnemaspis mundanthuraiensis* **sp. nov.** (holotype, NRC-AA-1175): **A** dorsal aspect of mid-body, **B** ventral aspect of mid-body, and **C** right side lateral aspect of mid-body. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

Figure 12. Colouration in life of *Cnemaspis mundanthuraiensis* **sp. nov.**: **A** adult male (holotype, NRC-AA-1175), and **B** adult male (paratype, NRC-AA-1177). Photos by Akshay Khandekar and Satpal Gangalmale.

er than half the head length (ES/HL 0.52), slightly larger than 2.5 times eye diameter (ES/ED 2.66); scales on snout and canthus rostralis subcircular, subequal, weakly keeled, twice the size of those on forehead and interorbital region; scales on forehead similar to those on snout and canthus rostralis except much smaller and weakly conical; scales on interorbital region, still smaller, granular; scale occipital, and temporal region with small, smooth granular scales intermixed with slightly enlarged, weakly keeled, conical tubercles (Fig. 10A). Eye small (ED/HL 0.19); with round pupil; supraciliaries short, larger anteriorly; seven interorbital scale rows across narrowest point of frontal bone; 30 or 31 scale rows between left and right supraciliaries at mid-orbit (Fig. 10A). Ear-opening deep, oval, small (EL/HL 0.06); eye to ear distance greater than diameter of eye (EE/ED 1.53) (Fig. 10C). Rostral twice as wide (1.4 mm) as high (0.7 mm), incompletely divided dorsally by a strongly developed rostral groove and by an internasal scale for more than half of its height; a single enlarged supranasal on each side, slightly larger than upper postnasal, separated from each other by a smaller, elongated internasal on the snout; rostral in contact with supralabial I, nostril, supranasal, internasal, and a lower postnasal on either side; nostrils oval, surrounded by two postnasals, supranasal, and rostral on either side; two postnasals on either side, both almost half the size than supranasal; a single row of scales separate orbit from supralabials (Fig. 10C). Mental enlarged, subtriangular,

Figure 13. Paratype series of *Cnemaspis mundanthuraiensis* **sp. nov.** from left to right, NRC-AA-1176, NRC-AA-1177, NRC-AA-1178, NRC-AA-1179, BNHS 2823, BNHS 2824, BNHS 2825, BNHS 2822. Scale bar 10 mm; photo by Akshay Khandekar and Satpal Gangalmale.

slightly wider (1.8 mm) than high (1.3 mm); two pairs of postmentals, inner pair roughly rectangular, much shorter (0.6 mm) than mental, separated from each other below mental by a single enlarged median chin shield; inner pair bordered by mental, infralabial I, outer postmental and two enlarged chin shields on either side; outer postmentals roughly square, marginally smaller (0.5 mm) than inner pair, bordered by inner postmentals, infralabial I and II, and three enlarged chin shields on either side; two enlarged gular scales between left and right outer postmentals; all chin scales bordering postmentals flat, subcircular, smooth, smaller than outermost postmentals; scales on rest of the throat granular, smooth, decreasing in size posteriorly (Fig. 10B). Infralabials bordered below by a row or two of slightly enlarged, much elongated scales, decreasing in size posteriorly and laterally. Six supralabials up to angle of jaw on left and seven on right side, and six at midorbital position on each side; supralabial I largest, gradually decreasing in size posteriorly; seven infralabials up to angle of jaw, six at midorbital position on either side; infralabial I largest, gradually decreasing in size posteriorly (Fig. 10C).

Body relatively slender (BW/AGL 0.43), trunk less than half of SVL (AGL/SVL 0.41) without ventrolater-

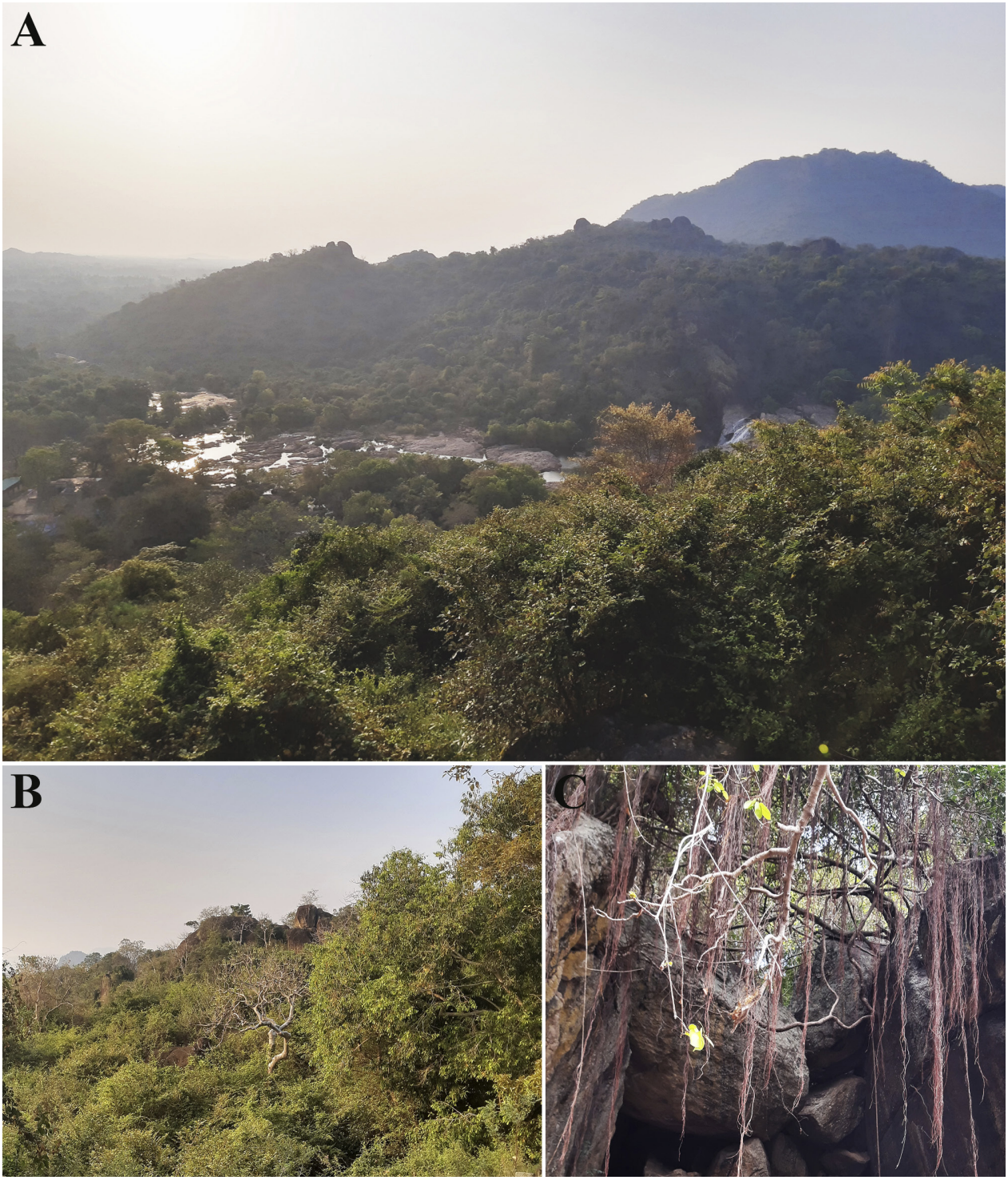

Figure 14. Habitat at the type locality of *Cnemaspis mundanthuraiensis* **sp. nov.**: **A** general habitat showing the moist deciduous forest dominated by rocks, and **B** & **C** microhabitat showing the rock and its base from where the type series were collected. Photos by Akshay Khandekar.

al folds (Fig. 11B, C). Dorsal pholidosis heterogeneous; weakly keeled, weakly conical granular scales intermixed with irregularly arranged rows of enlarged, strongly keeled, conical tubercles which are gradually increasing in size towards flank; last two rows of enlarged tubercles on flank largest, spine-like; approximately six longitudinal rows at mid-body; only a few scattered enlarged tubercles in paravertebral region, not forming rows; granular scales on nape slightly smaller than paravertebral granules, still smaller and smooth on occiput (Fig. 11A). Ventral scales much larger than granular scales on dorsum, subcircular, smooth, subequal from chest to vent; scales on precloacal region slightly enlarged; mid-body scale rows across belly 30; 115 scales from mental to anterior border of cloaca (Fig. 9B). Scales on throat marginally smaller than those on belly, gular region with still smaller, smooth scales, those bordering postmentals enlarged, smooth, subcircular and flattened (Fig. 10B). Three femoral pores on left

Table 6. Mensural (mm) data for the type series of *Cnemaspis mundanthuraiensis* **sp. nov.**. Abbreviations are listed in Materials and Methods. * = incomplete tail.

Type	**Holotype**	**Paratypes**							
Specimen no.	NRC-AA-1175	NRC-AA-1176	NRC-AA-1177	NRC-AA-1178	NRC-AA-1179	BNHS 2822	BNHS 2823	BNHS 2824	BNHS 2825
Sex	Male	Male	Male	Male	Female	Male	Female	Male	Male
SVL	31.2	31.4	30.8	32.2	22.6	32.6	29.5	27.5	29.6
TL	43.5	30.7	39.7	12.9*	24.5	33.0	10.8*	34.5	36.9
TW	2.8	3.1	3.1	3.2	1.8	3.1	2.7	2.7	2.7
LAL	4.8	4.8	4.9	5.1	3.4	5.2	4.6	4.4	4.5
CL	5.9	5.8	5.6	6.2	4.3	6.2	5.5	5.3	5.3
AGL	13.1	13.2	13.3	13.4	9.2	13.6	12.1	11.6	12.2
BH	2.8	3.2	3.4	4.1	1.8	3.7	3.1	2.6	2.4
BW	5.7	5.8	5.3	6.5	3.8	6.6	5.1	4.6	4.4
HL	7.6	7.8	7.9	8.1	5.7	8.6	7.0	7.1	7.0
HW	5.2	5.4	5.3	5.5	3.7	5.3	4.9	4.6	5.0
HD	3.2	3.6	3.1	3.3	2.3	3.6	2.9	2.6	2.9
ED	1.5	1.6	1.5	1.6	1.3	1.8	1.5	1.4	1.5
EE	2.3	2.5	3.3	2.4	1.7	2.5	2.3	2.2	2.5
ES	4.0	4.3	3.9	4.0	2.9	4.3	3.7	3.6	3.5
EN	3.2	3.2	3.2	3.3	2.4	3.5	2.9	2.9	2.9
IN	0.9	1.0	0.9	0.9	0.7	1.1	0.9	0.8	0.8
IO	1.4	1.4	1.7	1.4	1.0	1.7	1.2	1.2	1.3
EL	0.5	0.4	0.5	0.5	0.3	0.6	0.4	0.4	0.4

thigh and four on right, separated by 10 poreless scales on left and nine on right side from two precloacal pores, precloacal pores separated medially by two poreless scales (Fig. 10D). Scales on palm and soles small, smooth, subimbricate; scales on dorsal aspects of limbs heterogeneous is size, those on upper arm and thigh large, strongly keeled and imbricates except those near limb insertions that are much smaller, smooth and granular, posterolateral aspect of thigh with small, smooth to weakly keeled granular scales; dorsal aspect of lower arm and shank with scales smaller than those on upper arm and thigh, strongly keeled, imbricate; ventral aspect of upper arm with small, granular scales, lower arm with slightly larger, smooth, subimbricate scales; ventral aspect of thigh with scales similar to mid-body ventrals, scales on shank slightly larger than those on thigh, smooth, flattened and imbricate (Fig. 9A, B).

