



A revision and redescription of the rock gecko *Cnemaspis siamensis* (Taylor 1925) (Squamata: Gekkonidae) from Peninsular Thailand with descriptions of seven new species

L. LEE GRISMER¹, MONTRI SUMONTHA², MICHAEL COTA³, JESSE L. GRISMER⁴,
PERRY L. WOOD, JR.⁴, OLIVIER S. G. PAUWELS⁵ & KIRATI KUNYA⁶

¹Department of Biology, La Sierra University, 4500 Riverwalk Parkway, Riverside, California, 92515-8247 USA.

E-mail: lgrismer@lasierra.edu

²Ranong Marine Fisheries Station, 157 M. 1, Saphan-Pla Road, Paknam, Muang, Ranong 85000, THAILAND.

E-mail: knot_sumontha@yahoo.com

³Thailand Natural History Museum, National Science Museum, Technopolis, Khlong 5, Khlong Luang, Pathum Thani 12120, THAILAND. E-mail: herpetologe@gmail.com

⁴Department of Biology, Villanova University, 800 Lancaster Avenue, Villanova, Pennsylvania 19108 USA.

E-mail: jesse.grismer@villanova.edu; perry.wood@villanova.edu

⁵Département des Vertébrés Récents, Institut Royal des Sciences naturelles de Belgique, 29 rue Vautier, 1000 Brussels, BELGIUM.

E-mail: osgpauwels@yahoo.fr

⁶Nakhonratchasima Zoo, ZPO, 111 M. 1, Nakhonratchasima-Pak Thongchai Road, Chaimongkol, Muang, Nakhonratchasima 30000, THAILAND. E-mail: kkunya@yahoo.com

Table of contents

Abstract	2
Introduction	2
Material and methods	3
Systematics	6
<i>Cnemaspis siamensis</i> Smith	6
<i>Cnemaspis chanardi</i> sp. nov.	16
<i>Cnemaspis vandeventeri</i> sp. nov.	24
<i>Cnemaspis kamolnorranathi</i> sp. nov.	29
<i>Cnemaspis huaseesom</i> sp. nov.	33
<i>Cnemaspis punctatonuchalis</i> sp. nov.	38
<i>Cnemaspis narathiwatensis</i> sp. nov.	42
<i>Cnemaspis niyomwanae</i> sp. nov.	46
Discussion	50
Acknowledgements	52
References	53
Appendix	54

Abstract

A taxonomic revision of *Cnemaspis siamensis* (Smith 1925) revealed it to be a complex composed of four species: *C. siamensis* (Smith 1925) which occurs on Ko Tao Island, Surat Thani Province and on the peninsula ranges from Khao Mod, Surat Thani Province in the south, northward east of the Tenasserim Mountains to Kaeng Krachan National Park, Phetchaburi Province; *C. chanardi* **sp. nov.** ranging from Tai Rom Yen National Park, Surat Thani Province in the north, southward through the western foothills of the Nakhon Si Thammarat and Sankalakhiri Mountains to Phuphaphet Cave, Satun Province and westward to Khlong Thom District, Krabi Province; *C. vandeventeri* **sp. nov.** ranging from Kapur District, Ranong Province southward to at least Khlong Had Sompen, District, Ranong Province west of the Tenasserim and Phuket Mountains and possibly all the way to Phuket Island; and *C. kamolnorranathi* **sp. nov.** restricted to the northwestern section of the Isthmus of Kra, ranging from Tham Khao Sonk, Thachana District, Surat Thani Province southward to Tai Rom Yen National Park, Surat Thani Province. These species are easily separated from one another on the basis of their unique combination of having or lacking precloacal pores, dark gular markings, a series of lightly colored bars on the flanks, and a lightly colored, prescapular crescent as well as other aspects of squamation. Four additional new species from western and southern Thailand are also described: *C. huaseesom* **sp. nov.** from Sai Yok National Park, Kanchanaburi Province; *C. punctatonuchalis* **sp. nov.** from Thap Sakae District, Prachuap Khiri Khan Province; *C. narathiwatensis* **sp. nov.** ranging from Waeng District, Narathiwat Province south to Bang Lang, Yala Province; and *C. niyomwanae* **sp. nov.** from Thum Khao Ting, Palean District, Trang Province, Thailand. These species are differentiated from each other and all other *Cnemaspis* on the basis of their unique combinations of color pattern and squamation characters. This brings the total number of species of *Cnemaspis* in Thailand from five to 12 and continues to illustrate that the unrealized diversity in this group is a function of unfocused collecting efforts coupled with poor taxonomy.

