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## Description of Five New Day Geckos of *Cnemaspis kandiana* Group (Sauria: Gekkonidae) from Sumatra and Mentawai Archipelago, Indonesia

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**ABSTRACT.**—We investigated diminutive day geckos (SVL < 40 mm) of the genus *Cnemaspis* (*Cnemaspis kandiana* Group) from mainland Sumatra and islands along its western margin (Nias, Siberut, Pagai, and Enggano). The assemblage includes several species based on morphological evidence, five of which we describe as new. The new species occur in the Sumatran provinces of Aceh, North Sumatra, and West Sumatra. Finally, we provide a new key and redescriptions for three previously recognized species: *Cnemaspis dezwaani*, *Cnemaspis modiglianii*, and *Cnemaspis whittenorum*, based on recently collected material, and clarify contradictory information concerning their original descriptions and their key under each species account.

The genus *Cnemaspis* (family Gekkonidae) is species-rich and geographically widespread (Strauch, 1887), with many new species recently discovered and described from Africa, the Indian subcontinent, and Southeast Asia (Bauer et al., 2007; Gamble et al., 2012; Grismer et al., 2014; Amarasinghe et al., 2015). Interestingly, the genus is polyphyletic, with at least three divergent unrelated clades (one each in Africa, India, and Southeast Asia), while species of the Southeast Asian clade have been reported from Vietnam, Cambodia, Laos, Thailand, Peninsular Malaysia, Singapore, Borneo, Sumatra, several islands close to the Peninsular Malaysia, and Borneo (de Rooij, 1915; Leong et al., 2003; Grismer et al., 2014; Amarasinghe et al., 2015). Species representing a clade of diminutive *Cnemaspis* species (*Cnemaspis kandiana* Group) were reported from the Indian Subcontinent (including Sri Lanka), Andaman and Nicobar islands, Phuket Island (Thailand), and islands off the southwest coast of Sumatra including Simeulue, Nias, Siberut, and Enggano (Das and Leong, 2004; Das, 2005; Manamendra-Arachchi et al., 2007; Giri et al., 2009).

Although a large number of diminutive *Cnemaspis* species occur on the Indian Subcontinent (including Sri Lanka, Andaman, and Nicobar islands), only five species occur in the Southeast Asian region: *Cnemaspis dezwaani* Das, 2005 (from Nias), *Cnemaspis jacobsoni* Das, 2005 (from Simeulue), *Cnemaspis modiglianii* Das, 2005 (from Enggano), *Cnemaspis whittenorum* Das, 2005 (from Siberut), and *Cnemaspis phuketensis* Das and Leong, 2004 (from Phuket Island). Each of these species occurs on smaller islands (Simeulue, Nias, Siberut, and Enggano islands and Phuket Island) fringing the Greater Sunda Shelf and have not been reported from the Malay Peninsula or the larger Sundaic islands of Sumatra, Borneo, and Java. The herpetological diversity of Sumatra, in particular, remains substantially underexplored (Inger and Iskandar, 2005; Iskandar and Erdelen, 2006), despite being the sixth largest island in the world and certainly home to an extremely diverse biota. Few herpetofaunal species have been added to this island's list since prior to World War II, and much of the progress has been concentrated within the last decade (see Harvey et al., 2002; Iskandar and Mumpuni, 2004; Inger et al., 2009; McLeod et al., 2011).

Our team has been working on Sumatra for 3 decades, and our efforts have shown that the paucity of *Cnemaspis* species on this mega-island is the result of inadequate collecting of these small and secretive species. Specimens in collections are relatively scarce. Among the more than 5,000 amphibian and reptile specimens collected during the last 3 decades from numerous expeditions, as well as from sporadic and short-term explorations, only 20 specimens of *Cnemaspis* were collected from the mainland of Sumatra, and most are from scattered areas across the provinces of Aceh, North Sumatra, and West Sumatra. Upon closer examination, this small collection clearly comprises several distinct species. Information about the species inhabiting Sumatra is increasingly important as it will shed light on past and present relationships with mainland Asia. Furthermore, information and knowledge from the neighboring land areas are growing rapidly, which has provided additional motivation to evaluate the status of *Cnemaspis* on Sumatra and to describe newly investigated species.

### MATERIALS AND METHODS

We collected the type series by hand, euthanized the specimens with sodium pentobarbital, and fixed the specimens in 10% buffered formalin prior to storage in 70% ethanol. We compared the specimens to specimens and descriptions of all congeners (Appendix 1). Museum acronyms are those of Sabaj Pérez (2016). We deposited all the name-bearing types in the Museum Zoologicum Bogoriense, Cibinong, Indonesia (MZB).

When diagnosing and describing the new species, we scored specimens for the same morphological characters used in recent descriptions of members of the *C. kandiana* group (e.g., Das, 2005; Manamendra-Arachchi et al., 2007). Measurements were obtained from the left side of the body to the nearest 0.1 mm using digital calipers (Mitutoyo, Corp., Kawasaki, Japan) under a Leica-Wild M3Z dissecting microscope (Leica Corp., Wetzlar, Germany). We measured snout–vent length (SVL, from tip of snout to anterior margin of vent), brachium length (on the dorsal surface from the axilla to the inflection of the flexed elbow), antebrachium length (on the dorsal surface from the posterior margin of the elbow while flexed to the inflection of the flexed wrist), thigh length (from the anterior margin of the hind limb at its insertion point on the body to the knee while flexed), shank length (from the posterior surface of the knee

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DOI: 10.1670/15-047

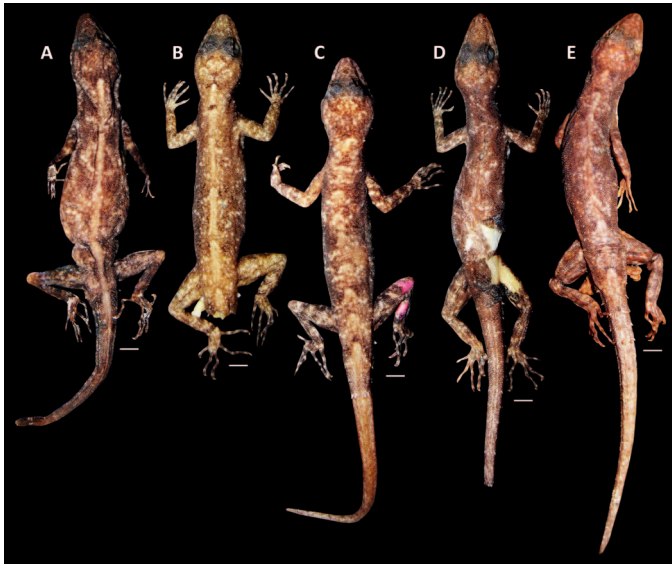


FIG. 1. Dorsal view of the holotype of (A) *Cnemaspis aceh* sp. nov. (B) *Cnemaspis andalas* sp. nov. (C) *Cnemaspis minang* sp. nov. (D) *Cnemaspis pagai* sp. nov. (E) *Cnemaspis tapanuli* sp. nov. Scale bar = 1 mm.

while flexed to the base of the heel), axilla–groin length (from the posterior margin of the forelimb at its insertion point on the body to the anterior margin of the hind limb at its insertion point on the body), head length (from posterior edge of mandible to tip of snout); head width (maximum width of head at the angle of the jaws), eye diameter (the greatest horizontal diameter of the orbit); tympanum–eye length (from posterior border of orbit to anterior border of tympanum), snout length (from anterior border of orbit to tip of snout), eye–nostril length (from anterior border of orbit to middle of nostril), interorbital width (shortest distance between dorso-medial margins of orbits), tympanum diameter (greatest horizontal diameter of tympanum), internarial length (shortest distance between dorsal margins of nostrils), eye to mandible length (from posterior border of orbit to posterior tip of mandible), palm length (from wrist [carpus] to distal tip of longest finger), foot length (from heel to tip of longest toe), and finger and toe lengths (from tip of claw to the nearest fork).