Forelimbs and hindlimbs slightly long, slender (LAL/SVL 0.15); (CL/SVL 0.18); digits long, with a strong, recurved claw, distinctly inflected, distal portions laterally compressed conspicuously. Digits with unpaired lamellae, separated into a basal and narrower distal series by single enlarged lamella at inflection; basal lamellae series: (1-3-4-5-3 right manus, 2-4-5-6-5 right pes), (1-3-3-5-4 left manus, Fig. 10E; 2-4-5-7-5 left pes, Fig. 10F); distal lamellae series: (9-10-11-13-11 right manus, 9-13-14-13-12 right pes), (9-11-13-12-11 left manus, Fig. 10E; 9-12-13-13-12 left pes, Fig. 10F). Relative length of digits (measurements in mm in parentheses): IV (2.7) = III (2.7) > V (2.3) = II (2.3) > I (1.7) (left manus); IV (3.7) > V (3.1) = III (3.1) > II (2.6) > I (1.6) (left pes).

Tail original, entire, subcylindrical, slender, slightly longer than snout-vent length (TL/SVL 1.39; Fig. 9C–E). Dorsal pholidosis on tail heterogeneous; small, weakly keeled, flattened, and subimbricate scales (becoming larger, elongated and imbricates posteriorly) intermixed with enlarged, strongly keeled, pointed, and spine-like tubercles forming whorls; six tubercles on first six whorl, five tubercles on seventh, and four on eight whorl; rest of the tail (tail tip) with tubercles only on the paravertebral rows (Fig. 9C, E). Scales on tail venter much larger than those on tail dorsal, smooth, flattened, and sub-imbricate; with a series of three enlarged subcaudal scales of which the median series almost twice the size of adjunct two rows, roughly pentagonal (Fig. 9D). Scales on tail base much smaller, imbricate, and smooth; a single enlarged, conical postcloacal spur on each side (Fig. 9D, E).

Colouration in life (Fig. 12A). Dorsal ground colour of head, body, limbs and tail pale brown. Head with indistinct reddish markings and light grey blotches; anterior edge of brille yellow; upper labials dull white to yellow with dark blotches. Indistinct dark brown preorbital streak; three dark brown postorbital streaks, upper merging with light grey blotches on occiput, middle continuing until ear opening and lower to throat. Single central small black ocellus on occiput followed by a larger white marking and subsequently a larger dark central spot just anterior to forelimb insertions. About four light blotches on vertebral region between forelimbs and tail base, reddish patches and light spots scattered across dorsum; dorsum of forelimbs and hindlimbs with light blotches and bands, dark blotches speckled with yellow scales, digits with alternating dark and light yellow bands; dorsum of original tail with eight black and nine light

Table 7. Meristic data for the type series of *Cnemaspis mundanthuraiensis* **sp. nov.**. Abbreviations are listed in Materials and Methods except for: L&R = Left & Right; irr = irregular; abs. = absent; * = dorsal tubercle rows and tail tuberculation incomplete.

Type	**Holotype**	**Paratypes**							
Specimen no.	NRC-AA-1175	NRC-AA-1176	NRC-AA-1177	NRC-AA-1178	NRC-AA-1179	BNHS 2822	BNHS 2823	BNHS 2824	BNHS 2825
Sex	Male	Male	Male	Male	Female	Male	Female	Male	Male
SL (L&R)	6&7	8&8	9&9	7&7	7&7	7&7	7&7	7&7	7&7
IL (L&R)	7&7	7&7	8&8	7&7	7&7	7&7	7&7	7&7	7&8
SL M (L&R)	6&6	6&5	5&6	6&6	7&7	5&6	6&7	6&6	6&6
IL M (L&R)	6&6	5&5	5&6	5&6	6&6	5&5	6&6	5&5	5&6
ESFL (L&R)	4&3	2&3	3&3	6&5	4&3	6&4	5&4	3&3	3&3
PVT (L&R)	irr	irr	irr	irr	irr	irr	irr	irr	irr
DTR	6	5*	8	6	6	8	6	8	6
MVSR	30	32	33	34	34	33	30	33	32
VS	115	126	120	124	128	121	125	115	122
LamF1 (L&R)	10&10	11&11	10&10	10&11	11&11	11&11	11&11	10&11	10&10
LamF4 (L&R)	17&18	16&15	17&16	14&14	17&17	18&18	18&18	17&17	17&16
LamT1 (L&R)	11&11	10&11	9&10	12&12	11&11	11&11	10&10	9&9	10&10
LamT4 (L&R)	20&19	18&19	20&20	20&19	21&22	21&20	20&19	20&20	20&20
LamT5 (L&R)	17&17	16&16	16&17	18&19	18&19	19&19	18&18	17&17	19&18
PP (L&R)	1&1	abs.	1&1	1&1	abs.	1&1	abs.	abs.	abs.
SBPP	2	abs.	4	2	abs.	3	abs.	abs.	abs.
SB PP&FP (L&R)	10&9	abs.	10&10	11*&10	abs.	10&9	abs.	abs.	abs.
FP (L&R)	3&4	4&4	4&3	5&5	abs.	5&4	abs.	4&4	4&4
SBFP	abs.	25	abs.	abs.	abs.	abs.	abs.	24	23
PCT (L&R)	1&1	1&1	1&1	1&1	1&1	1&1	1&1	1&1	1&1
PVTT (L&R)	14*&16	11*&11*	13&3	6*&5*	14&14	/	6*&6*	16&16	14&14
LTT (L&R)	12&13	11*&11*	6&8	6*&7*	10&9	/	6*&6*	12&12	10&12
VLTT (L&R)	8&8	6&6	6&4	6*&6*	6&6	/	7*&7*	8&8	8&7

grey bands. Ventral surfaces white except sternal region, edges of belly and underside of hindlimbs suffused with yellow; gular region with numerous streaks along the posterior edge; underside of tail white. Pupil black, iris golden.

Variation and additional information from type series. Mensural, meristic and additional character state data for the type series is given in Tables 6, 7 & 8 respectively. There are six adult males, a single adult female and a subadult female specimens ranging in size from 22.6–32.2 mm (Fig. 13). All paratypes resemble holotype except as follows: two internasal scales between supranasals on snout in NRC-AA-1176 and BNHS 2823; supranasals in contact with each other posteriorly on the snout in NRC-AA-1177 and BNHS 2824. Upper postmentals in contact with each other below mental in BNHS 2822; upper postmentals bordered by infralabial I, outer postmental and by a single large chin scale on left side in NRC-AA-1178 and BNHS 2822. Outer postmental bordered by inner postmental, infralabials I & II, and four chin scales on left side in NRC-AA-1176 and BNHS 2824; outer postmental bordered by inner postmental, infralabials I & II, and four chin scales on either side in NRC-AA-1177, NRC-AA-1178, BNHS 2822, and BNHS 2823; outer postmental bordered by inner postmental, infralabials I & II, and four chin scales on right side in NRC-AA-1179; outer postmental bordered by inner postmental, infralabials II, and four chin scales on right side in BNHS 2825; outer postmental separated from each other below mental by three enlarged chin scales in NRC-AA-1176, NRC-AA-1179, BNHS 2823, BNHS 2824, and BNHS 2825. Four paratypes — NRC-AA-1177, BNHS 2824, BNHS 2825, and NRC-AA-1179 with original and complete tails, slightly longer than body (TL/SVL 1.28, 1.25 and 1.24 respectively) and tail marginally longer than body in NRC-AA-1179 (TL/SVL 1.08); tail partially detached from the body and lost in NRC-AA-1178 and BNHS 2823; NRC-AA-1176 is with tail partially detached from the body, marginally shorter than the body (TL/SVL 0.97); BNHS 2822 with complete but fully regenerated tail, almost equal to body (TL/SVL 1.01). All paratypes agree with the holotype in colouration except that the female paratypes (NRC-AA-1179 and BNHS 2822) have a muted dorsal colouration with less red and are ventrally off-white. Original tail with 8–10 alternating black and light grey bands, regenerated tail in BNHS 2822 uniform light brown (Figs 12B & 13).

Distribution and Natural history. *Cnemaspis mundanthuraiensis* **sp. nov.** is currently known only from around its type locality (Papanasam reserve forest, Mundanthurai forest range, *ca*. 150–350 m asl.) in Kalakad

Table 8. Additional morphological character states evaluation for the type series of *Cnemaspis mundanthuraiensis* **sp. nov.**. abs. = absent; / = data unavailable.

Type	**Holotype**	**Paratypes**							
Specimen no.	NRC-AA-1175	NRC-AA-1176	NRC-AA-1177	NRC-AA-1178	NRC-AA-1179	BNHS 2822	BNHS 2823	BNHS 2824	BNHS 2825
Sex	Male	Male	Male	Male	Female	Male	Female	Male	Male
Anterior extra-brillar fringe scales enlarged (1) or not enlarged (0)	1	1	1	1	1	1	1	1	1
Ventral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Gular scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Pectoral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0
Precloacal pores continuous (1) or separated (0)	0	abs.	0	0	abs.	0	abs.	abs.	abs.
Precloacal pores elongate (1) or round (0)	1	abs.	1	1	abs.	1	abs.	abs.	abs.
femoral pores elongate (1) or round (0)	1	1	1	1	abs.	1	abs.	1	1
Dorsal pholidosis homogeneous (1) or heterogeneous (0)	0	0	0	0	0	0	0	0	0
Dorsal tubercles keeled (1) or not keeled (0)	1	1	1	1	1	1	1	1	1
Tubercles linearly arranged (1) or more random (0)	0	0	0	0	0	0	0	0	0
Spine-like tubercles on flank present (1) or absent (0)	1	1	1	1	1	1	1	1	1
Lateral caudal furrows present (1) or absent (0)	1	1	1	/	1	/	1	1	1
Subcaudals keeled (1) or smooth (0)	0	0	0	/	0	/	0	0	0
Single median row of subcaudals keeled (1) or smooth (0)	0	0	0	/	0	/	0	0	0
Caudal tubercles encircle tail (1) or not (0)	1	1	1	/	1	/	1	1	1
Enlarged median subcaudal scale row (1) or not (0)	1	1	1	/	1	/	1	1	1
Enlarged femoral scales present (1) or absent (0)	1	1	0	1	1	0	1	0	1
Subtibial scales keeled (1) or smooth (0)	0	0	0	0	0	0	0	0	0

Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu (Fig. 1). Like most other members of the *gracilis* clade, the new species seems to be diurnal, rupicolous, and locally abundant. At all three collection sites, many individuals (n = >25) were observed active during the daytime (0900–1230 hrs) on rocks below 2 m height in moist deciduous forest patches (Fig. 14A–C). Individuals of the new species were observed inactive during the night, resting on rocks openly less than 1 meter from where holotype and two paratypes were collected. Sympatric geckos encountered on the rocks at the locality include *Cnemaspis regalis*, *Hemidactylus* cf. *acanthopholis*, *Hemidactylus* cf. *frenatus*, and *Hemidactylus* cf. *leschenaultii*.