Key words: Squamata, Gekkonidae, *Cnemaspis*, Thailand, new species

Introduction

The monophyletic Southeast Asian genus *Cnemaspis* (*sensu* Bauer *et al.*, 2007 and whose use is restricted here to exclude African and *kandiana* group taxa of South Asia and the western Malay Peninsula and Mentawi Archipelago) contains 31 species of rock geckos that collectively range from Laos, southern Vietnam, Cambodia, and Thailand, southward through the Malay Peninsula to Borneo and their adjacent archipelagos (Chan *et al.*, 2010; Grismer, 2010; Grismer & Chan *et al.*, 2010; Grismer *et al.*, 2010a,b). *Cnemaspis* are usually relatively small, cryptically colored species inhabiting primary and old secondary rainforests. They are inherently difficult to find and to collect, being that they are agile, secretive, microhabitat specialists that generally restrict their movements to the shaded surfaces of rocks, trees and caves during the day, or are nocturnal. Their restrictive body plan of having a broad, flattened head; large, somewhat forward and upwardly directed eyes; a flattened body; and long, widely splayed limbs bearing long, inflected digits are adaptations for climbing on flat surfaces in all planes or orientations and show extreme conservatism across all species. This combination of cryptic behavior, microhabitat specialization, and morphological conservatism has often made it difficult to delimit species boundaries and has generated considerable taxonomic confusion within the group as a whole (see Bauer & Das, 1998; Chan & Grismer, 2008; Das & Bauer 1998; Dring, 1979; Grismer *et al.*, 2008a,b, 2009). In the past, this confluence of circumstances meant that many species simply went unnoticed, unrecognized, or existed as synonyms of previously described species. Researchers now, however, have a better understanding of how and where to look for *Cnemaspis* and what characters to use to differentiate the various lineages from one another. Furthermore, access into previously unexplored territories and unique landscapes has greatly increased the rate at which new species are being discovered (J. Grismer *et al.*, 2010; Grismer, 2010; Grismer & Chan, 2008, 2009; Chan *et al.* 2010; Grismer & Ngo, 2007; Grismer *et al.*, 2008a,b, 2009; Grismer *et al.*, 2010b).

The highest diversity of *Cnemaspis* occurs in the southern one-third of the Malay Peninsula, namely Peninsular Malaysia, where 20 species have been recorded, 14 of which having been described within the last six years (Chan & Grismer, 2008; Chan *et al.*, 2010; Das & Grismer, 2003; Grismer & Chan, 2008; Grismer & Das, 2006; Grismer *et al.*, 2008a,b; Grismer *et al.*, 2009, 2010b). The low diversity of *Cnemaspis* in Borneo

and the Thai portion of the Malay Peninsula (hereinafter referred to as Peninsular Thailand) with respect to Peninsular Malaysia is a collecting artifact (see Grismer & Chan, 2009) coupled with poor taxonomy. To date, there are five species of *Cnemaspis* known from Thailand; *C. chanthaburiensis* Bauer & Das 1998, *C. siamensis* (Smith 1925), *C. kumpoli* Taylor 1963, *C. mcguirei* Grismer, Grismer, Wood, & Chan 2008 and *C. biocellata* Grismer, Chan, Nurolhuda & Sumontha 2008. The latter four occur in Peninsular Thailand and three of these, *C. kumpoli*, *C. mcguirei* and *C. biocellata* also range into northern Peninsular Malaysia (Fig. 1). The low species diversity in Peninsular Thailand (five) stands in stark contrast to the 16 species of geographically contiguous Peninsular Malaysia, underscoring the absence of focused research on this group outside the southern portion of the Malay Peninsula.

Prior to Taylor (1963), all *Cnemaspis* in Thailand were considered to be *C. siamensis* (Smith, 1925, 1930, 1935). This stemmed partly from Smith's (1925) uncharacteristically incomplete description of *C. siamensis* which we will demonstrate below, was composed of at least four separate species that collectively ranged throughout nearly all of southern and eastern Thailand. Taylor (1963) reported additional material of *C. siamensis sensu* Smith (1925) from Khao Chong, Trang Province which we demonstrate below are not *C. siamensis*. This trend of assigning populations of *Cnemaspis* from Peninsular Thailand to *C. siamensis* continued with Manthey and Grossmann (1997) and Cox *et al.* (1998) in considering *C. biocellata* from the Thai-Malaysia border as *C. siamensis* (see Grismer *et al.* 2008a for a discussion of this taxon) and Grismer *et al.*, (2008a:Fig.2) implying in their figure 2 that *C. kamolnorranathi* **sp. nov.** (described herein) from the Isthmus of Kra was *C. siamensis*. Dring (1979) was the first to recognize discrete character state differences in the Thai species of *Cnemaspis*, prompting the description of *C. chanthaburiensis* (Bauer & Das, 1998) from eastern Thailand and *C. flavigaster* Chan & Grismer 2008 from southern Peninsular Malaysia. Dring (1979) was also the first to expressly note discrete character state differences within *C. siamensis* on opposite sides of the Isthmus of Kra and gave the first indications that *C. siamensis* may have been composed of multiple species. Presented here are additional character state and distributional data that not only support this dichotomy north and south of the Isthmus of Kra, but recognize two species north of the Isthmus (*C. siamensis* and one new species), another new species restricted to the Isthmus of Kra, and two other new species south of the Isthmus of Kra—all of which are currently masquerading under the nomen of *C. siamensis* (Grismer *et al.*, 2008a; Smith 1925, 1930, 1935; Taylor 1963; Fig. 1). These new species are described below along with a restricted diagnosis and redescription of *C. siamensis*.