Most of our meristic data are self-explanatory; however, a few characters require further comment here. We counted supralabial and infralabial scales from below the middle of the orbit to the rostral and mental scales, respectively. Our counts of ventrals include all scales from the mental to the last scale bordering the vent. We counted subdigital lamellae on toe IV from the first proximal enlarged scensor wider than the width of the largest palm scale to the distal-most lamella (excluding the claw sheath) at the base of the claw. We counted the number of longitudinal ventral and dorsal scale rows at midbody. We evaluated the texture of the scales on the ventral surface of brachium and antebrachium. We counted the total number of precloacal and femoral pores and assessed their orientation. We measured the degree and arrangement of body and tail tuberculations, the relative size and morphology of the subcaudal scales, and the number of cloacal tubercles on each side of the tail base. We obtained some information on character states and their distributions in other species from Das and Leong (2004) and Das (2005). We sexed specimens by examining everted hemipenes or hemipenial bulges at the tail base. To view

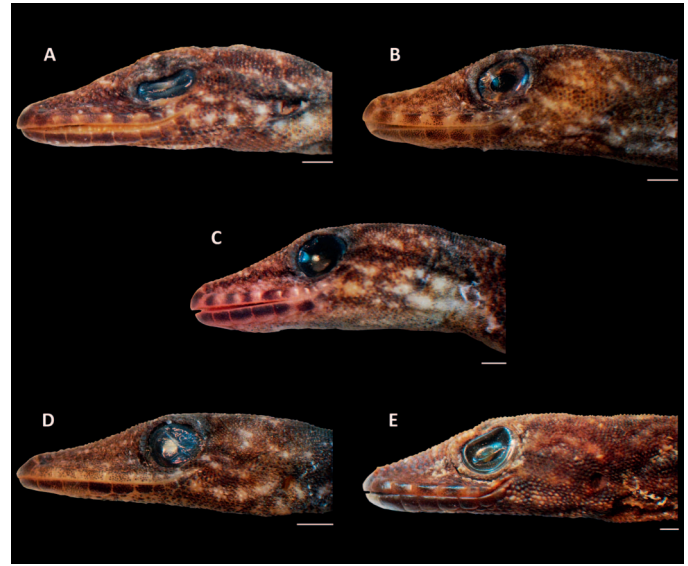


FIG. 2. Lateral view of the head of the holotype of (A) *Cnemaspis aceh* sp. nov. (B) *Cnemaspis andalas* sp. nov. (C) *Cnemaspis minang* sp. nov. (D) *Cnemaspis pagai* sp. nov. (E) *Cnemaspis tapanuli* sp. nov. Scale bar = 1 mm.

some small characters such as keeling of the ventrals, we applied the reversible stain methylene blue in 70% ethanol.

## RESULTS

We present comparative morphometric and meristic data obtained for the type specimens (Tables 1, 2). Statistically informative tests could not be performed because of the small sample sizes. Nonetheless, interspecific comparisons of morphological and meristic characters (discrete or nondiscrete) revealed a suite of characters that distinguish the new species from congeners (Table 2). In the diagnosis and identification keys, we summarize the differences between Southeast Asian *C. kandiana* groupspecies.

## SYSTEMATICS

### *Cnemaspis aceh* sp. nov. (Figs. 1–3, 4A; Tables 1, 2)

*Holotype*.—Female, MZB 12998, SVL 30.7 mm, Krueng Teunom, Sarah Raya Village, Aceh Jaya, Aceh, Indonesia, 67 m (4°40′07″N, 96°00′32″E), collected on 18 July 2007 by M. Kamsi.

*Diagnosis*.—*Cnemaspis aceh* sp. nov. differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 30.7 mm; each postmental bounded by four scales; dorsal scales keeled; six spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales keeled; ventral scales of thigh smooth; subcaudals keeled, scales on median row enlarged and keeled; seven supralabials; 18 lamellae under fourth toe. The number of precloacal or femoral pores is unknown because the holotype is female.

*Cnemaspis aceh* sp. nov. is most similar to *C. dezwaani*, but it can be distinguished from this species (characters in parentheses) by having six (four) spine-like tubercles on flank and no marblings on dorsum (dark brown marblings present sides of vertebral stripe).

TABLE 1. Meristic and mensural character states of the new *Cnemaspis* (*C. kandiana* group) species in Sumatra. NA = not applicable.

Character	<i>C. aceh</i> sp. nov. (n = 1)	<i>C. andalas</i> sp. nov. (n = 2)	<i>C. minang</i> sp. nov. (n = 2)	<i>C. pagai</i> sp. nov. (n = 1)	<i>C. tapanuli</i> sp. nov. (n = 2)
Supralabials	7	6–7	7–8	7	6
Infralabials	7	7	7	7	6
Total number of preloacal pores	NA	6	4	2	4
Number of of femoral pores (on each side)	NA	4	4	3	4–5
Number of tubercles on flanks	6	6	4	4	4
Lamellae under fourth toe	18	18–20	18	20	18
Snout–vent length	30.7	31.3	30.4–31.3	31.9	31.7–32.1
Brachium length	3.6	4.0	3.9–4.0	3.8	3.3–4.0
Antebrachium length	4.8	5.2	5.1–5.4	5.1	4.7–5.0
Thigh length	6.2	6.2	5.0	6.6	5.7–6.3
Shank length	6.0	6.2	5.7–5.8	6.0	5.0–5.7
Axilla–groin length	16.2	14.1	13.7–14.4	15.4	14.0–14.2
Head length	8.5	9.4	8.9–9.1	9.2	8.8–9.2
Head width	4.8	5.1	5.0–5.1	5.1	5.0
Eye diameter	2.1	2.3	2.3–2.4	2.4	2.4–2.6
Tympanum–eye length	2.1	1.8	1.6–2.0	1.9	1.8–2.1
Snout length	3.4	3.4	3.4–3.6	3.6	3.6
Eye–nostril length	2.6	2.6	2.7–2.8	3.0	2.4–2.7
Interorbital width	0.7	0.9	0.8	0.7	0.8–1.0
Tympanum diameter	0.5	0.5	0.5–0.9	0.6	0.5–0.6
Internarial distance	1.0	1.0	0.8–0.9	1.0	0.8–1.0
Eye to mandible length	3.2	3.3	3.4–3.5	3.0	2.7
Palm length	3.8	3.7	3.7	3.7	3.7–4.4
Foot length	6.1	5.3	5.8–6.5	5.7	5.5–6.1
Finger I length	1.6	1.7	1.5–1.7	1.7	1.3
Finger II length	2.5	2.4	2.2–2.5	2.3	2.8
Finger III length	2.9	2.7	2.5–2.9	2.3	3.5
Finger IV length	3.0	3.0	2.5–2.9	2.8	3.3
Finger V length	2.6	2.4	2.1–2.6	2.7	2.3
Toe I length	1.3	1.8	1.2–1.4	1.7	2.6
Toe II length	2.2	3.0	2.4–2.8	2.8	2.9
Toe III length	3.0	3.3	2.8–3.3	3.0	2.3
Toe IV length	3.3	3.8	3.8–4.1	3.8	2.0
Toe V length	2.7	3.3	2.8–3.3	2.7	1.3

TABLE 2. Diagnostic characters differentiating diminutive *Cnemaspis* (*C. kandiana* Group) species in Southeast Asia. ? = Character could not be evaluated from specimens or literature.