Cnemaspis kalakadensis sp. nov.

Figs 15–20; Tables 9–11

https://zoobank.org/E9612848-F982-4E91-AC08-7F2B5F3B-1ADE

Holotype. NRC-AA-1180 (AK-R 648), adult male, from near Sengaltheri forest guesthouse, Kalakad forest range (8.5340°N, 77.4502°E; *ca*. 960 m asl.), Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India; collected by Akshay Khandekar, and team on 30 April 2021.

Paratypes. NRC-AA-1182 (AK-R 644), BNHS 2826 (AK-R 646), adult males; NRC-AA-1181 (AK-R 643), NRC-AA-1183 (AK-R 645), BNHS 2827 (AK-R 647), BNHS 2828 (AK-R 654), adult females. AK-R 644 and AK-R 646 collected from same locality and other details as holotype; AK-R 643 and AK-R 645 collected from 8.5379°N, 77.4536°E, *ca*. 910 m asl.; AK-R 647 and AK-R 654 collected from 8.5290°N, 77.4467°E, *ca*. 1060 m asl; all from Kalakadu reserve forest, Kalakad forest range, Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu state, India, collectors and date same as holotype.

Etymology. The specific epithet is a toponym for the Kalakad forest range of Kalakad-Mundanthurai Tiger Reserve in Tirunelveli district of Tamil Nadu, the type and currently only known locality for this species.

Suggested Common Name. Kalakad dwarf gecko.

Diagnosis. A small-sized *Cnemaspis*, snout to vent length less than 33 mm (*n*=7). Dorsal pholidosis heterogeneous; smooth, subcircular, weakly conical granular scales intermixed with irregularly arranged rows of enlarged, smooth, laterally compressed, spine-like scales on flanks; four or five rows of dorsal tubercles at mid-body, enlarged scales or tubercles absent in paravertebral region; ventral scales subcircular, smooth, subimbricate, subequal from chest to vent; 28–34 scales across belly at mid-body, 122–134 longitudinal scales from mental to cloaca; subdigital scansors smooth, unpaired, unnotched; basal scansors distinctly enlarged, plate like; 11 or 12 lamellae under digit I of manus and pes, 16–19 lamellae under digit IV of manus and 19–22 lamellae under digit IV of pes; males (*n*=3/7) with a series of 12–14 femoral pores on each thigh separated medially by 10 or 11 poreless scales; tail dorsum with enlarged, smooth, flattened scales only in the paravertebral rows, not forming whorls; 16–18 scales in paravertebral rows on either side, only 2–4 enlarged scales in the lateral row on either side; median row of subcaudals smooth, roughly subcircular, and distinctly enlarged. Dorsum grey-brown with indistinct dark bands; single longitudinally placed hourglass shaped black marking anterior to forelimb insertions; tail with ~12 alternating dark and pale bands; underside of body, limbs and tail in males pale yellow with precloacal and femoral region off-white, gular region bright yellow; ventral surfaces in females off-white to cream.

Comparison with members of *C. littoralis* clade. *Cnemaspis kalakadensis* **sp. nov.** is a member of the *littoralis* clade and can be easily distinguished from all four members of the clade by combination of following differing or non-overlapping characters: four or five rows of dorsal tubercles at mid-body restricted to flanks, laterally compressed, spine-like (*versus* few scattered tubercles on the flank, reduced, subconical in *C. flavigularis*; a few scattered tubercles on flanks, spine-like tubercles only in the lowermost row on flanks in *C. littoralis*; conical or spine-like tubercles absent on flanks in *C. palakkadensis*; a few scattered spinose tubercles on the flanks in *C. palanica* Pal, Mirza, Dsouza and Shanker, 2021); 28–34 scales across belly at mid-body (*versus* 21–23 scales across belly at mid-body in *C. flavigularis*, and 16–18 in *C. palanica*); 122–134 longitudinal scales from mental to cloaca (*versus* 104–108 longitudinal scales from mental to cloaca in *C. flavigularis*, 143–157 in *C. littoralis*, and 103–106 in *C. palanica*); 19–22 lamellae under digit IV of pes (*versus* 16–18 lamellae under digit IV of pes in *C. flavigularis*, 16–18 in *C. littoralis*, 14–17 in *C. palakkadensis*, and 17 or 18 in *C. palanica*); males with a series 12–14 femoral pores on each thigh separated medially by 10 or 11 poreless scales (*versus* males with a series of 15–18 femoral pores separated by 14–16 poreless scales in *C. littoralis*, and 15 or 16 femoral pores separated by at least 15 poreless scales in *C. palakkadensis*).

Description of the holotype. Adult male in good state of preservation except head marginally bent towards right and fully everted hemipenis on left side (Fig. 15A, B) and digit V of left manus incomplete (indicated by *). SVL 29.6 mm, head short (HL/SVL 0.25), slightly wider (HW/HL 0.61), not strongly depressed (HD/HL 0.38), distinct from neck. Loreal region marginally inflated, canthus rostralis indistinct. Snout marginally shorter than half the head length (ES/HL 0.46), 2.5 times larger than eye diameter (ES/ED 2.50); scales on snout and canthus rostralis smooth, subcircular, subequal, hemispherical and protrudent, slightly larger than those on forehead and almost twice the size than those on interorbital region and occiput; scales on forehead similar to those on snout and canthus rostralis except slightly smaller and weakly protrudent; scales on interorbital region, occipital and temporal region smooth, still smaller, granular (Fig. 16A). Eye small (ED/HL 0.18); with round pupil; supraciliaries short, larger anteriorly; seven interorbital scale rows across narrowest point of frontal bone; 28 or 29 scale rows between left and right supraciliaries at mid-orbit (Fig. 15A). Ear-opening deep, oval, small (EL/HL 0.05); eye to ear distance greater than diameter of eye (EE/ED 1.78) (Fig. 16C). Rostral marginally more than twice as wide (1.3 mm) as high (0.6 mm), incompletely divided dorsally by a strongly developed rostral groove for more than half of its height; a single enlarged supranasal on each side, almost twice the size of upper postnasal, separated from each other by a smaller, elongated internasal on the snout; rostral in contact with supralabial I, nostril, supranasal, internasal and a lower postnasal on either side; nostrils subcircular, surrounded by two postnasals, supranasal, and rostral on either side; two postnasals on either side, similar in size to each other, both almost half the size than supranasal; one or two rows of scales separate orbit from supralabials (Fig. 16C). Mental enlarged, subtriangular, slightly wider (1.7 mm) than high (1.2 mm); two pairs of postmentals, inner pair roughly rectangular, much shorter (0.5 mm) than mental, separated from each other below mental by a single enlarged median chin shield; inner pair bordered by mental, infralabial I, outer postmental and three enlarged chin shields on left side and bordered by mental, infralabial I & II, outer post-

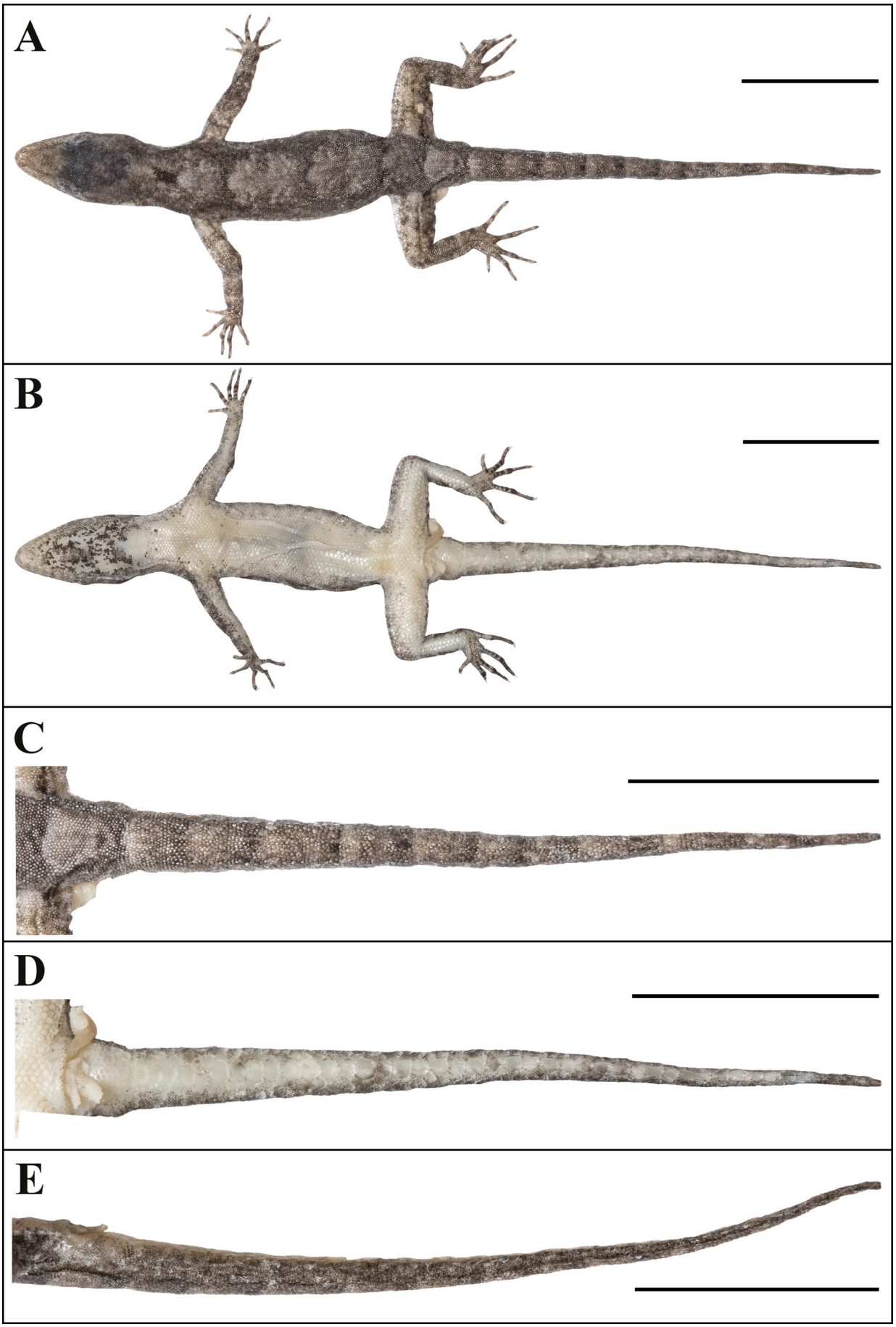

Figure 15. *Cnemaspis kalakadensis* **sp. nov.** (holotype, NRC-AA-1180): **A** dorsal aspect of body, **B** ventral aspect of body, **C** dorsal aspect of tail, **D** ventral aspect of tail, and **E** lateral aspect of tail. Scale bars 10 mm; photos by Akshay Khandekar and Satpal Gangalmale.