Additionally, we report three newly discovered populations of geckos from Thailand that we assign to the genus *Cnemaspis* on the basis of their members having broad, flattened heads; large, somewhat forward and upwardly directed eyes with round pupils and no eyelids; flattened bodies; long, widely splayed limbs with long, inflected digits; and no femoral pores. The northernmost population is from Sai Yok National Park, Kanchanaburi Province, near the border of the Union of Myanmar (Fig. 1). The remaining populations are from Peninsular Thailand; one from Thap Sakae District, Prachuap Khiri Khan Province and the other from Waeng District, Narathiwat Province and Bang Lang, Bannang Sata District, Yala Province (Fig. 1). All three populations have strikingly unique color pattern and squamation characteristics which separates them from any known species of *Cnemaspis* and are thusly described herein as new.

Material and methods

Color characters were taken from digital images of living specimens cataloged in the La Sierra University Digital Photo Collection (LSUDPC) and in some cases, from living specimens. The following measurements on the type series were taken with Mitutoyo dial calipers to the nearest 0.1 mm under a Nikon SMZ 1500 dissecting microscope on the left side of the body where appropriate: snout-vent length (SVL), taken from the tip of snout to the vent; tail length (TL), taken from the vent to the tip of the tail, original or regenerated; tail width (TW), taken at the base of the tail immediately posterior to the postcloacal swelling; forearm length (FL), taken on the dorsal surface from the posterior margin of the elbow while flexed 90° to the inflection of the flexed wrist; tibia length (TBL), taken on the ventral surface from the posterior surface of the knee while

flexed 90° to the base of the heel; axilla to groin length (AG), taken 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 (HL), the distance from the posterior margin of the retroarticular process of the lower jaw to the tip of the snout; head width (HW), measured at the angle of the jaws; head depth (HD), the maximum height of head from the occiput to the throat; eye diameter (ED), the greatest horizontal diameter of the eye-ball; eye to ear distance (EE), measured from the anterior edge of the ear opening to the posterior edge of the eye-ball; eye to snout distance (ES), measured from anteriormost margin of the eye-ball to the tip of snout; eye to nostril distance (EN), measured from the anterior margin of the eye-ball to the posterior margin of the external nares; inner orbital distance (IO), measured between the anterior edges of the orbit; ear length (EL), the greatest horizontal distance of the ear opening; and internarial distance (IN), measured between the nares across the rostrum. Additional character states evaluated were numbers of supralabial and infralabial scales counted from below the middle of the orbit to the rostral and mental scales, respectively; size and number of postmental scales contacting the metal; the texture of the scales on the anterior margin of the forearm; the number of paravertebral tubercles between limb insertions counted in a straight line immediately left of the vertebral column (where applicable); the presence or absence of a row of enlarged, widely spaced, tubercles along the ventrolateral edge of the body between the limb insertions; the number of subdigital lamellae beneath the fourth toe counted from the base of the first phalanx to the claw; the total number of precloacal pores, their orientation, shape, and degree of separation; the degree and arrangement of body and tail tuberculation; the relative size and morphology of the subcaudal scales, subtibial scales, and submetatarsal scales beneath the first metatarsal; and the number of precloacal tubercles on each side of the tail base. Longitudinal rows of caudal tubercles on the non-regenerated portion of the tail are quite variable between species and useful in differentiating several taxa. Up to five pairs of the following rows may be present in varying combinations: paravertebral row — the dorsal row adjacent to the middorsal, caudal furrow; dorsolateral row — the row between the paravertebral row and the lateral, caudal furrow on the dorsolateral margin of the tail; lateral row — the row immediately below the lateral, caudal furrow; and ventrolateral row — the row below the lateral row on the ventrolateral margin of the tail. When present, this row is usually restricted to the anterior 25% (or less) of the tail. Rarely there may be a row of tubercles within the lateral, caudal furrow. Various color pattern characteristics were also evaluated (TABLE 2).