Character	<i>C. aceh</i>	<i>C. andalas</i>	<i>C. dezwaani</i>	<i>C. jacobsoni</i>	<i>C. minang</i>	<i>C. modiglianii</i>	<i>C. pagai</i>	<i>C. phuketensis</i>	<i>C. tapanuli</i>	<i>C. whittenorum</i>
Number of specimens evaluated	1	2	2	1	2	23	1	1	2	2
Maximum SVL (mm)	30.7	33.8	31.3	30.5	31.3	33.6	31.9	29.1	32.1	32.0
Supralabials	7	6, 7	5–7	6, 7	8	6, 7	7	6, 7	6	5, 6
Number of bounding scales of each postmental	4	4	4	4	3, 4	3–5	3	3	3	4
Number of spine-like tubercles on flank	6	6	4	?	4	4	4	?	4	4
Number of preloacal pores	?	6	8–12	0	4	2–4	2	0	4	4
Number of femoral pores (on each side)	?	4	3, 4	0	4	4, 5	3	0	4, 5	6
Number of lamellae under fourth toe	18	18–20	16–19	14	18	16–18	20	16, 17	18	18
Gular scales keeled (1) or smooth (0)	1	0	1	1	1	1	1	1	1	1
Pectoral scales keeled (1) or smooth (0)	1	0	1	1	0	1	1	1	1	1
Abdominal scales keeled (1) or smooth (0)	1	0	1	1	0	1	1	0	0	1
Ventral scales on thigh keeled (1) or smooth (0)	0	0	1	1	0	1	1	?	0	1
Subcaudals keeled (1) or smooth (0)	1	0	1	1	0	1	1	0	0	1
Median subcaudal row enlarged (1) or subequal (0)	1	1	1	1	1	1	1	0	1	1
Pale vertebral stripe present (1) or absent (0)	1	1	1	1	0	0	0	0	1	1

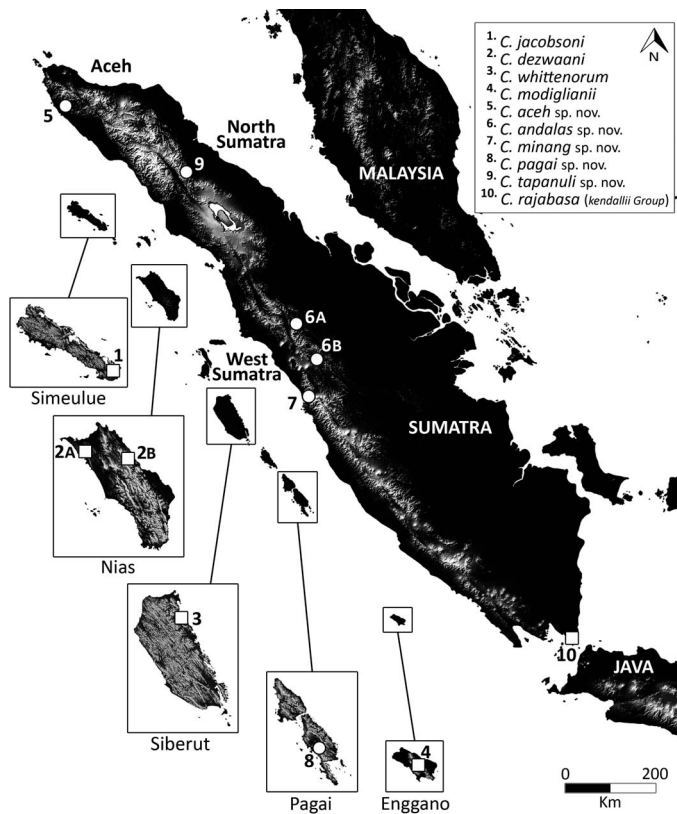


FIG. 3. Distribution of *Cnemaspis* in Sumatra; the type localities of new species are in circles and localities of known species are in squares: (1) Labuhan Bajau, Simeulue, Aceh; (2A) Lauru, Nias, North Sumatra; (2B) Madula, Nias, North Sumatra; (3) Pokhai, Siberut, West Sumatra; (4) Malakoni, Enggano, Bengkulu; (5) Sarah Raya, Aceh Jaya, Aceh; (6A) Rimbo Panti, West Sumatra; (6B) Payakumbuh, West Sumatra; (7) Indarung, Padang, West Sumatra; (8) Bulasat, South Pagai, West Sumatra; (9) Bohorok, Bukit Lawang, North Sumatra; and (10) Rajabasa, Lampung, Sumatra.

**Description of Holotype.**—An adult female, 30.7 mm SVL; head moderately large, narrow, elongate, distinct from neck, its length 27.7% of SVL; head width 56.5% of head length and 15.6% of SVL; snout elongate, its length 70.7% of head width and greater than eye diameter (eye diameter 61.8% of snout length); interorbital region relatively broad; interorbital distance 8.6% of head length; eye large, its diameter 24.7% of head length; pupil rounded; ear-opening deep, oval, taller than wide; diameter of eyes equal to tympanum–eye length; scales on snout keeled, larger than those of occipital region; scales of interorbital and occipital regions granular; rostral scale concave, partially divided by a medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale which is similar in size to supranasals; nostrils round, dorsally orientated; three postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by four smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on neck keeled;

three scale rows separating orbit from supralabials at level of pupil; nine supralabials (7th at mid orbit position), seven infralabials, decreasing in size towards angle of jaw.

Body slender, elongate; axilla–groin length 49.6% of SVL; mid-dorsal granules bluntly pointed, heterogeneous, keeled, intermixed with keeled, enlarged tubercles; dorsal scales at midbody smaller than ventrals at same level; six spine-like tubercles on flank; pectoral scales and abdominal scales keeled, rounded, and imbricate; 24 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; no preloocal or femoral pores as the holotype is a female.

Arms moderately short; length of antebrachium 15.6% of SVL, length of brachium 11.6% of SVL; legs relatively long; length of shank 19.4% of SVL; thigh somewhat longer than shank, its length 20.1% of SVL; dorsal scales on both arm and leg pointed and keeled; ventral scales on antebrachium keeled, bluntly pointed, and imbricate; scales on ventral surface of thigh rounded and smooth; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 18 on toe IV; interdigital webbing absent; relative length of fingers and toes  $4 > 3 > 5 > 2 > 1$ .

Tail tip broken (intact portion 20.8 mm); a single conical postcloacal spur present on each side; dorsal scales on tail pointed and keeled; present tail segmented with seven whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by 1–5 small scales; each whorl separated from its neighbor by about six scale rows; subcaudal scales at base rounded and smooth; distally subcaudals bluntly pointed and keeled; subcaudals on median row enlarged, bluntly pointed, and keeled.

**Coloration.**—The holotype of *Cnemaspis aceh* sp. nov. is dark brown dorsally, with distinct continuous pale vertebral stripe starting from posterior occipital region making a bright patch. Mid-dorsal surface ornamented by four short, wide bars beside the vertebral stripe; tail with light cross-bars. After 8 yr in preservative, the distinct continuous pale vertebral stripe is still visible on dark brown dorsum, limbs with indistinct irregular pale spots; whitish ventrally.

**Etymology.**—The specific epithet refers to the region inhabited by this species, Aceh, the northernmost province of Sumatra Island, Indonesia, formed here as an invariable noun in apposition.

**Natural History.**—*Cnemaspis aceh* sp. nov. is distributed in primary rain forests. The holotype was found in a crevice on a tree trunk during daytime.

*Cnemaspis andalas* sp. nov.  
 (Figs. 1–3; Tables 1, 2)

**Holotype.**—Male, MZB 12999, SVL 31.3 mm, Rimbo Panti, West Sumatra, Indonesia, 296 m (0.3405°N, 100.07283°E), collected on 5 November 2008 by J. A. McGuire and party.