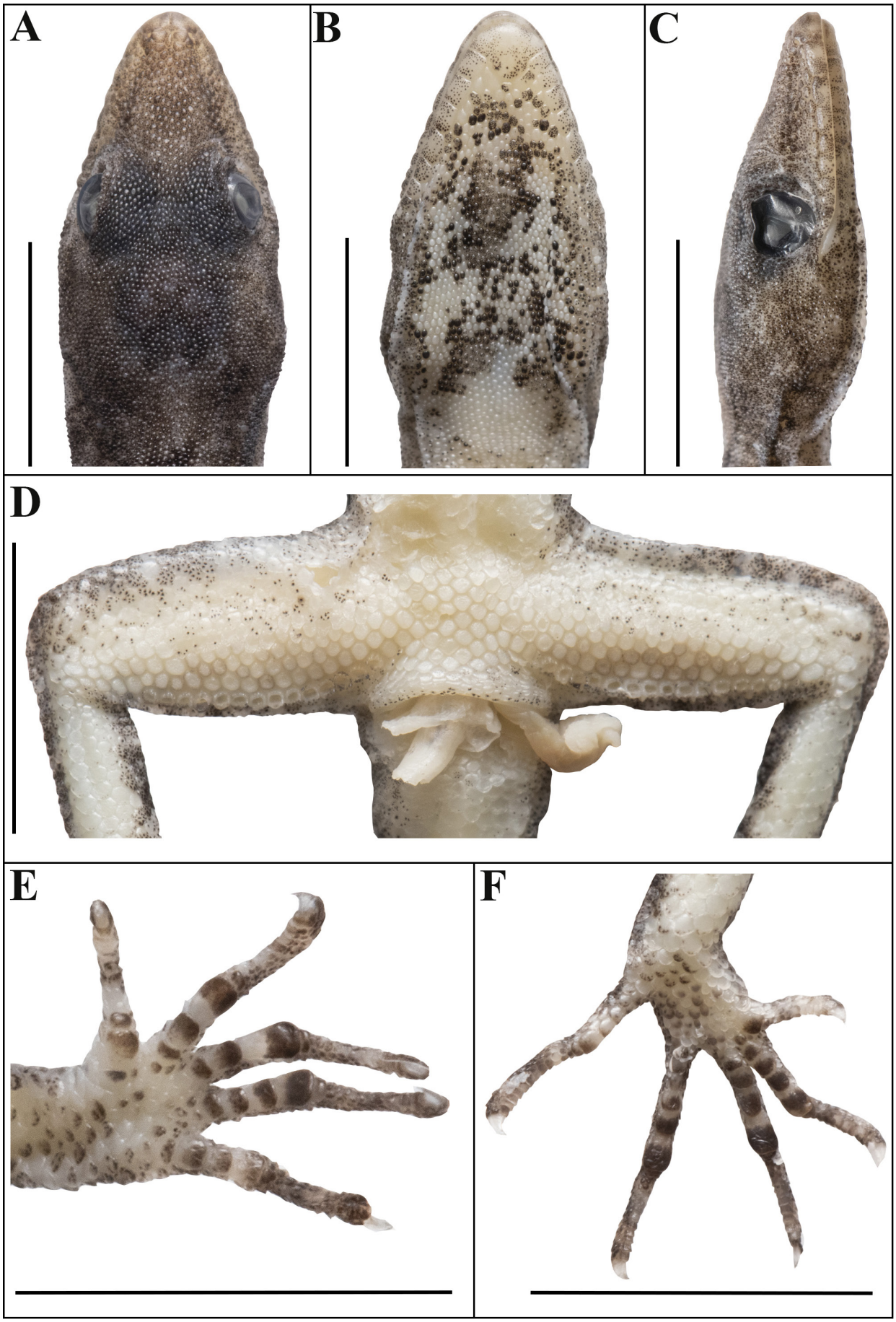

Figure 16. *Cnemaspis kalakadensis* **sp. nov.** (holotype, NRC-AA-1180): **A** dorsal aspect of head, **B** ventral aspect of head, **C** lateral aspect of right side head, **D** aspect of cloacal region showing femoral pores, **E** ventral aspect of left manus, and **F** ventral aspect of left pes. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

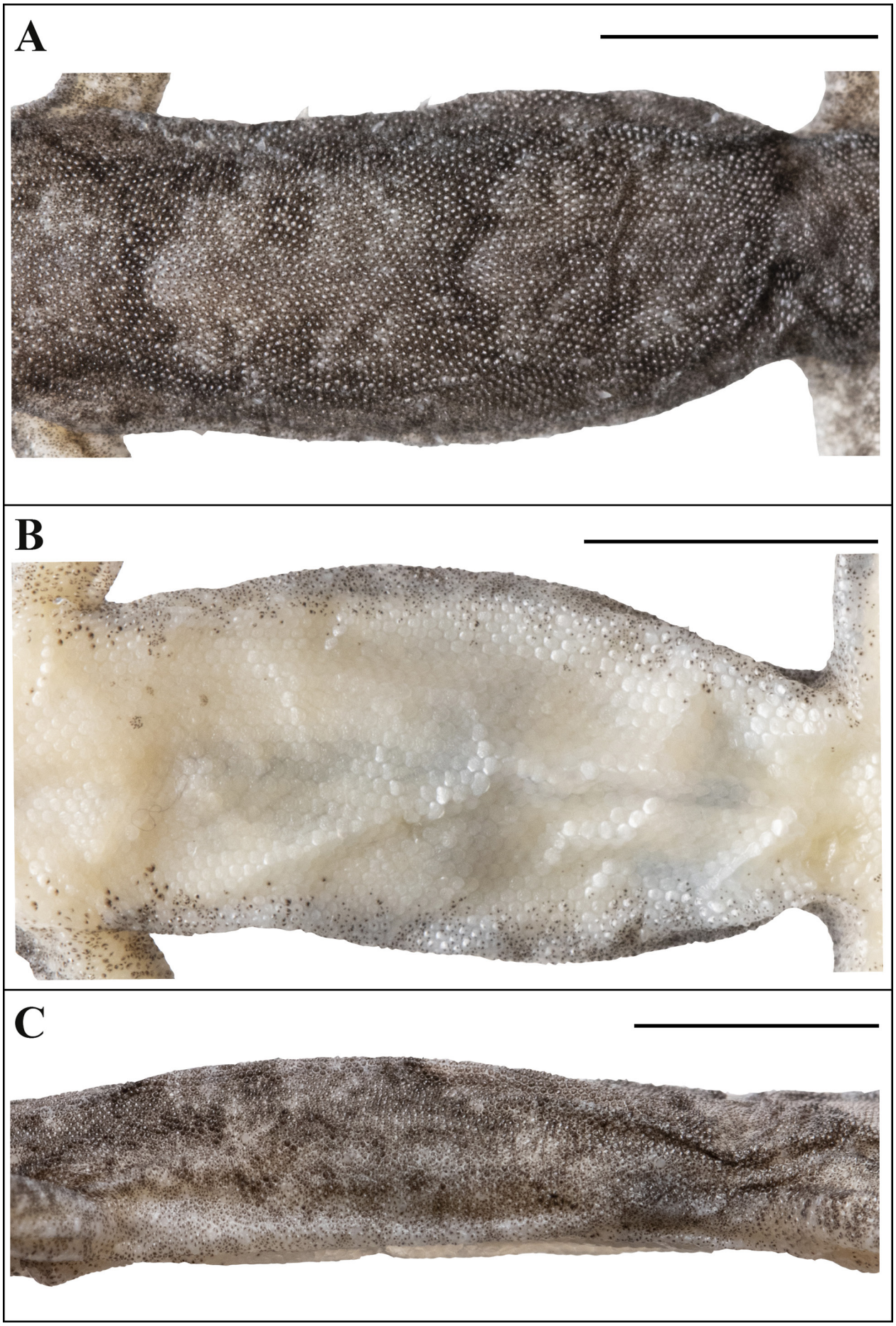

Figure 17. *Cnemaspis kalakadensis* **sp. nov.** (holotype, NRC-AA-1180): **A** dorsal aspect of mid-body, **B** ventral aspect of mid-body, and **C** right side lateral aspect of mid-body. Scale bars 5 mm; photos by Akshay Khandekar and Satpal Gangalmale.