Much of the information on character states and their distribution in other species of *Cnemaspis* was originally obtained from the literature (e.g. Grismer *et al.* 2008a:TABLE 1 for the latest compilation) and as such, was often subject to inconsistencies between the methods various authors over the last 112 years used to gather data. We have now examined first hand specimens from every species of *Cnemaspis* (except *C. argus*) and scored all character states consistently across all species as outlined above in the Materials and Methods. High resolution photographs (LSUDPC 2276–2282) of the type series of *C. argus* (BM 1974.4910–11) were analyzed to score the appropriate character states according to the outlined protocol. The revised data set is presented here (TABLE 1) and the additional specimens examined are listed in the appendix. Institutional abbreviations follow Leviton *et al.* (1985), except we retain ZRC for USDZ, following conventional usage. DWNP refers to the Department of Wildlife and National Parks collection, Krau, Pahang, Peninsular Malaysia; LSUHC refers to the La Sierra University Herpetological Collection, La Sierra University, Riverside, California, USA; LSUDPC refers to the La Sierra University Digital Photo Collection; HC refers to the Herpetological Collection of the Universiti Kebangsaan Malaysia, Bangi, Selangor; THNHM refers to the Thailand Natural History Museum, National Science Museum, Khlong Luang, Pathum Thani, Bangkok; CUMZ refers to the Chulalongkorn University Museum of Zoology, Bangkok, Thailand; PSUZZC refers to the Prince of Songkhla University Zoological Collection, Songkhla, Thailand; ZMKU refers to the Zoological Museum of the Kasetsart University, Bangkok, Thailand; KZM refers to the Nakhonratchasima Zoo Museum, ZPO, Nakhonratchasima, Thailand; MS refers to the collection of Montri Sumontha at the Ranong Marine Fisheries Station, Paknam, Ranong, Thailand; and UNS refers to the University of Natural Sciences, Ho Chi Minh City, Vietnam.