**Paratypes.**—Female, MVZ 269630, SVL 27.2 mm, Rimbo Panti, West Sumatra, Indonesia, 775 m (0.35001°N, 100.03278°E), bears the same data as the holotype. Female, MZB 13000, SVL 33.8 mm, Ngala Seribu (=Thousand Caves), Harau Valley, Payakumbuh, West Sumatra, Indonesia (0°23'S, 100°63'E), collected on 29 August 2009 by D. Gusman and Desman.

**Diagnosis.**—*Cnemaspis andalas* sp. nov. differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 33.8 mm; each postmental bounded by four scales; dorsal scales keeled; six spine-like tubercles on flank; gular scales smooth; pectoral scales and

abdominal scales smooth; ventral scales of thigh smooth; six preloacal pores; four femoral pores on each side; subcaudals smooth, scales on median row enlarged and smooth; 6 or 7 supralabials; 18–20 lamellae under fourth toe.

*Cnemaspis andalas* sp. nov. is most similar to *Cnemaspis minang* sp. nov. and *Cnemaspis tapanuli* sp. nov., but it can be distinguished from both of these species (characters in parentheses) by having gular scales smooth (keeled), six (four) preloacal pores in males, and a continuous pale vertebral stripe (no stripe).

*Description of Holotype*.—An adult male, 31.3 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 30.0% of SVL; head width 54.2% of head length and 16.3% of SVL; snout elongate, its length 66.7% of head width and greater than eye diameter (eye diameter 67.6% of snout length); interorbital region relatively broad; interorbital width 9.6% of head length; eye large, its diameter 24.5% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eyes greater than tympanum–eye length (eye diameter 127.8% of tympanum–eye length); scales of snout keeled, larger than those of occipital region; scales of interorbital and occipital regions granular; rostral scale concave, partially divided by medial groove, postero-ventrally in contact with first supralabial, contacted ventrally by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally orientated; three postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular and truncate posteriorly to level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by four smooth scales, including medial scale; scales on throat rounded and smooth; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on neck bluntly pointed and keeled; six scale rows separating orbit from supralabials at level of pupil; eight supralabials (7th at mid-orbit position), seven infralabials, decreasing in size toward angle of jaw.

Body slender, elongate, axilla–groin length 45.0% of SVL; mid-dorsal granules bluntly pointed, homogeneous, keeled intermixed with keeled, enlarged tubercles; six spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales smooth, bluntly pointed, and imbricate; 18 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; six preloacal pores; four femoral pores on each side.

Arms moderately short; length of antebrachium 16.6% of SVL, length of brachium 12.8% of SVL; legs relatively long; length of thigh and shank 19.8% of SVL and equal in size; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium and antebrachium smooth, bluntly pointed, and imbricate; scales on ventral surface of thigh bluntly pointed and smooth; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 20 on toe IV; interdigital webbing absent; relative length of fingers and toes  $4 > 3 > 5 > 2 > 1$ .

Tail broken (intact portion 2.5 mm); tail base swollen; a single, conical, post-cloacal spur present on each side; dorsal scales on tail elongate, pointed, and keeled; tail segmented with eleven whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by 3–5

small scales; each whorl separated from its neighbor by five scale rows; subcaudals at base smooth; distally, subcaudals bluntly pointed and smooth; subcaudals on median row enlarged, bluntly pointed, and smooth.

*Coloration*.—After 7 yr in preservative, the holotype remains dark brown dorsally with a distinct continuous pale vertebral stripe; eight small, pale, inverted chevrons on vertebral region; a bright pale color spot on the nape, two dark spots on the neck, limbs with pale irregular spots; whitish ventrally.

*Variation of Paratypes*.—The paratype from Rimbo Panti (MVZ 269630) is identical in every aspect with the holotype, taking into account that it is a female. The paratype from Harau Valley, Payakumbuh (MZB 13000) has paired postmentals separated by two scales, six supralabials, and 20 lamellae under the fourth toe.

*Etymology*.—Andalas is the local common name of the tree *Morus macrourus* (family Moraceae) but is more frequently used for the region inhabited by this species. Andalas also is an ancient name used in the 13th Century for Sumatra, Indonesia, and is formed here as an invariable noun in apposition.

*Natural History*.—*Cnemaspis andalas* was found to be active during the day time on tree trunks, and associated with crevices in karst formations (karst surface) within primary forests, but apparently does not reside inside the caves. This species has a wide geographic range that extends from Rimbo Panti to the Harau Valley along the Bukit Barisan Mountain Range (Fig. 3). It has been collected at sites ranging from 296–775 m in elevation.

*Cnemaspis dezwaani* Das 2005  
(Fig. 3; Tables 1, 2)

*Holotype (not examined)*.—Male, ZMA 11988, SVL 31.3 mm, Lelewua (spelled as Lelenaea in the past; currently known as “Lauru”), Nias Island, North Sumatra, Indonesia, 360 m (01°13'N, 97°34'E), collected in 1910 by J. P. K. de Zwaan.

*Examined Material*.—Male, MZB 13001, SVL 24.1 mm, Desa Madula, Nias Island, North Sumatra, Indonesia, 58 m (01.23499°N, 97.62046°E), collected on 05 June 2009 by J. A. McGuire and party.

*Diagnosis*.—*Cnemaspis dezwaani* differs from all other South-east Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 31.3 mm; each postmental bounded by four scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales keeled; ventral scales of thigh keeled; 8–12 preloacal pores; 3 or 4 femoral pores on each side; subcaudals keeled, scales on median row enlarged and keeled; 5–7 supralabials; 16–19 lamellae under fourth toe.

*Cnemaspis dezwaani* is most similar to *C. aceh*, but it can be distinguished from this species (characters in parentheses) by having four (six) spine-like tubercles on flank, and dark brown marblings present on either side of the vertebral stripe (no marblings on dorsum).

*Description of Examined Material*.—A subadult male, 24.1 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 32.7% of SVL; head width 50.6% of head length and 16.5% of SVL; snout elongate, its length 67.3% of head width and greater than eye diameter (eye diameter 67.9% of snout length); interorbital region relatively broad; interorbital width 9.4% of head length; eye large, its diameter 23.1% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eyes greater than tympanum–eye length (eye diameter 115% of tympanum–eye length); scales of snout

keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally oriented; two postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by four smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on neck pointed and keeled; four scale rows separating orbit from supralabials at level of pupil; eight supralabials (7th at mid-orbit position), seven infralabials, decreasing in size towards angle of jaw.

Body slender, elongate, axilla-groin length 45.5% of SVL; mid-dorsal granules bluntly pointed, homogeneous, keeled, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales keeled, bluntly pointed, and imbricate; 24 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; preloacal pores indistinct; four femoral pores on each side.

Arms moderately short; length of antebrachium 16.7% of SVL, length of brachium 14.7% of SVL; legs relatively long; length of shank 18.8% of SVL, thigh longer than shank, its length 19.7% of SVL; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium and antebrachium keeled, pointed, and imbricate; scales on ventral surface of thigh bluntly pointed and keeled; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 16 on toe IV; inter-digital webbing absent; relative length of fingers and toes  $4 > 3 > 2 > 5 > 1$ .

Tail complete; tail base swollen; a single, conical, post-cloacal spur present on each side; dorsal scales on tail elongate, pointed and keeled; subcaudal scales at base damaged; distally, subcaudals pointed and keeled; subcaudals on median row enlarged, pointed, and keeled.

*Coloration*.—After 5 yr in preservative, our specimen is light brown dorsally with distinct but irregular longitudinally oriented paravertebral patches, a pale, indistinct vertebral stripe, and limbs with indistinct irregular pale blotches; whitish ventrally.

*Natural History*.—The specimen was collected in the early evening (2130 h) approximately 0.5 m above the ground on the trunk of a rubber tree in disturbed habitat adjacent to a rural village.