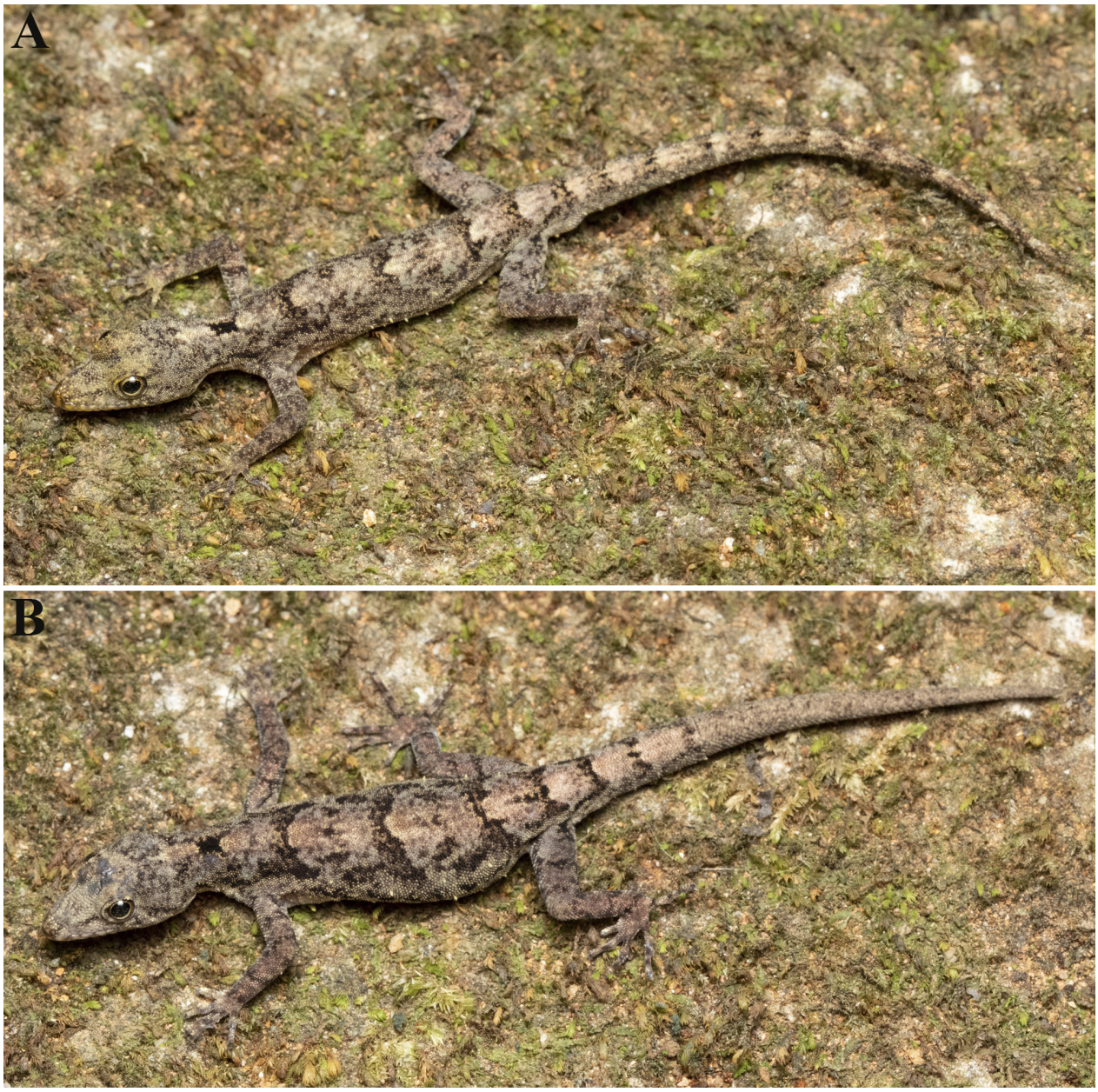

Figure 18. Colouration in life of *Cnemaspis kalakadensis* **sp. nov.**: **A** adult male (holotype, NRC-AA-1180), and **B** adult female (paratype, BNHS 2828). Photos by Akshay Khandekar and Satpal Gangalmale.

mental and three enlarged chin shields on right side; outer postmentals roughly square, much smaller (0.3 mm) than inner pair, bordered by inner postmentals, infralabial I, and two enlarged chin shields on left side and bordered by inner postmentals, infralabial I & II, and two enlarged chin shields on right side; five enlarged, gular scales between left and right outer postmentals; all chin scales bordering postmentals hemispherical and protrudent, subcircular, smooth, smaller or equal in size to outermost postmentals; scales on rest of the gular with smooth, subcircular, hemispherical, and protrudent scales decreasing in size posteriorly (Fig. 16B). Infralabials bordered below by a row or two of slightly enlarged, somewhat circular scales, decreasing in size posteriorly and laterally. Eleven supralabials up to angle of jaw on left and 10 on right side and eight at midorbital position on each side; supralabial I largest, gradually decreasing in size posteriorly; 10 infralabials up to angle of jaw on left side and nine or right, and seven at midorbital position on left and six on right side; infralabial I largest, gradually decreasing in size posteriorly (Fig. 16C).

Body relatively slender (BW/AGL 0.40), trunk less than half of SVL (AGL/SVL 0.42) without ventrolateral folds (Fig. 17B, C). Dorsal pholidosis heterogeneous; smooth, subcircular, weakly conical granular scales intermixed with irregularly arranged rows of enlarged, smooth, laterally compressed, spine-like scales on flank; approximately five longitudinal rows spine-like scales at mid-body; enlarged scales absent on paravertebral region; granular scales on nape similar in size to those on paravertebral region, slightly smaller on occiput (Fig. 17A). Ventral scales much larger than granular scales on dorsum, subcircular, smooth, subimbricate, subequal from chest to vent; mid-body scale rows across belly 30;

Figure 19. Paratype series of *Cnemaspis kalakadensis* **sp. nov.** from left to right, NRC-AA-1181, NRC-AA-1182, NRC-AA-1183, BNHS 2826, BNHS 2827, BNHS 2828. Scale bar 10 mm; photo by Akshay Khandekar and Satpal Gangalmale.

122 scales from mental to anterior border of cloaca (Fig. 15B). Scales on throat marginally smaller than those on belly, gular region with still smaller, smooth and protrudent scales, those on chin bordering postmentals, enlarged, smooth, subcircular, and protrudent (Fig. 16B). A series of fourteen femoral pores each thigh, separated from each other 11 poreless scales (Fig. 16D). Scales on palm and soles small, smooth, subimbricate; scales on dorsal aspects of limbs heterogeneous is size, those on upper arm and thigh larger, smooth, subcircular and subimbricate except those near limb insertions are much smaller, smooth and granular; posterolateral aspect of thigh with small, and smooth granular scales; dorsal aspect of lower arm and shank with scales smaller than those on upper arm and thigh, smooth and subimbricate; ventral aspect of upper arm with small, granular scales, lower arm with slightly larger, smooth, subimbricate scales; ventral aspect of thigh with scales similar to mid-body ventrals, scales on shank marginally larger than those on thigh, smooth, flattened and subimbricate (Fig. 15A, B).

Forelimbs and hindlimbs slightly long, slender (LAL/SVL 0.13); (CL/SVL 0.16); digits long, with a strong, recurved claw, distinctly inflected, distal portions laterally compressed.

Digits with unpaired lamellae (except 1–3 paired lamellae at the base), separated into a basal and narrower distal series by single enlarged lamella at inflection, basal lamellae much enlarged, plate like; basal lamellae series: (2-3-3-4-4 right manus, 2-4-4-6-5 right pes), (2-3-3-4-4 left manus, Fig. 16E; 2-5-5-6-5 left pes, Fig. 16F); distal lamellae series: (9-9-12-12-10 right manus, 9-11-14-13-13 right pes), (9-10-12-12-10* left manus, Fig. 16E; 9-10-13-13-13 left pes, Fig. 16F). Relative length of digits (measurements in mm in parentheses): IV (2.5) > III (2.4) > V (2.0) = II (2.0) > I (1.5) (left manus); IV (3.5) > V (3.1) = III (3.1) > II (2.7) > I (1.5) (left pes).

Tail original, entire, subcylindrical, slender, marginally longer than snout-vent length (TL/SVL 1.12; Fig. 15C–E). Dorsal pholidosis on tail heterogeneous; small, smooth, flattened, subcircular and subimbricate scales (becoming slightly larger and elongated posteriorly) intermixed with enlarged, smooth, flattened scales only in the paravertebral rows, not forming whorls; 16 scales in paravertebral rows on either side, only two enlarged scales in the lateral row on either side (Fig. 15C, E). Scales on tail venter much larger than those on tail dorsum, smooth, flattened, and sub-imbricate; with a series of three enlarged subcaudal scales of which the median series almost twice the size of adjunct two rows, roughly subcircular (Fig. 15D). Scales on tail base small, smooth and subimbricate; a single enlarged, smooth, weakly conical postcloacal spur on each side (Fig. 15D, E).

Colouration in life (Fig. 18A). Dorsal ground colour of head, body, limbs and tail pale grey-brown; finely speckled with darker markings. Anterior edge of brille and snout tip faintly suffused with yellow; labials dull white to yellow, finely speckled with dark markings, dark markings prominent on outer margins. Indistinct dark brown preorbital streak runs from nostril to orbit, postorbital streaks indistinct. A single longitudinally placed, hourglass-shaped black marking anterior to forelimb insertions, flanked by a poorly defined lighter blotch anteriorly and posteriorly. About four poorly defined dark bands between axilla and tail base of which the first is most prominent, narrowest in vertebral region and flaring out on flanks, alternating with lighter, elongate mid-dorsal blotches; dorsum of forelimbs, hindlimbs and digits mottled with small dark blotches and

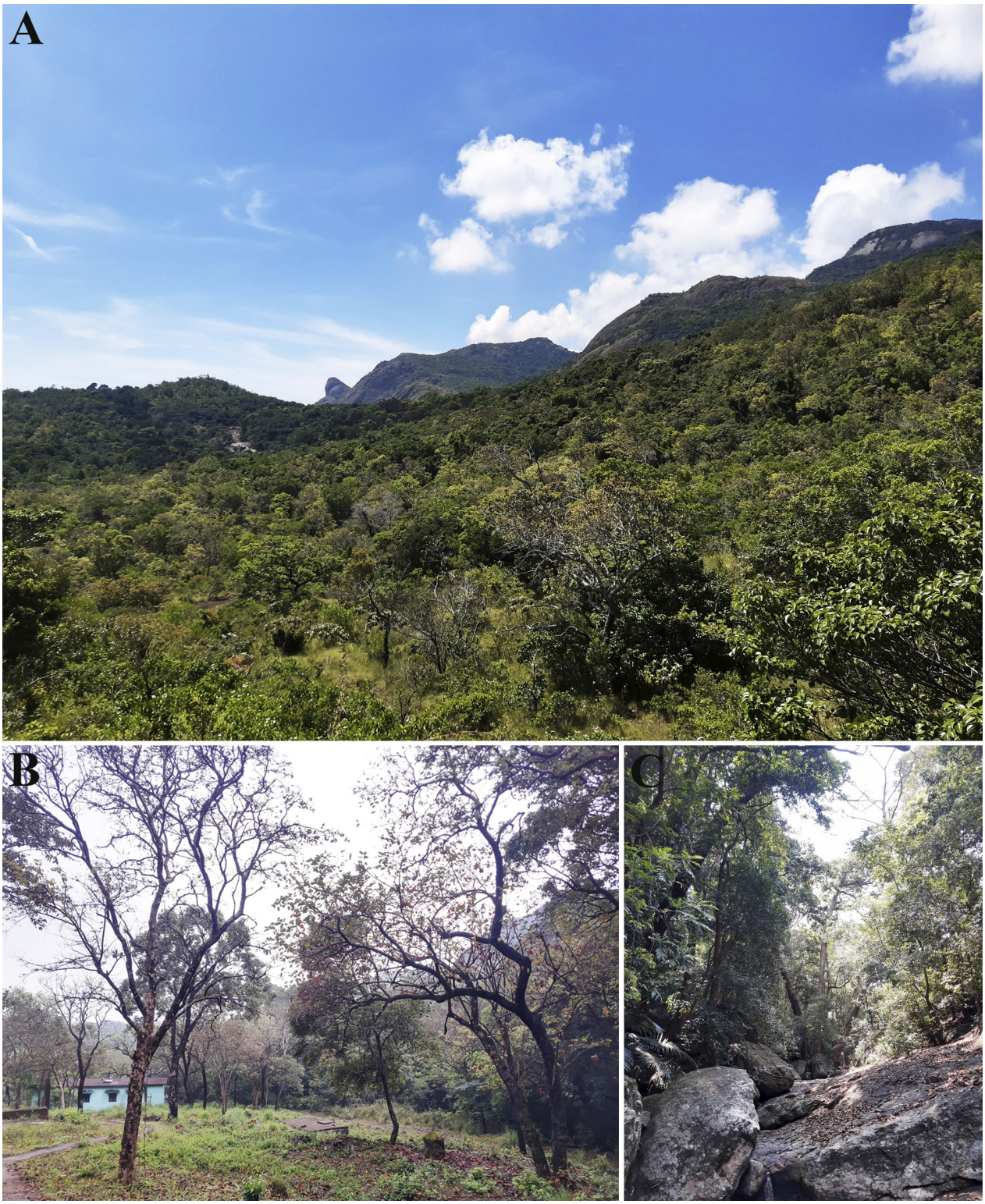

Figure 20. Habitat at the type locality of *Cnemaspis kalakadensis* **sp. nov.**: **A** general habitat showing the wet evergreen forest, and **B** & **C** microhabitat showing the trees and a stream inside forested area from where the type series were collected. Photos by Akshay Khandekar.