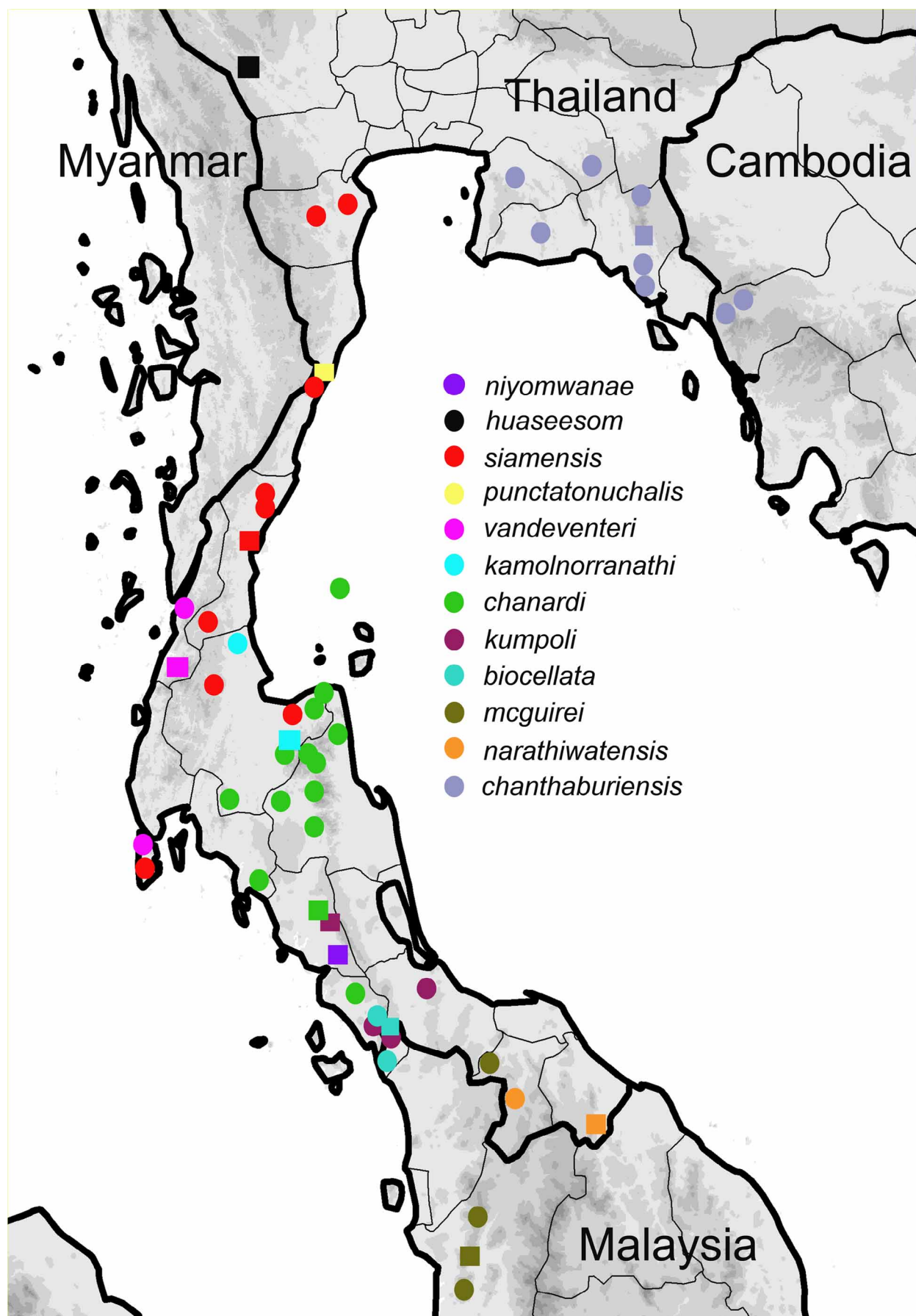


FIGURE 1. Distribution of *Cnemaspis* in Thailand. Squares represent type localities.

Systematics

Cnemaspis siamensis Smith

Siamese Rock Gecko

Djing Djok Niew Yaow Thai

Figure 2

Gonatodes siamensis Smith, M. A., 1925:21. IV.—Contributions to the herpetology of Borneo. Sarawak Museum Journal 8:15–34. Type locality: Maprit, near Patiyu (=Pathio), Peninsular Siam [Thailand].

Gonatodes kendallii Smith, M. A. 1916:151. *non* Boulenger *fide* Taylor, 1963:740.

Gonatodes siamensis Smith, 1930:16.

Cnemaspis siamensis Smith, 1935:71.

Cnemaspis (*Cnemaspis*) *siamensis* Rösler, 2000:63.

Diagnosis. Adult males and females reaching 37.3 mm SVL; eight or nine supralabials; 6–8 infralabials; gular scales smooth; forearm, subtibials, ventrals, subcaudals, and dorsal tubercles keeled; 19–25 paravertebral tubercles; tubercles on flanks not linearly arranged; no ventrolateral caudal tubercles; caudal tubercles do not encircle tail; lateral, caudal tubercles may or may not occur with lateral, caudal furrow; scales of median, subcaudal scale row slightly enlarged and keeled; precloacal pores absent; one or two postcloacal tubercles; shield-like subtibials absent; metatarsal scales may be slightly enlarged; 22–26 subdigital lamellae on fourth toe; dark, longitudinal gular markings present; head not yellow in adult males; no dark shoulder or neck patch enclosing a white to yellow ocellus; no yellow to white, prescapular crescent or lightly colored, transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.

Description. Head oblong in dorsal profile, moderate in size, somewhat narrow, flat, distinct from neck; snout short, slightly concave in lateral profile; postnasal region constricted medially; raised scales of rostrum keeled, larger than similarly shaped scales on occiput; low, supraorbital ridges; shallow frontonasal sulcus; canthus rostralis smoothly rounded; eye large; extra-brillar fringe scales small in general but largest anteriorly; pupil round; ear opening oval, taller than wide; rostral slightly concave dorsally, dorsal 70% divided by longitudinal groove; rostral bordered posteriorly by two supranasals and one smaller azygous internasal, bordered laterally by first supralabials and nostrils; eight or nine slightly raised supralabials of similar size; 6–8 infralabials, decreasing gradually in size posteriorly; nostrils small, round, oriented posterolaterally, bordered posteriorly by small, granular, postnasal scales; mental large, triangular, medially concave, extending to level of second infralabials, bordered posteriorly by two or three (usually three) postmentals; gular scales slightly raised, smooth; throat scales smaller, weakly keeled.

Body slender, elongate; small, weakly keeled, dorsal scales equal in size throughout body, intermixed with numerous, large, multi-keeled, semi-longitudinally arranged tubercles; tubercles extend from top of head to base of tail and are smallest anteriorly; 19–25 paravertebral tubercles; pectoral and abdominal scales slightly raised, subimbricate, keeled; abdominal scales slightly larger than pectoral and dorsal scales; pore-bearing, precloacal scales and precloacal depression absent; forelimbs moderately long, slender; dorsal scales of forelimbs keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, juxtaposed, raised; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched, wide throughout length of digits, bearing a greatly enlarged, projecting scale at digital inflections; interdigital webbing absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales keeled, raised, juxtaposed; ventral scales of thigh smooth to weakly keeled; subtibials keeled, larger than dorsal tibials; plantar scales smooth, slightly raised, juxtaposed; slightly enlarged, submetatarsal scales beneath first metatarsal may be present; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; greatly enlarged, projecting scale at digital inflections; interdigital webbing absent to weak; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 22–26 subdigital lamellae on fourth toe; dorsal caudal scales arranged in segmented whorls; caudal scales flat anteriorly, weakly keeled, juxtaposed; very shallow, middorsal furrow; deep, single, lateral furrow; median row of slightly enlarged, keeled, subcaudal scales with three or four scales per caudal