*Variation*.—Based on the original description of Das (2005), the holotype has six supralabials, three postnasals bounding the nasal, each postmental is posteriorly bounded by three scales, and a total of 18 or 19 lamellae under fourth toe.

*Cnemaspis minang* sp. nov.  
(Figs. 1–3; Tables 1, 2)

*Holotype*.—Male, MZB 13002, SVL 31.3 mm, along the Solok Valley, near Gua Baba, Indarung, Padang, West Sumatra, Indonesia (0.9°S, 100.4°E), collected on 18 July 2007 by D. Gusman.

*Paratype*.—Male, MZB 13003, SVL 30.4 mm, bears the same data as the holotype.

*Diagnosis*.—*Cnemaspis minang* sp. nov. differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 31.3 mm; each postmental bounded by 3 or 4 scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales smooth; ventral scales of thigh smooth; four preloacal pores; four femoral pores on each side; subcaudals smooth, scales on median row enlarged and smooth; eight supralabials; 18 lamellae under fourth toe.

*Cnemaspis minang* sp. nov. is most similar to *C. tapanuli* sp. nov., but it can be distinguished from this species (characters in parentheses) by having eight supralabials (six) and no vertebral stripe (present).

*Description of Holotype*.—An adult male, 31.3 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 28.4% of SVL; head width 56.2% of head length and 16.0% of SVL; snout elongate, its length 72.0% of head width and greater than eye diameter (eye diameter 66.7% of snout length); interorbital region relatively broad; interorbital width 9.0% of head length; eye large, its diameter 27.0% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eye greater than tympanum-eye length (eye diameter 120% of tympanum-eye length); scales of snout keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally oriented; two postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals posteriorly bordered by four smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on neck pointed and keeled; five scale rows separating orbit from supralabials at level of pupil; nine supralabials (8th at mid-orbit position), seven infralabials, decreasing in size towards angle of jaw.

Body slender, elongate, axilla-groin length 46.0% of SVL; mid-dorsal granules bluntly pointed, heterogeneous, and keeled, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales bluntly pointed, smooth, and imbricate; 20 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed, keeled; four preloacal pores; four femoral pores on each side.

Arms moderately short; length of antebrachium 17.2% of SVL, length of brachium 12.4% of SVL; legs relatively long; length of shank 18.2% of SVL, thigh shorter than shank, its length 16.0% of SVL; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium and antebrachium smooth, rounded, and imbricate; scales on ventral surface of thigh bluntly pointed and smooth; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 18 on toe IV; interdigital webbing absent; relative length of fingers  $4 > 3 > 5 > 2 > 1$ ; those of toes  $4 > 3 > 2 > 1 > 5$ .

Tail complete, regenerated; tail base swollen; a single, conical, post-cloacal spur present on each side; dorsal scales on tail elongate, pointed and keeled; tail segmented with three whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by 1–5 small scales; each whorl separated from its neighbor by five scale rows; subcaudal scales at base smooth; distally, subcaudals bluntly pointed and smooth; subcaudals on median row of the original tail enlarged, bluntly pointed, and smooth.

*Coloration.*—After 7 yr in preservative, the holotype is dark brown dorsally with an indistinct and irregular pale blotches, limbs with pale irregular stripes; white ventrally.

*Variation of Paratype.*—The paratype differs from the holotype by having seven supralabials, each postmental posteriorly bordered by three scales including medial scale. Otherwise both specimens are identical in every aspect.

*Etymology.*—The specific epithet refers to the area that Minangkabau people inhabit (the highlands of West Sumatra) and is formed here as an invariable noun in apposition. Minang is an abbreviation commonly used for this indigenous group as well. The name “Minangkabau” is derived from “Minang” (victorious) and “kabau” (buffalo) in reference to the legend that the people shrewdly won the rights to their land from a powerful neighboring prince by way of a buffalo fight. Traditional houses in the Minangkabau region have their roofs in the shape of buffalo horns.

*Natural History.*—This species occurs in primary rain forests of West Sumatra, where it has been found in crevices on tree trunks along the banks of the Tarusan River.

*Cnemaspis modiglianii* Das 2005  
(Figs. 3, 4B; Tables 1, 2)

*Holotype (not examined).*—Male, MSNG 31289.8, SVL 32.0 mm, Malacomni (note: currently known as “Malakoni”), Enggano Island, Bengkulu Province, Sumatra, Indonesia, (05°24'S, 102°16'E), collected in 1891 by E. Modigliani.

*Examined Material.*—MZB 4595–4616: male, 31.7 mm SVL; male, 29.2 mm SVL; male, 29.5 mm SVL; female, 32.3 mm SVL; male, 30.3 mm SVL; male, 30.8 mm SVL; female, 27.6 mm SVL; female, 32.3 mm SVL; female, 31.1 mm SVL; male, 31.7 mm SVL; male, 30.6 mm SVL; female, 31.0 mm SVL; male, 29.4 mm SVL; male, 28.4 mm SVL; female, 31.1 mm SVL; female, 31.6 mm SVL; female, 28.9 mm SVL; male, 30.3 mm SVL; male, 29.8 mm SVL; near Malakoni Village, Enggano Island, Bengkulu Province, Sumatra, Indonesia, 1 m (05.35290°S, 102.27742°E) collected on 9–15 May 2003 by J. A. McGuire and party.

*Diagnosis.*—*Cnemaspis modiglianii* differs from all other South-east Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 33.6 mm; each postmental bounded by 3–5 scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales keeled; ventral scales of thigh strongly keeled; 2–4 precloacal pores; 4 or 5 femoral pores on each side; subcaudals keeled, scales on median row enlarged, keeled; 6 or 7 supralabials; 16–18 lamellae under fourth toe.

*Cnemaspis modiglianii* is most similar to *C. whittorum*, but it can be distinguished from this species (characters in parentheses) by having 4 or 5 (6) femoral pores (on each side) in males. *Cnemaspis modiglianii* is also similar to *Cnemaspis pagai* sp. nov., but it can be distinguished from this species (characters in parentheses) by having 4 or 5 (3) femoral pores (on each side) in males, and 16–18 (20) lamellae under fourth toe.

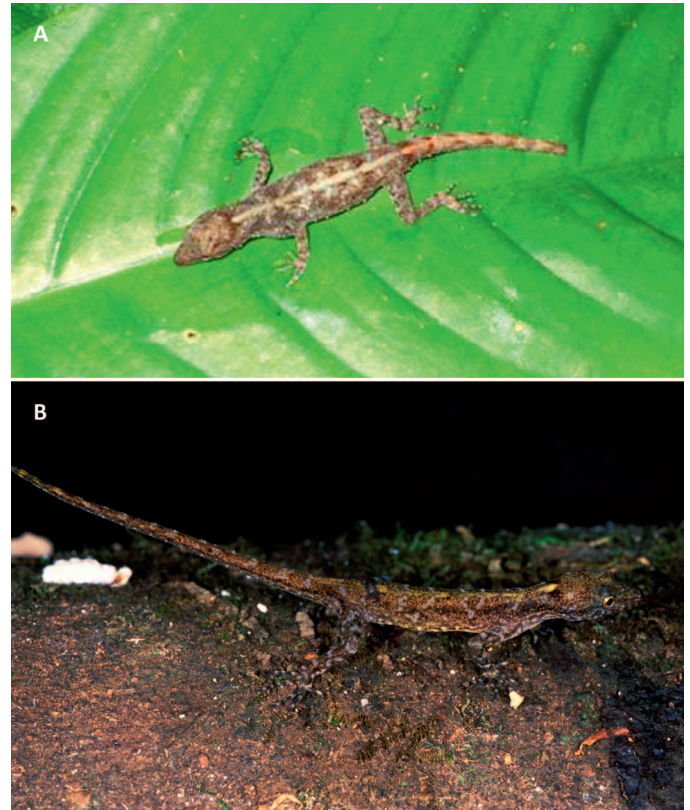


FIG. 4. (A) Adult female holotype of *Cnemaspis aceh* sp. nov. in life. (B) Adult female (MVZ 239561) of *C. modiglianii* in life from Malakoni Village, Enggano Island.