bands; dorsum of original tail with about 12 alternating dark and pale bands. Underside of body, limbs and tail pale yellow with a few scattered grey scales, only precloacal and femoral region off-white; gular region almost entirely covered by a bright yellow patch mottled with a few black scales and very few larger grey blotches. Pupil black, iris greyish.

Variation and additional information from type series. Mensural, meristic and additional character state data for the type series is given in Tables 9, 10 & 11 respectively. There are two adult males and four adult females ranging in size from 27.4–32.8 mm (Fig. 19). All paratypes resemble the holotype except as follows: supranasals marginally in contact with each other anteri-

Table 9. Mensural (mm) data for the type series of *Cnemaspis kalakadensis* **sp. nov.**. Abbreviations are listed in Materials and Methods. * = incomplete tail.

Type	**Holotype**	**Paratypes**					
Specimen no.	NRC-AA-1180	NRC-AA-1181	NRC-AA-1182	NRC-AA-1183	BNHS 2826	BNHS 2827	BNHS 2828
Sex	Male	Female	Male	Female	Male	Female	Female
SVL	29.6	32.8	30.5	33.1	27.4	31.6	32.5
TL	33.4	15.6*	19.6*	32.2	6.7*	34.3	31.2
TW	2.9	2.6	2.7	2.7	2.7	2.7	3.1
LAL	4.1	4.5	4.4	4.2	3.9	4.3	4.1
CL	5.0	5.4	5.3	5.0	4.5	5.2	4.8
AGL	12.7	16.5	13.8	15.0	11.4	13.8	13.7
BH	3.0	4.0	2.8	3.4	2.8	3.5	4.9
BW	5.2	7.8	5.2	6.7	5.0	6.1	7.3
HL	7.5	8.2	7.8	7.7	6.8	7.6	7.7
HW	4.6	5.2	4.9	4.9	4.4	4.8	5.3
HD	2.9	2.9	2.8	2.8	2.5	3.0	3.6
ED	1.4	1.5	1.5	1.4	1.3	1.3	1.5
EE	2.5	2.9	2.7	2.4	2.1	2.4	2.7
ES	3.5	4.0	3.6	3.9	3.5	3.7	4.0
EN	3.0	3.2	3.0	3.0	2.7	3.4	3.3
IN	0.8	0.8	0.8	0.8	0.7	0.8	0.9
IO	2.0	2.1	2.0	1.9	1.7	2.1	2.4
EL	0.4	0.6	0.4	0.4	0.4	0.4	0.4

Table 10. Meristic data for the type series of *Cnemaspis kalakadensis* **sp. nov.**. Abbreviations are listed in Materials and Methods except for: L&R = Left & Right; abs. = absent; * = lamellae and tail tuberculation incomplete.

Type	**Holotype**	**Paratypes**					
Specimen no.	NRC-AA-1180	NRC-AA-1181	NRC-AA-1182	NRC-AA-1183	BNHS 2826	BNHS 2827	BNHS 2828
Sex	Male	Female	Male	Female	Male	Female	Female
SL (L&R)	11&10	9&8	11&10	11&10	10&10	10&10	11&10
IL (L&R)	10&9	9&9	9&8	8&9	8&9	9&9	9&9
SL M (L&R)	8&8	8&8	10&9	9&8	8&7	8&8	7&7
IL M (L&R)	7&6	6&7	8&8	6&6	7&6	7&6	7&6
ESFL (L&R)	3&2	4&3	4&6	5&5	3&1	4&3	2&2
PVT	abs.	abs.	abs.	abs.	abs.	abs.	abs.
DTR	5	4	4	4	4	5	5
MVSR	30	28	30	33	29	34	28
VS	122	129	128	126	125	134	124
LamF1 (L&R)	11&11	11&12	12&11	12&11	12&12	12 &12	11&11
LamF4 (L&R)	16&16	16&16	18&17	18&18	19&18	18&6*	16&16
LamT1 (L&R)	11&11	11&11	11&12	12&11	12&12	12&12	11&11
LamT4 (L&R)	19&19	22&21	21&20	19&20	21&21	21&22	19&19
LamT5 (L&R)	18&18	15&19	19&18	19&19	20&18	20&18	18&17
FP (L&R)	14&14	abs.	13&14	abs.	13&12	abs.	abs.
SBFP (L&R)	11	abs.	10	abs.	10	abs.	abs.
PCT (L&R)	1&1	1&1	1&1	1&1	1&1	1&1	1&1
PVTT (L&R)	16&16	8*&8*	13*&13*	7*&7*	4*&4*	18&18	4*&4*
DLTT (L&R)	A	0	3&2	A	A	A	A
LTT (L&R)	2&2	0&1	1&2	2&2	1&1	4&4	2&3

orly on the snout in NRC-AA-1181 and NRC-AA-1183. Upper postmentals separated medially by two small chin scales below mental in BNHS 2826 and BNHS 2827; upper postmentals bordered by mental, infralabial I, outer postmental, and three chin scales on left side and two on right side in NRC-AA-1181, NRC-AA-1182; upper postmentals bordered by infralabial I & II on right and infralabial I on left side, and by mental, outer postmental, and three chin scales on either side in NRC-AA-1183; upper postmentals bordered by mental, infralabial I, outer postmental, and two chin scales on either side in BNHS 2826 and BNHS 2827; upper postmental bordered by in-

Table 11. Additional morphological character states evaluation for the type series of *Cnemaspis kalakadensis* **sp. nov.**. abs. = absent; / = data unavailable.

Type	**Holotype**	**Paratypes**					
Specimen no.	NRC-AA-1180	NRC-AA-1181	NRC-AA-1182	NRC-AA-1183	BNHS 2826	BNHS 2827	BNHS 2828
Sex	Male	Female	Male	Female	Male	Female	Female
Anterior extra-brillar fringe scales enlarged (1) or not enlarged (0)	1	1	1	1	1	1	1
Ventral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0
Gular scales keeled (1) or smooth (0)	0	0	0	0	0	0	0
Pectoral scales keeled (1) or smooth (0)	0	0	0	0	0	0	0
femoral pores elongate (1) or round (0)	1	abs.	0	abs.	1	abs.	abs.
Dorsal pholidosis homogeneous (1) or heterogeneous (0)	0	0	0	0	0	0	0
Dorsal tubercles keeled (1) or not keeled (0)	0	0	0	0	0	0	0
Tubercles linearly arranged (1) or more random (0)	0	0	0	0	0	0	0
Spine-like scales on flank present (1) or absent (0)	1	1	1	1	1	1	1
Lateral caudal furrows present (1) or absent (0)	0	0	0	0	/	0	/
Subcaudals keeled (1) or smooth (0)	0	0	0	0	0	0	0
Single median row of subcaudals keeled (1) or smooth (0)	0	0	0	0	0	0	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0	/	0	/
Enlarged median subcaudal scale row (1) or not (0)	1	1	1	1	1	1	1
Enlarged femoral scales present (1) or absent (0)	0	0	1	0	0	0	1
Subtibial scales keeled (1) or smooth (0)	0	0	0	0	0	0	0

fralabial I & II and two chin scales on left and infralabial I and three chin scales on right side in BNHS 2828. Outer postmental bordered by inner postmental, infralabials I & II, and four chin scales on left and three on right side in NRC-AA-1181; outer postmental bordered by inner postmental, infralabials II on left and infralabial I & II on right side, and three chin scales on either side in NRC-AA-1182 and NRC-AA-1183; outer postmental bordered by inner postmental, infralabials I & II, and three chin scales on either side in BNHS 2826 and BNHS 2827; outer postmental bordered by inner postmental, infralabials II and two chin scales on right and infralabial I & II and three chin scales on left side in BNHS 2828. Outer postmental separated from each other below mental by four enlarged chin scales in BNHS 2827 and BNHS 2828. A single paratype (BNHS 2827) has original and complete tail, marginally longer than body (TL/SVL 1.08); two paratypes (NRC-AA-1183 and BNHS 2828) have complete but partially regenerated tail, marginally shorter and longer than body respectively (TL/SVL 0.97 and 1.08 respectively); tail partially detached from the body and lost in NRC-AA-1181, NRC-AA-1182, and BNHS 2826. All paratypes agree with the holotype in colouration except for the four female paratypes which differ in ventral

colouration, lacking the yellow seen in males: with ventral surfaces off-white with faint, scattered grey stippling; belly and underside of tail light cream. Dark markings on dorsum poorly defined in NRC-AA-1182, BNHS 2826 and prominent in NRC-AA-1181, BNHS 2828 (Figs 18B & 19).

Distribution and Natural history. *Cnemaspis kalakadensis* **sp. nov.** is currently known only from in and around its type locality (Sengaltheri in Kalakadu reserve forest, *ca*. 900–1060 m asl.) in Kalakad Mundanthurai Tiger Reserve, Tirunelveli district, Tamil Nadu (Fig. 1). Individuals of the new species were seen active during the daytime (1030–1600 hrs) on tree trunks (2–5 m above the ground) inside wet evergreen forest patches (Fig. 20A–C). *Cnemaspis kalakadensis* **sp. nov.** appears to be a tree specialist as they were only observed on tree trunks, some individuals were seen effortlessly climbing above approximately 4 m on trees when disturbed. They were observed to be fairly common (n = >15) at all three collection sites indicating good abundance. The new species were recorded in good numbers only at places with high canopy cover and were seen only during the daytime. Sympatric lizards encountered on tree trunks at the locality include *Cnemaspis australis* Manamendra-Arachchi, Batuwita and Pethiyagoda, 2007; *Dravidogecko douglasadamsi* Chaitanya, Giri, Deepak, Datta-Roy, Murthy and Karanth, 2019; *Hemidactylus frenatus* Duméril and Bibron, 1836; *Dasia johnsinghi* Harikrishnan, Vasudevan, De Silva, Deepak, Kar, Naniwadekar, Lalremruata, Prasoona and Aggarwal, 2012; *Draco dussumieri* Duméril and Bibron, 1837; and *Monilesaurus ellioti* (Günther, 1864).