segment; other subcaudals keeled; paravertebral, dorsolateral, and lateral rows of keeled, caudal tubercles; paravertebral and lateral, caudal tubercles largest, spinose; caudal tubercles do not encircle tail, not present in lateral, caudal furrow; one or two enlarged, postcloacal tubercles on lateral surfaces of hemipenial swellings at base of tail; tail approximately 1.3% times SVL.

Coloration (in life, Fig. 2). Dorsal ground color of head, body, limbs and tail pale gray; top of head bearing numerous small, brown markings with dark lines radiating out from eyes; dark, irregular, postorbital stripe of varying intensities extends onto nape followed by paired, dark brown, offset, paravertebral markings countershaded by larger, lightly colored blotches extending to level of axillae; posterior to axillae markings become elongate and extend to base of tail; dark paravertebral markings on body often connect medially to form short, irregularly shaped bands; flanks bearing small, light brown and cream colored, irregularly shaped, randomly distributed blotches; limbs covered with distinct, light and dark markings, appearing weakly banded; dark bands on digits; original tail distinctly marked with dark brown and cream colored bands; regenerated tail uniform gray; gular region, throat, and anterior portion of pectoral region yellow; gular region in males bearing a dark brown, median stripe or longitudinally arranged spots flanked by longitudinally arranged dark brown spots; gular markings faint in females; ventral surfaces of limbs, remainder of body, and anterior one-half of tail, beige with dark stippling on limbs and lateral edges of belly; posterior one-half of original subcaudal region yellow with cream colored bands. There appears to be no sexual dimorphism with respect to color with the exception of the gular markings.

Distribution. *Cnemaspis siamensis* ranges throughout the lowland, hilly regions east of the Tenasserim and Phuket Mountains from Kaeng Krachan National Park, Phetchaburi Province in the north, southward to Khao Mod, Surat Thani Province on the east coast and at least Kaeng Krung National Park, Surat Thani Province in the west (Fig. 1). We have examined close-up photographs (LSUDPC 5273–78) of an adult male and female (BM 1916.6.22.2–3) from Khlong Banlai, Phuket Island which have longitudinal gular markings and no precloacal pores indicating they are *C. siamensis*.

Natural history. The only natural history observations made on *Cnemaspis siamensis* were that of Pauwels *et al.* (2003) just west of Kaeng Krachan National Park, Phetchaburi Province. They reported finding a dead specimen 1.6 m above the ground beneath a detached piece of bark on the trunk of a tree that had been smashed by passing elephants. During October of 2009, we observed two specimens at the type locality in Pathio, Chumpon Province. One (LSUHC 9474; Fig. 2), a gravid female carrying two eggs, was found in disturbed forest near sea level at the foot of a hill composed of karst outcroppings (Fig. 3) at 2300 hrs. The specimen was 35 m from the nearest karst formation and was running and hopping through the leaf litter on the forest floor beneath a dead tree branch. An adult male (LSUDPC 5241; Fig. 2) was found at 2400 hrs on a forested hillside covered with scattered, small rocks (some of which had been cemented together to form walls) as it was emerging from a crack in a rock wall. Pauwels *et al.* (2000) reported finding what may be *C. siamensis* at Phang-Nga Wildlife Breeding Station beneath a decaying stump in an evergreen forest, but these observations may also apply to *C. vandeventeri* **sp. nov.** (see below). Collectively, these observations suggest that *C. siamensis* is not a saxicolous, microhabitat specialist as are the majority of other species of *Cnemaspis* but is a nocturnal, lowland, scansorial, forest dwelling species that opportunistically utilizes rocky microhabitats when available.