*Description of Examined Material.*—Characters of MZB 4595 male, followed when appropriate by those of examined material in parentheses. An adult male, 31.7 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 30.1% of SVL; head width 53.0% of head length and 15.9% of SVL, snout elongate, its length 62.2% of head width and greater than eye diameter (eye diameter 78.3% of snout length); interorbital region relatively broad; interorbital width 10.3% of head length; eye large, its diameter 25.8% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eye greater than tympanum–eye length (eye diameter 111.9% of tympanum–eye length); scales of snout keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by a medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally orientated; three (2 or 3) postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by three (3–5) smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on the neck keeled; four (4–6) scale rows separating orbit from supralabials at level of pupil; eight (7 or 8) supralabials, 6th at mid-orbit position (6th or 7th), six (6 or 7) infralabials, decreasing in size towards gape.





FIG. 5. (A) Adult male holotype of *Cnemaspis pagai* sp. nov. in life. (B) Adult male (MVZ 269631) of *Cnemaspis whittenorum* in life from Pokhai Village, Siberut Island.

Body slender, elongate, axilla–groin length 43.0% of SVL; mid-dorsal granules bluntly pointed, homogeneous, keeled, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales keeled, bluntly pointed, and imbricate; 24 (24–26) ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; four (2–4) precloacal pores; five (4 or 5) femoral pores in each side.

Arms moderately short; length of antebrachium 14.6% of SVL, length of brachium 11.7% of SVL; legs relatively long; length of shank 18.0% of SVL, thigh shorter than shank, its length 16.1% of SVL; dorsal scales on both fore- and hind limbs pointed, keeled; ventral scales on brachium smooth and rounded, on antebrachium keeled, bluntly pointed, and imbricate; scales on ventral surface of thigh pointed and strongly keeled; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 18 (16–18) on toe IV; interdigital webbing absent; relative length of fingers and toes  $4 > 3 > 5 > 2 > 1$ .

Tail complete; tail base swollen, a single conical post-cloacal spur present on each side; dorsal scales on tail shortened, pointed, and keeled; tail segmented with ten whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by 1–6 small scales; each whorl separated from its neighbor by 6–8 scale rows; subcaudal scale at base smooth; distally, subcaudals pointed and keeled; subcaudals on median row enlarged, pointed, and keeled.

**Coloration.**—After 11 yr in preservative, our specimens are dark brown dorsally with distinct irregular “M” shaped markings mid-vertebrally, the M-shaped markings intercon-

nected with a distinct continuous pale vertebral stripe, limbs with indistinct irregular pale stripes; venter whitish.

**Variation.**—Based on the original description of Das (2005), the holotype has two (five, in its diagnosis) postnasals bounding the nasals and each postmental bounded posteriorly by five (three, in its diagnosis) scales.

**Natural History.**—Unknown.

*Cnemaspis pagai* sp. nov.  
(Figs 1–3, 5A; Tables 1, 2)

**Holotype.**—Male, MZB 13004, SVL 31.9 mm, Bulasat Village, Pagai Selatan Island, West Sumatra, Indonesia, 34 m (03.07941°S, 100.29394°E), collected on 2 July 2009 by J. A. McGuire and party.

**Diagnosis.**—*Cnemaspis pagai* sp. nov. differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 31.9 mm; each postmental bounded by three scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales keeled; ventral scales of thigh strongly keeled; two precloacal pores; three femoral pores on each side; subcaudals keeled, scales on median row enlarged and keeled; seven supralabials; 20 lamellae under fourth toe.

*Cnemaspis pagai* sp. nov. is most similar to *C. modiglianii*, but it can be distinguished from this species (characters in parentheses) by having three (4 or 5) femoral pores (on each side) in males, and 20 (16–18) lamellae under the fourth toe.

**Description of Holotype.**—An adult male, 31.9 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 28.8% of SVL; head width 55.4% of head length and 16.0% of SVL, snout elongate, its length 70.6% of head width and greater than eye diameter (eye diameter 66.7% of snout length); interorbital region relatively broad; interorbital width 7.6% of head length; eye large, its diameter 26.1% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eye greater than tympanum–eye length (eye diameter 126.3% of tympanum–eye length); scales of snout keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally oriented; three postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals posteriorly bordered by three smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on the neck pointed and keeled; four scale rows separating orbit from supralabials at level of pupil; eight supralabials (7th at mid-orbit position), seven infralabials, decreasing in size towards angle of jaw.

Body slender, elongate, axilla–groin length 48.3% of SVL; mid-dorsal granules keeled, homogeneous, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales bluntly pointed, keeled, and imbricate; 20 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; two precloacal pores; three femoral pores on each side.

Arms moderately short; length of antebrachium 16.0% of SVL, length of brachium 12.0% of SVL; legs relatively long; length of shank 20.7% of SVL, thigh shorter than shank, its length 18.8% of SVL; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium and antebrachium rounded and smooth; scales on ventral surface of thigh pointed and strongly keeled; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 20 on toe IV; interdigital webbing absent; relative length of fingers  $4 > 3 > 5 > 2 > 1$ ; those of toes  $4 > 3 > 2 > 1 > 5$ .

Tail broken (intact portion 21.0 mm); tail base swollen, a single conical post-cloacal spur present on each side; dorsal scales on tail elongate, pointed, and keeled; tail segmented with 10 whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by three or less small scales; each whorl separated from its neighbor by 6–15 scale rows; subcaudal scales at base smooth; distally, subcaudals pointed and keeled; subcaudals on median row enlarged, pointed, and keeled.

*Coloration*.—After 5 yr in preservative, the holotype is dark brown dorsally with indistinct and irregular pale dorsal markings, limbs with pale irregular patches, tail with nine irregular pale cross bars.

*Etymology*.—The specific epithet refers to the island in the Mentawai Archipelago of Western Sumatra Province that is inhabited by this species. The specific epithet is formed here as an invariable noun in apposition.

*Natural History*.—Unknown.

*Cnemaspis tapanuli* sp. nov.

(Figs. 1, 2, 3; Tables 1, 2)

*Holotype*.—Male, MZB 2240, SVL 31.7 mm, Bohorok, Bukit Lawang Forest, Tapanuli Utara, North Sumatra, Indonesia, 85–413 m (3°31'N, 98°08'E) collected on 18 June 1975 by H. K. Voris.

*Paratype*.—Female, MZB 2241, SVL 32.1 mm, bears the same data as the holotype.

*Diagnosis*.—*Cnemaspis tapanuli* sp. nov. differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 32.1 mm; each postmental bounded by three scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales slightly keeled; pectoral scales keeled and abdominal scales smooth; ventral scales of thigh smooth; four precloacal pores; 4 or 5 femoral pores on each side; subcaudals smooth, scales on median row enlarged and smooth; six supralabials; 18 lamellae under fourth toe.

*Cnemaspis tapanuli* sp. nov. is most similar to *C. minang*, but it can be distinguished from this species (characters in parentheses) by having subcaudals smooth (keeled) and a pale vertebral stripe (no vertebral stripe).