Discussion

South Asian *Cnemaspis* continue to be named at an unprecedented rate from peninsular India, the description of these three new species taking the number of species known from peninsular India to 63, and the Western Ghats alone to 47 (Pal et al. 2021; Khandekar et al. 2020; Uetz et al. 2022). A staggering 71 % of known species (45/63) have been described in the last decade, with almost every area surveyed yielding at least one new species, again highlighting the fact that we are far from uncovering the true diversity of this exceptionally diverse and ancient clade. Each of the three new species is the southernmost representative of its respective clade, with *Cnemaspis azhagu* **sp. nov.** being the most southern representative of the genus in mainland India.

All three new species are from the Kalakad Mundanthurai Tiger Reserve (KMTR), in southern Tamil Nadu; which forms part of the Agasthyamalai Biosphere Reserve along with the contiguous Neyyar, Peppara and Shendurney Wildlife Sanctuaries in Kerala. Spread across 895 km^2, KMTR spans an elevational range from <100 m to >1800 m and includes both west-facing and east-facing slopes, receiving rainfall during the summer (southwest) and winter (northeast) monsoons (see Ganesh et al. 1996). These features result in a high diversity of habitats, from open scrub to deciduous, tropical dry evergreen and moist evergreen forests. A host of lizard species are endemic to KMTR, including the geckos *Cnemaspis beddomei*, *C. regalis*, *Dravidogecko douglasadamsi* Chaitanya, Giri, Deepak, Datta-Roy, Murthy & Karanth, 2019, *Hemidactylus acanthopholis* Mirza and Sanap, 2014 and *Hemiphyllodactylus peninsularis* Agarwal, Bauer, Pal, Srikanthan and Khandekar, 2020 (Chaitanya et al. 2019; Agarwal et al. 2020c; Pal et al. 2021) in addition to the three new species described in this paper.

Four clades of South Asian *Cnemaspis* are distributed south of the Shencottah Gap —the *beddomei* clade with six known species, and the *gracilis*, *littoralis* and *monticola* clades with a single species each. *Cnemaspis azhagu* **sp. nov.** is the 14th member to be described from the *beddomei* clade, 11 of which have been described in the last four years, and all of which are diurnal, sexually dimorphic and distributed south of the Palghat Gap in the Western Ghats with narrow distributional ranges (except *C. regalis* which is known from two localities about 25 km apart from each other) (Cyriac et al. 2018; Sayyed et al. 2019; Pal et al. 2021). *Cnemaspis azhagu* **sp. nov**. is most similar to *C. aaronbaueri*, *C. galaxia*, *C. nigriventris*, *C. ornata* and *C. regalis*, in superficial morphology and colour pattern; with all these species known from low to mid elevations (< 400 m asl. except *C. ornata* which is known from 900–1000 m asl.) in dry deciduous forests along the eastern slopes of the southern Western Ghats. The distributional range of *Cnemaspis azhagu* **sp. nov**. is 36 km south from its geographically closest congener *C. regalis* (holotype locality) and just 15 km south from the additional paratype locality in straight-line distance. A vast area of suitable habitat along the eastern slopes of the southern Western Ghats remains to be explored and it is almost certain that additional fieldwork in these areas will reveal additional undescribed species within the *beddomei* clade across both low and high elevational forests.

Cnemaspis mundanthuraiensis **sp. nov.** is a member of the *gracilis* clade and is only the third species from this clade known from the Western Ghats after *C. gracilis* and *C. jackieii*, the other four species distributed in granite boulder habitats in southern India outside the Western Ghats (Khandekar 2019; Khandekar et al. 2019a; Agarwal et al. 2020a; Pal et al.2021). The distributional range of *Cnemaspis mundanthuraiensis* **sp. nov.** is approximately 55 km south from its closest described member (*C. jackieii*) of the clade, which also spans the Shencottah Gap – though these are both low elevation species and much more sampling is needed to understand the role of the gap in speciation. Members of this clade are all diurnal, largely rupicolous and sexually dimorphic. We take this opportunity to correct an error in a previous publication on the *gracilis* clade; in the original description of *Cnemaspis shevaroyensis*, Khandekar et al. (2019a) accidentally listed the same museum number for a female paratype as the holotype (NCBS-BH 674) in the species description but provided the correct number in table 5 (NCBS-BH 676).

Cnemaspis kalakadensis **sp. nov.** is the fifth member of the *littoralis* clade and second to be described from Tamil Nadu state. Three out of four Indian species from this clade were described in the last few years (Sayyed et al. 2020; Pal et al. 2021). *Cnemaspis kalakadensis* **sp. nov.** extends the known distribution of the clade by 160 km south from its closest described member (*C. flavigularis*). Indian members of this clade appear to be tree specialists and are unique among peninsular Indian congeners in having much enlarged, plate-like basal lamellae. *Cnemaspis kalakadensis* **sp. nov.** is superficially similar in morphology to one of the only two Indian *Cnemaspis* species that lack precise type locality data — *C. jerdonii* in having similar dorsal pholidosis, presence of spine-like scales on flanks, absence of enlarged lateral tubercles on tail and possessing only femoral pores in males. However, it can be easily distinguished from the latter by having higher number of femoral pores on each thigh (12–14) in males *versus* eight femoral pores on each thigh in males; maximum SVL 33 mm *versus* maximum SVL 38.1 mm; scales on lateral sides of tail smooth *versus* scales on lateral side of the tail carinate. Based on superficial similar morphology, it is likely that the *C. jerdonii* could be a member of the *littoralis* clade and most probably described from the Western Ghats of either Kerala or Tamil Nadu.

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References

Agarwal I, Bauer AM, Khandekar A (2020a) A new species of South Asian *Cnemaspis* (Squamata: Gekkonidae) from the Eastern Ghats, India. Zootaxa 4802: 449–462. https://doi.org/10.11646/zootaxa.4802.3.3

Agarwal I, Kamei RG, Mahony S (2021a) The phylogenetic position of the enigmatic Assam day gecko *Cnemaspis* cf. *assamensis* (Squamata: Gekkonidae) demonstrates a novel biogeographic connection between Northeast India and south India-Sri Lanka. Amphibia-Reptilia 42: 355–367. https://doi.org/10.1163/15685381-bja10062

Agarwal I, Thackeray T, Khandekar A (2020b) Geckos in the granite: two new geckos (Squamata: Gekkonidae) from rocky, scrub habitats in Rishi Valley, Andhra Pradesh, India. Zootaxa 4838: 451–474. https://doi.org/10.11646/zootaxa.4838.4.1

Agarwal I, Bauer AM, Pal S, Srikanthan AN, Khandekar A (2020c) Two more new *Hemiphyllodactylus* Bleeker, 1860 (Squamata: Gekkonidae) from Tamil Nadu, India. *Zootaxa* 4729 (2): 249–265. https://doi.org/10.11646/zootaxa.4729.2.6

Agarwal I, Thackeray T, Khandekar A (2021b) A new medium-sized rupicolous *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) of the *C. bangara* clade from granite boulder habitats in Krishnagiri, Tamil Nadu, India. Zootaxa 4969: 351–366. https://doi.org/10.11646/zootaxa.4969.2.7

Agarwal I, Thackeray T, Pal S, Khandekar A (2020c) Granite boulders act as deep-time climate refugia: a Miocene divergent clade of rupicolous *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Mysore Plateau, India, with descriptions of three new species. Journal of Zoological Systematics and Evolutionary Research 00: 1–28. https://doi.org/10.1111/jzs.12391

Amarasinghe TAA, Karunarathna S, Madawala M, De Silva A (2021) Two new rupicolous day geckos of the *Cnemaspis alwisi* group (reptilia: gekkonidae) from Sri Lanka. Taprobanica 10: 23–38. https://doi.org/10.47605/tapro.v10i1.245

Beddome RH (1870) Descriptions of some new lizards from the Madras Presidency. Madras Monthly Journal of Medical Science 1: 30–35.

Chaitanya R, Giri VB, Deepak V, Datta-Roy A, Murthy BHCK, Karanth P (2019) Diversification in the mountains: a generic reappraisal of the Western Ghats endemic gecko genus *Dravidogecko* Smith, 1933 (Squamata: Gekkonidae) with descriptions of six new species. Zootaxa 4688 (1): 001–056. https://doi.org/10.11646/zootaxa.4688.1.1

Chandramouli SR (2020) A new species of dwarf gecko of the genus *Cnemaspis* Strauch, 1887 (Reptilia: Sauria: Gekkonidae) from the Nicobar archipelago with an expanded description of *Cnemaspis andersonii* (Annandale 1905) of the Andaman Islands. Asian Journal of Conservation Biology 9: 3–10. https://ajcb.in/journals/full_papers_july_2020/AJCB-Vol9-No1-Chandramouli.pdf

Cyriac VP, Johny A, Umesh PK, Palot MJ (2018) Description of two new species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Western Ghats of Kerala, India. Zootaxa 4459: 85–100. https://doi.org/10.11646/zootaxa.4459.1.3

Cyriac VP, Palot MJ, Deuti K, Umesh PK (2020) A preliminary 16S rRNA phylogeny of the Indian *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) with the description of two new cryptic species from the *C. wynadensis* clade. Vertebrate Zoology 70: 171–193. https://doi.org/10.26049/VZ70-2-2020-06

Duméril AMC, Bibron G (1836) Erpetologie Générale ou Histoire Naturelle Complete des Reptiles. Libr. Encyclopédique Roret, Paris 3: 528 pp.

Duméril AMC, Bibron G (1837) Erpétologie Générale ou Histoire Naturelle Complete des Reptiles. Libr. Encyclopédique Roret, Paris 4: 570 pp.

Ganesh T, Ganesan R, Devy MS, Davidar P, Bawa K S (1996) Assessment of plant biodiversity at a mid-elevation evergreen forest of Kalakad–Mundanthurai Tiger Reserve, Western Ghats, India. Current Science, 379–392.

Giri VB, Bauer AM, Gaikwad KS (2009) A new ground-dwelling species of *Cnemaspis* Strauch (Squamata: Gekkonidae) from the north-

ern Western Ghats Maharashtra, India. Zootaxa 2164: 49–60. https://doi.org/10.5281/zenodo.189040

Günther ACLG (1864) The Reptiles of British India. London (Taylor & Francis): xxvii + 452 pp.