Remarks. Smith's (1925) brief, nearly anecdotal description of *Cnemaspis siamensis* reported it on the Malay Peninsula from Phuket; Tasan and Pak Chan (*C. vandeventeri* **sp. nov.**); Krabi (*C. chanardi* **sp. nov.**); and Khao Seabab (=Khao Sa Bap), Chanthaburi (*C. chanthaburiensis*) in southeastern Thailand. In later treatments, Smith (1930, 1935) provided slightly expanded descriptions of *C. siamensis* but they were still based on multiple species from throughout Thailand and reported on additional material from the mountains of Nakhon Si Thammarat (*C. chanardi* **sp. nov.**). Smith (1925) designated the type locality for *C. siamensis* as "Maprit, near Patiyu" which currently is Pathio, Chumpon Province and lizards from this locality bear the diagnostic character states of lacking precloacal pores; a lightly colored, prescapular crescent; lightly colored, transverse bars on the flanks; and having dark, longitudinal markings on the gular region (Fig. 2). Smith (1925) noted in the series he examined that males had 0–8 precloacal pores which is a clear indication he was examining multiple species. He made no mention of the presence or absence of gular markings, markings on the flanks, or a prescapular crescent.



FIGURE 2. *Cnemaspis siamensis* from Pathio, Chumpon Province. Upper: male LSUHC 9485. Middle: female LSUHC 9474. Lower: ventral view of male LSUHC 9485 (photos by L. Grismer).



FIGURE 3. The urbanized type locality of *Cnemaspis siamensis* in the town of Pathio, Chumpon Province (photo by L. Grismer).

Although Taylor's (1963) description of what he thought was *Cnemaspis siamensis* was far more complete than any of Smith's (1925, 1930, 1935), it was based on a different species, *C. chanardi* sp. nov. from Khao Chong, Trang Province (see below), and thus continued to conflate undescribed taxa with *C. siamensis*. Taylor (1963) did note the prescapular, crescent-shaped markings in his material and expressed surprise that according to Smith (1925, 1930, 1935), some males had precloacal pores and others did not.

Dring (1979) was the first to begin to untangle the cumulative errors of Smith (1925, 1930, 1935) and Taylor (1963) by noting character differences between many of the Thai populations. Although he gave these populations no formal names, he flagged them for subsequent researchers. Referring to specimens from southeastern Thailand as species A, led Bauer & Das (1998) to describe *Cnemaspis chanthaburiensis*. Similarly, he was the first to indicate that populations of *C. siamensis* north of the Isthmus of Kra lacked precloacal pores and had dark, gular markings and those south of the Isthmus did not. This was emphasized in his key to the species of *Cnemaspis* showing that these two populations of *C. siamensis* emerged separately. Similar contributions by Dring (1979) led directly to the descriptions of *C. dringi* (Das & Bauer 1998) from Sarawak, Malaysian Borneo and *C. flavigaster* (Chan & Grismer 2008) from Selangor in southern Peninsular Malaysia.

Material examined. Chumpon Province: Krom Luang District THNHM 0372; Pha To District, Ngao National Park THNHM 1086; Pathio LSUHC 9474, 9485, MCZ 39025; Kapoh Water Fall FMNH 215977. Phetchaburi Province: Muang District THNMH 1441–42, 1448–49. Prachuap Khiri Khan Province :Pa-La-U, Kaeng Krachan National Park, Hua Hin District, Prachuap Khiri Khan THNHM 1336–37; Thap Sakae District THNHM 2000. Surat Thani Province: Kanchanadit District MS16; Kaeng Krung National Park THNHM 1084.

TABLE 1. Diagnostic characters of Southeast Asian species of *Cnemaspis*. New species in bold type. / = character not evaluated.

	<i>affinis</i>	<i>argus</i>	<i>aurantiacopes</i>	<i>baueri</i>
Maximum SVL	48.0	65.2	56.6	64.9
Supralabials	9–13	15	9–11	11–13
Infralabials	8–10	10–12	8–10	10–12
Ventral scales keeled (1) or not (0)	0	1	0	1
No. of precloacal pores	5–6	10	0	0
Precloacal pores continuous (1) or separated (0)	0	1	/	/
Precloacal pores elongate (1) or round (0)	0	0	/	/
No. of paravertebral tubercles	20–28	28–31	23–29	18–27
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	1	0
Tubercles present (1) or absent (0) on flanks	1	1	1	1
Caudal tubercles in lateral furrow (1) or not (0)	0	0	0	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	1	1
Lateral caudal tubercle row present (1) or absent (0)	1	1	1	1
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0
Subcaudals keeled (1) or not (0)	1	1	0	0
Single median row of keeled subcaudals (1) or not (0)	0	0	1	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	1
Enlarged median subcaudal scale row (1) or not (0)	0	0	1	0
No. of postcloacal tubercles	2	3,4	2	2
Enlarged femoral scales present (1) or absent (0)	0	0	0	0
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0
Subtibial scales keeled (1) or not (0)	1	1	1	1
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	1	0
No. of 4th toe lamellae	17–20	37–39	27–30	26–27

continued.