*Description of Holotype*.—An adult male, 31.7 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 28.9% of SVL; head width 54.5% of head length and 15.8% of SVL; snout elongate, its length 71.4% of head width and greater than eye diameter (eye diameter 66.7% of snout length); interorbital region relatively broad; interorbital width 10.6% of head length; eye large, its diameter 28.6% of head length; pupil rounded; ear-opening deep, oval, and taller than wide; diameter of eye greater than tympanum–eye length (eye diameter 133.3% of tympanum–eye length); scales of snout keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by a medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two

nasals, two subcircular supranasals and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally oriented; two postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by three smooth scales, including medial scale; scales on throat rounded and slightly keeled; bluntly pointed scales on side of neck, similar in size to those at mid-dorsum; scales on the neck smooth and rounded; four scale rows separating orbit from supralabials at level of pupil; eight supralabials (6th at mid-orbit position), six infralabials, decreasing in size toward angle of jaw.

Body slender, elongate, axilla–groin length 44.3% of SVL; mid-dorsal granules bluntly pointed, homogeneous, keeled, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales bluntly pointed, keeled, and imbricate; abdominal scales bluntly pointed, smooth, and imbricate; 24 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; four precloacal pores, and four (right) or five (right) femoral pores on each side.

Arms moderately short; length of antebrachium 15.0% of SVL, length of brachium 12.6% of SVL; legs relatively long; length of shank 15.8% of SVL, thigh longer than shank, its length 19.8% of SVL; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium and antebrachium smooth, bluntly pointed, and imbricate; scales on ventral surface of thigh pointed and smooth; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 18 on toe IV; interdigital webbing absent; relative length of fingers  $4 > 3 > 5 > 2 > 1$ ; those of toes  $4 > 3 > 2 > 1 > 5$ .

Tail complete; tail base swollen; a single, conical, post-cloacal spur present on each side; dorsal scales on tail elongate, pointed, and keeled; tail segmented with 16 whorls of tubercles, each whorl consisting of six conical, enlarged, keeled tubercles separated from one another by 1–5 small scales; each whorl separated from its neighbor by seven scale rows; subcaudal scales at base smooth; distally, subcaudals bluntly pointed and smooth; subcaudals on median row enlarged, bluntly pointed, and smooth.

*Coloration*.—After 40 yr in preservative, the holotype is dark brown dorsally with an indistinct and irregular pale vertebral stripe, limbs with indistinct pale irregular patches; dark ventrally (but this may be an artifact of preservation).

*Variation of Paratype*.—The paratype is identical in every aspect with the holotype, taking into account that it is a female.

*Etymology*.—The specific epithet refers to the northern Sumatra, also known as Tapanuli, signifying a beautiful beach (*tapan nan uli*) or coastal area (of Toba Lake), formed here as an invariable noun in apposition.

*Natural History*.—This species is most frequently found on tree buttresses or among leaf litter between tree buttresses during daytime. Several specimens were observed between ground level and 1 m in height.

*Cnemaspis whittenorum* Das 2005

(Figs. 3, 5B; Tables 1, 2)

*Holotype*.—Female, BMNH 1979.225, 31.5 mm SVL, Siberut Island, West Sumatra, Indonesia (01°21'S, 98°59'E) collected on 25 August 1977 by A. J. Whitten and J. Whitten.

*Other Examined Material.*—Male, MVZ 269631, 32.0 mm SVL, Pokhai Village, Siberut Island, West Sumatra, Indonesia, 9 m (01°12'021"S, 98°9'3813"E) collected on 10 June 2009 by J. A. McGuire and party.

*Diagnosis.*—*Cnemaspis whittendorum* differs from all other Southeast Asian diminutive *Cnemaspis* in having the unique combination of a maximum SVL of 32.0 mm; each postmental bounded by four scales; dorsal scales keeled; four spine-like tubercles on flank; gular scales keeled; pectoral scales and abdominal scales keeled; ventral scales of thigh slightly keeled; four precloacal pores; six femoral pores on each side; subcaudals keeled, scales on median row enlarged, keeled; 5 or 6 supralabials; 18 lamellae under fourth toe.

*Cnemaspis whittendorum* is most similar to *C. modiglianii*, but it can be distinguished from this species (characters in parentheses) by having 6 (4 or 5) femoral pores (on each side) in males. *Cnemaspis whittendorum* is also similar to *Cnemaspis jacobsoni*, but it can be distinguished from this species (characters in parentheses) by having precloacal and femoral pores (lacking) in males and 18 (14) lamellae under fourth toe.

*Description of Other Examined Material.*—Characters of MVZ 269631, an adult male, 32.0 mm SVL; head moderately large, elongate, narrow, distinct from neck, its length 27.4% of SVL; head width 58.4% of head length and 16.0% of SVL; snout elongate, its length 73.2% of head width and greater than eye diameter (eye diameter 64.8% of snout length); interorbital region relatively broad; interorbital width 10.5% of head length; eye large, its diameter 27.0% of head length; pupil rounded; ear-opening deep, oval, taller than wide; diameter of eyes greater than tympanum–eye length (eye diameter 126.3% of tympanum–eye length); scales of snout keeled, larger than those of occipital region; scales on interorbital and occipital regions granular; rostral scale concave, partially divided by medial groove, postero-ventrally in contact with first supralabial, contacted posteriorly by two nasals, two subcircular supranasals, and an internasal; nasals separated by two enlarged supranasals and a single internasal scale; nostrils oval, dorsally orientated; two postnasals, the lower one in broad contact with first supralabial; nasals in narrow contact with first supralabial.

Mental subtriangular, truncate posteriorly to the level of first infralabial, wider than long, postero-laterally in contact with two enlarged postmentals; postmentals medially separated by single postmental scale; postmentals bordered posteriorly by four smooth scales, including medial scale; scales on throat rounded and keeled; bluntly pointed scales at side of neck, similar in size to those at mid-dorsum; scales on the neck pointed and keeled; five scale rows separating orbit from supralabials at level of pupil; eight supralabials (6th at mid-orbit position), six infralabials, decreasing in size towards gape.

Body slender, elongate, axilla–groin length 43.2% of SVL; mid-dorsal granules bluntly pointed, homogeneous, keeled, intermixed with keeled, enlarged tubercles; four spine-like tubercles on flank; dorsal scales at midbody smaller than ventrals at same level; pectoral scales and abdominal scales bluntly pointed, keeled, and imbricate; 20 ventral scales across midbody; ventro-lateral scales on trunk bluntly pointed and keeled; four precloacal pores; six femoral pores on each side.

Arms moderately short, length of antebrachium 16.2% of SVL, length of brachium 12.8% of SVL; legs relatively long; length of thigh and shank 18.7% of SVL and equal in size; dorsal scales on both fore- and hind limbs pointed and keeled; ventral scales on brachium rounded and smooth, those on antebrachium pointed and keeled; scales on ventral surface of thigh

pointed and slightly keeled; digits elongate, slender, all bearing slightly recurved claws; subdigital lamellae entire, 18 on toe IV; interdigital webbing absent; relative length of fingers and toes  $4 > 3 > 5 > 2 > 1$ .

Tail is complete, regenerated; a single, conical, post-cloacal spur present on each side; dorsal scales on tail elongate, pointed, and keeled; subcaudal scales at base smooth; distally subcaudals pointed and keeled; subcaudals on median row enlarged, pointed, and keeled.

*Coloration.*—Dark brown dorsally with indistinct irregular pale dorsal spots. Bright whitish markings present on neck, originating from the irregular vertebral stripe, with three bright patches overlaying the stripe; limbs with indistinct irregular pale spots; tail light brown; venter whitish. After 5 yr in preservative, our specimen remains dark brown dorsally, and the pale spots on the dorsum, pale marking on the neck, and pale spots on the limbs are still visible.

*Variation.*—Based on our examination, the holotype has the mental bordered by six (right side) and five (left side) postmentals. The original description of Das (2005) noted five scales in the description but four scales in the diagnosis and key to the species. There are three postnasals bounding the nasal in the holotype, although the original description mentioned two postnasals and the key mentioned five postnasals.

*Natural History.*—Unknown.