Harikrishnan S, Vasudevan K, De Silva A, Deepak V, Kar NB, Naniwadekar R, Lalremruata A, Prasoona KR, Aggarwal RK (2012) Phylogeography of *Dasia* Gray, 1830 (Reptilia: Scincidae), with the description of a new species from southern India. Zootaxa 3233: 37–51. https://doi.org/10.11646/zootaxa.3233.1.3

Inger RF, Shaffer HB, Koshy M, Bakde R (1984) A report on a collection of amphibians and reptiles from the Ponmudi, Kerala, South India. Journal of Bombay Natural History Society 81: 551–570.

Iskandar DT, McGuire JA, Amarasinghe AT (2017) Description of five new day geckos of *Cnemaspis kandiana* group (Sauria: Gekkonidae) from Sumatra and Mentawai Archipelago Indonesia. Journal of Herpetology 51: 142–153. https://doi.org/10.1670/15-047

Jerdon TC (1853) Catalogue of the Reptiles inhabiting the Peninsula of India. Part 1. Journal of Asiatic Society of Bengal xxii [1854]: 462–479 (1853 fide Bauer et al. 2008)

Karunarathna S, De Silva A, Gabadage D, Botejue M, Madawala M, Ukuwela KD (2021) A new species of day gecko (Reptilia, Gekkonidae, *Cnemaspis* Strauch, 1887) from Sri Lanka with an updated ND2 gene phylogeny of Sri Lankan and Indian species. Zoosystematics and Evolution 97: 191–209. https://doi.org/10.3897/zse.97.60099

Khandekar A (2019) A new species of rock-dwelling *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from Tamil Nadu, southern India. Zootaxa 4571: 383–397. https://doi.org/10.11646/zootaxa.4571.3.6

Khandekar A, Gaitonde N, Agarwal I (2019a) Two new *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Shevaroy massif, Tamil Nadu, India, with a preliminary ND2 phylogeny of Indian *Cnemaspis*. Zootaxa 4609: 68–100. https://doi.org/10.11646/zootaxa.4609.1.3

Khandekar A, Thackeray T, Agarwal I (2022) Three new cryptic species of South Asian Cnemaspis Strauch, 1887 (Squamata, Gekkonidae) from Karnataka, India. Vertebrate Zoology 72 115–142. https://doi.org/10.3897/vz.72.e76308

Khandekar A, Thackeray T, Agarwal I (2019b) Two more new species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the northern Western Ghats, Maharashtra, India. Zootaxa 4646: 236–250. https://doi.org/10.11646/zootaxa.4656.1.2

Khandekar A, Thackeray T, Agarwal, I. (2020a) A new cryptic *Cnemaspis* Strauch (Squamata: Gekkonidae) from an isolated granite hill on the Mysore Plateau, Karnataka, India. Zootaxa 4845: 509–528. https://doi.org/10.11646/zootaxa.4845.4.3

Khandekar A, Thackeray T, Agarwal I (2021a) A new small-bodied, polymorphic *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) allied to *C. monticola* Manamendra-Arachchi, Batuwita & Pethiyagoda, 2007 from the Central Western Ghats of Karnataka, India. Zootaxa 4950: 501–527. https://doi.org/10.11646/zootaxa.4950.3.5

Khandekar A, Thackeray T, Agarwal I (2021b) A novel small-bodied rupicolous *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the northern Western Ghats, Maharashtra, India, with comments on the status of *C. indraneildasii*, Bauer 2000. Zootaxa 4969: 331–350. https://doi.org/10.11646/zootaxa.4969.2.6

Khandekar A, Thackeray T, Pal S, Agarwal I (2020b) A new large-bodied, rupicolous *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) allied to *Cnemaspis heteropholis* Bauer, 2002 from the Central Western Ghats of Karnataka, India. Zootaxa 4801, 57–84. https://doi.org/10.11646/zootaxa.4801.1.2

Lanfear R, Calcott B, Ho SYW, Guindon S (2012):Partitionfinder: combined selection of partitioning schemes and substitution models for phylogenetic analysis. Molecular Biology and Evolution 29 (6): 1695–1701. https://doi.org/10.1093/molbev/mss020

Lee JL, Miller AH, Zug GR, Mulcahy DG (2019) The discovery of Rock Geckos *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) in the Tanintharyi Region, Myanmar with the description of two new species. Zootaxa 4661: 40–64. https://doi.org/10.11646/zootaxa.4661.1.2

Macey JR, Larson A, Ananjeva NB, Fang Z, Papenfuss TJ (1997) Two novel gene orders and the role of light-strand replication in rearrangement of the vertebrate mitochondrial genome. Molecular Biology and Evolution 14: 91–104. https://doi.org/10.1093/oxfordjournals.molbev.a025706

Manamendra-Arachchi K, Batuwita S, Pethiagoda R (2007) A taxonomic revision of the Sri Lankan day-geckos (Reptilia: Gekkonidae: *Cnemaspis*), with description of new species from Sri Lanka and southern India. Zeylanica 7: 9–122.

Mirza ZA, Sanap R (2014) New cryptic species of gecko of the genus *Hemidactylus* Oken, 1817 (Reptilia: Gekkonidae) from Southern India. Taprobanica 6: 12–20.

Miller MA, Pfeiffer W, Schwartz T (2010) "Creating the CIPRES Science Gateway for inference of large phylogenetic trees" *in* Proceedings of the Gateway Computing Environments Workshop (GCE) 14 Nov. 2010, New Orleans, LA: 1–8.

Murthy BHCK, Anandan N, Sengupta S, Deepak P (2019) A new species of Day Gecko of the genus *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Nilgiri Hills, Tamil Nadu, India. Records of the Zoological Survey of India 119: 211–226. https://doi.org/10.26515/rzsi/v119/i3/2019/143339

Pal S, Mirza ZA, Dsouza P, Shanker K (2021) Diversifying on the Ark: multiple new endemic lineages of dwarf geckos from the Western Ghats provide insights into the systematics and biogeography of South Asian *Cnemaspis*. Zoological Research 42: 675−691. https://doi.org/10.24272/j.issn.2095-8137.2021.074

Palumbi SR, Martin A, Romano S, McMillan WO, Stice L, Grabowski G. (1991) The simple fool's guide to PCR, Version 2.0. University of Hawaii.

Sayyed A, Sulakhe S (2020) A new *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the northern Western Ghats, Maharashtra, India. Zootaxa 4885: 83–98. https://doi.org/10.11646/zootaxa.4885.1.5

Sayyed A, Cyriac VP, Dileepkumar R (2020). A new cryptic species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae), in the *C. littoralis* complex, from Anakkal, Palakkad, Kerala, India. Amphibian and Reptile Conservation 14: 31–45 (e251). DOI???

Sayyed A, Pyron RA, Dileepkumar R (2018) Four new species of the genus *Cnemaspis* Strauch, (Sauria: Gekkonidae) from the northern Western Ghats, India. Amphibian and Reptile Conservation, 12, 1–29.

Sayyed A, Grismer LL, Campbell PD, Dileepkumar R (2019) Description of a cryptic new species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Western Ghats of Kerala State of India. Zootaxa 4656: 501–514. https://doi.org/10.11646/zootaxa.4656.3.7

Sayyed A, Cyriac VP, Pardeshi A, Sulakhe S (2021) Dwarfs of the fortress: A new cryptic species of dwarf gecko of the genus *Cnemaspis* Strauch, 1887 (Squamata, Gekkonidae) from Rajgad fort in the northern Western Ghats of Maharashtra, India. Evolutionary Systematics 5: 25–38. https://doi.org/10.3897/evolsyst.5.62929

Stamatakis A (2006) RAxML-VI-HPC: maximum likelihood-based phylogenetic analyses with thousands of taxa and mixed models. Bioinformatics 22: 2688–2690. http://doi.org/10.1093/bioinformatics/btl446

Tamura K, Peterson D, Peterson N, Stecher G, Nei M, Kumar S (2011) MEGA5: Molecular evolutionary genetics analysis using maximum likelihood, evolutionary distance, and maximum parsimony methods. Molecular Biology and Evolution 28: 2731–2739. http://doi.org/10.1093/molbev/msr121

Theobald W (1876) Descriptive catalogue of the reptiles of British India. Thacker, Spink & Co., Calcutta: xiii + 238 pp.

Thompson JD, Higgins DG, Gibson TJ (1994) CLUSTAL W: improving the sensitivity of progressive multiple sequence alignment through sequence weighting, positions-specific gap penalties and weight matrix choice. Nucleic Acids and Research 22: 4673–4680.

Uetz P, Freed P, Hosek J (2022) The Reptile Database. Retrieved from: http://reptile-database.reptarium.cz (accessed on 13 January 2022).

Appendix 1

Material examined.

Institutional abbreviations are as follows: National Centre for Biological Sciences, Bengaluru (NCBS-AU/ NCBS-BH/ Akshay Khandekar field series [AK/ AK R]); Bombay Natural History Society, Mumbai (BNHS); Centre for Ecological Sciences, Bangalore (CES G).

Cnemaspis agarwali: holotype, NCBS-AU486 (adult male); paratypes, NCBS-AU487, BNHS 2337, NCBS-AU488, NCBSAU490, and BNHS 2338, (adult males), NCBS-AU485, BNHS 2336, and BNHS 2339, (adult females), from Sankari, Salem District, Tamil Nadu, India.

Cnemaspis gracilis: CESG385 from Chittur River, Palakkad District, Kerala, India. AK 133, AK 134, AK 135, AK 136, AK 137, AK 138, AK 139, AK 140, AK 141, AK 142, AK 143, AK 144, from Valparai, Coimbatore District, Tamil Nadu, India.

Cnemaspis shevaroyensis: holotype, NCBS-BH674 (adult male); paratypes, BNHS 2530, BNHS 2531, (adult males), NCBS-BH675, NCBS-BH676, BNHS 2529, (adult females) from the Shevaroy hills, Salem District, Tamil Nadu, India.

Cnemaspis thackerayi: holotype, NCBS-BH670 (adult male); paratypes, NCBS-BH671, BNHS 2527, (adult males), NCBS-BH672, NCBS-BH673, BNHS 2526, BNHS 2528, (adult females) from Yercaud, in Shevaroy hills, Salem District, Tamil Nadu, India.

Cnemaspis littoralis: AK 955, AK 956, AK 957, AK 958, AK 959, AK 960, AK 961, AK 962, from Kozhikode, Kozhikode District, Kerala, India.

Cnemaspis regalis: AK R 453, AK R 454, AK R 455, AK R 456, from Mundanthurai, Tirunelveli District, Tamil Nadu, India.

Cnemaspis beddomei: AK R 523, AK R 524, AK R 525, from Kakachi, Tirunelveli District; AK R 572, AK R 573, AK R 574, Upper Kodiyar, Kanyakumari District, Tamil Nadu, India.