#### DISCUSSION

In this paper, we contribute to the developing understanding of *Cnemaspis* diversity on Sumatra and its associated islands by describing five new species. Notably, Sumatra and the islands off of its western coast (including but not limited to the Mentawai Islands, Enggano, Nias, Simeulue, and the Banyak islands) are mostly inhabited by tiny *Cnemaspis* species of the *C. kandiana* group. Until recently, all of these populations were considered to be conspecific with *C. kandiana* from Sri Lanka, the Indian Subcontinent, and surrounding islands including Andaman and Nicobar, and on islands on the adjacent northwestern coasts of Thailand (Stoliczka, 1873; Annandale, 1905; Bauer et al., 2007; Manamendra-Arachchi et al., 2007).

The *C. kandiana* group in Sumatra actually represents at least nine species including the four species described by Das (2005)—one each from Enggano, Siberut, Nias, and Simeulue islands—and five additional species described herein from mainland Sumatra and the Mentawai Archipelago. We note that the *C. kandiana* group geckos reported from Bangkaru in the Banyak Islands by Tapley and Muurmans (2011) cannot be identified based on geography alone as they are equidistant from the islands of Simeulue and Nias and could furthermore represent a mainland species. The *C. kandiana* group has no known representatives on Peninsular Malaysia or other larger Sundaic Islands. This large disjunction in the geographic ranges of the members of the *C. kandiana* group suggests the possibility that this assemblage originated on Sumatra and its associated islands by independent overwater dispersal. The route of entry could include India, Sri Lanka, or the Andaman and Nicobar island chains.

Given that *Cnemaspis* is rarely encountered on Sumatra, and the limited available material representing four of the species, many more species likely will be discovered on this large island. The genus *Cnemaspis* is well known for its tendency to explore various habitats, with some species frequenting caves and others foraging in leaf litter or on tree trunks. Many species

occur in the lowlands, but some are restricted to highlands or montane areas. Species occur in a diversity of disturbance regimes ranging from secondary forest to primary forest habitats. These capabilities have allowed the genus to flourish in tropical Asia and Africa. Though our observations involve only a small number of specimens, many species appear to have distinct life history strategies, suggesting that we can expect to find many more *C. kandiana* group species exploring different habitats on the megadiverse island of Sumatra.

KEY TO DIMINUTIVE *CNEMASPIS* (*C. KANDIANA* GROUP) IN  
SOUTHEAST ASIA

1. Abdominal scales smooth ..... 2
- 1'. Abdominal scales keeled ..... 5
2. Pectoral scales smooth ..... 3
- 2'. Pectoral scales keeled ..... 4
3. Supralabials 6 or 7, six spine-like tubercles on flank, pale vertebral stripe present, and six preloacal pores in males ..... *C. andalas* sp. nov.
- 3'. Supralabials 8, four spine-like tubercles on flank, pale vertebral stripe absent, and four preloacal pores in males ..... *C. minang* sp. nov.
4. Median subcaudal row not enlarged, pale vertebral stripe absent, and males lack preloacal and femoral pores ..... *C. phuketensis*
- 4'. Median subcaudal row enlarged, pale vertebral stripe present, and males have preloacal and femoral pores ..... *C. tapanuli* sp. nov.
5. Scales on the ventral surface of thigh keeled, six spine-like tubercles on flank ..... 6
- 5'. Scales on the ventral surface of smooth, four spine-like tubercles on flank, and pale vertebral stripe present ..... *C. aceh* sp. nov.
6. 16–20 subdigital lamellae under fourth toe, males have preloacal and femoral pores ..... 7
- 6'. 14 subdigital lamellae under fourth toe, and pale vertebral stripe present ..... *C. jacobsoni*
7. Pale vertebral stripe present ..... 8
- 7'. Pale vertebral stripe absent ..... 9
8. Males have 8–12 preloacal pores and 3 or 4 femoral pores on each side ..... *C. dezwaani*
- 8'. Males have 4 preloacal pores and 6 femoral pores on each side ..... *C. whittendorum*
9. 20 lamellae under fourth toe, males have three femoral pores on each side. .... *C. pagai* sp. nov.
- 9'. 16–18 lamellae under fourth toe, males have four to five femoral pores each side. .... *C. modiglianii*

*Acknowledgments.*—Fieldwork by DTI and colleagues in the provinces of West Sumatra, Bengkulu, North Sumatra, Aceh, and West Kalimantan was performed under local permits issued by Natural Resources Conservation Agency in Indonesia (BKSDA). Research permits in support of expeditions involving multinational participants were granted to JAM by Indonesian Institute of Sciences (LIPI) LIPI (2002) and Ministry of Research and Technology (RISTEK) (RISTEK; 2008, 2009) to explore Bengkulu and Enggano islands and to sample across the whole length of Sumatra and the Mentawai and adjacent islands. We thank the Ministry of Research and Technology of the Republic of Indonesia, RISTEK, for coordinating and granting research permissions to JAM and AATA. In particular, we thank S. Wahyono and L. Shalahuddin for their help throughout the permitting process. We thank past and present representatives of LIPI at the Museum Zoologicum Bogoriense for facilitating

in-house study of specimens and for export and field research permits; R. Ubaidillah, Boeady, M. Amir, A. Hamidy, I. Sidik, R. M. Marwoto, A. Riyanto, Syaripudin, and W. Trilaksono (MZB) kindly provided laboratory assistance. This work would not be possible without the cooperation of H. K. Voris, R. F. Inger, K. Kelly, and A. Resetar, who provided the opportunity to study specimens under their care at the FMNH. P. D. Campbell and I. Neich kindly sent and borrowed the holotype of *C. whittendorum* from BMNH to MNHN. L. L. Grismer provided his insight and spent his valuable time reviewing and improving the manuscript. I. Das made available his personal notes associated with the type of *C. whittendorum*. We acknowledge the two anonymous reviewers who were willing to provide us with constructive suggestions to increase the value of this work. Our sincere thanks to M. Kamsi for providing the specimens from Aceh, North Sumatra, and West Sumatra and to D. Gusman who kindly made available all of the specimens he collected in West Sumatra for this work. The photo of *C. aceh* (Fig. 4A) was provided by M. Kamsi. Finally, we acknowledge S. Lawalata, D. Gusman, U. Arifin, M. Kamsi, A. Riyanto, Mulyadi, and D. I. Roesma for field and technical assistance. AATA thanks N. K. Amarasinghe, J. Supriatna, and the staff of the Research Center for Climate Change of the University of Indonesia (RCCC-UI) for their support.

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Accepted: 13 May 2016.  
Published online: 12 January 2017.

#### APPENDIX I. Additional Specimens Examined

*Cnemaspis andersonii* (Annandale, 1905): Andaman Archipelago: ZSI 15012 (holotype).

*Cnemaspis kandiana* (Kelaart, 1852): Sri Lanka: BMNH 53.4.1.1 (lectotype), 80.2.2.119A, 80.2.2.119B; WHT 7267, 7305, 7307, 7308, 7310, 7312–13, 7319, 7322.

*Cnemaspis modiglianii* Das, 2005: Malakoni, Enggano Island, Bengkulu, Sumatra: MZB 4199, 4203, 4205, 4206–4209, 4233, 4247, 4249–4251, 4273, 4276, 4279, 4383, 4386, 4391, 4392, 4394, 4399, 4402.

*Cnemaspis tapanuli* sp. nov.: Bohorok, Bukit Lawang, North Sumatra: MZB 2242–2246; FMNH 209469–209475.

*Cnemaspis whittenorum* Das, 2005: Pokai, Siberut Island, Sumatra: MZB 13005.

*Cnemaspis wicksii* (Stoliczka, 1873): Andaman Archipelago: ZSI 5868 (lectotype), 5866, 5867.