	<i>bayuensis</i>	<i>biocellata</i>	<i>boulengeri</i>	<i>caudanivea</i>
Maximum SVL	46.1	40.1	69.0	47.1
Supralabials	9,10	6–10	8–9	8,9
Infralabials	8,9	5–7	6,7	7,8
Ventral scales keeled (1) or not (0)	1	1	0	0
No. of precloacal pores	5–9	8–12	0	0–3
Precloacal pores continuous (1) or separated (0)	0	1	/	0
Precloacal pores elongate (1) or round (0)	0	0	/	0
No. of paravertebral tubercles	23–30	21–23	32–38	20–27
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	1	0

continued next page

TABLE 1. (continued)

	<i>bayuensis</i>	<i>biocellata</i>	<i>boulengeri</i>	<i>caudanivea</i>
Tubercles present (1) or absent (0) on flanks	1	1	0	weak
Caudal tubercles in lateral furrow (1) or not (0)	0,0	/	/	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	0	0
Lateral caudal tubercle row present (1) or absent (0)	1	1	0	1
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	1	0
Subcaudals keeled (1) or not (0)	1	0	0	0
Single median row of keeled subcaudals (1) or not (0)	0	0	0	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0
Enlarged median subcaudal scale row (1) or not (0)	0	1	1	0
No. of postcloacal tubercles	2	1	1	1,2
Enlarged femoral scales present (1) or absent (0)	0	0	1	0
Shield-like subtibial scales present (1) or absent (0)	0	0	1	1
Subtibial scales keeled (1) or not (0)	1	0	0	0
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	1	1
No. of 4th toe lamellae	27–30	29–37	29–32	23–30

continued.

	<i>chanthaburiensis</i>	<i>dringi</i>	<i>flavigaster</i>	<i>flavolineata</i>
Maximum SVL	42.1	46.4	50.1	46.7
Supralabials	8–10	11	9,10	8–10
Infralabials	7–9	9	8–10	8–10
Ventral scales keeled (1) or not (0)	0	1	0	1
No. of precloacal pores	7–9	5,6	7,8	7
Precloacal pores continuous (1) or separated (0)	1	0	1	1
Precloacal pores elongate (1) or round (0)	0	0	0	0
No. of paravertebral tubercles	23–25	25–27	21–24	22–24
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	0
Tubercles present (1) or absent (0) on flanks	1	0	1	1
Caudal tubercles in lateral furrow (1) or not (0)	1	0	0	1
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	0	0
Lateral caudal tubercle row present (1) or absent (0)	1	1	1	1
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0
Subcaudals keeled (1) or not (0)	0	1	0	1
Single median row of keeled subcaudals (1) or not (0)	0	1	0	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	1
Enlarged median subcaudal scale row (1) or not (0)	0	1	0	0
No. of postcloacal tubercles	1–3	2	1,2	2,3

continued next page

TABLE 1. (continued)

	<i>chanthaburiensis</i>	<i>dringi</i>	<i>flavigaster</i>	<i>flavolineata</i>
Enlarged femoral scales present (1) or absent (0)	0	0	0	0
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0
Subtibial scales keeled (1) or not (0)	0	1	1	1
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	1	0
No. of 4th toe lamellae	25–29	32–35	29–34	23–26

continued.

	<i>harimau</i>	<i>karsticola</i>	<i>kendallii</i>	<i>kumpoli</i>	<i>limi</i>
Maximum SVL	40.7	48.1	58.0	63.0	88.2
Supralabials	9,10	7,8	10–12	7,8	8–11
Infralabials	9,10	6,7	7–9	6,8	7–9
Ventral scales keeled (1) or not (0)	1	1	1	0	1
No. of precloacal pores	0	7,8	0	7,8	0
Precloacal pores continuous (1) or separated (0)	/	1	/	0	/
Precloacal pores elongate (1) or round (0)	/	0	/	0	/
No. of paravertebral tubercles	18–20	17–19	20–26	29–35	25–33
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	0	0
Tubercles present (1) or absent (0) on flanks	1	1	weak	1	1
Caudal tubercles in lateral furrow (1) or not (0)	0	0	0	0	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	1	0	0
Lateral caudal tubercle row present (1) or absent (0)	1	1	1	0	1
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0	0
Subcaudals keeled (1) or not (0)	1	1	1	0	0
Single median row of keeled subcaudals (1) or not (0)	0	0	1	0	0
Caudal tubercles encircle tail (1) or not (0)	1	0	1	0	0
Enlarged median subcaudal scale row (1) or not (0)		0	1	0	weakly
No. of postcloacal tubercles	0	2,3	1,3	2,3	1,2
Enlarged femoral scales present (1) or absent (0)	0	0	0	0	0
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0	0
Subtibial scales keeled (1) or not (0)	1	1	1	1	1
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	0	0	0
No. of 4th toe lamellae	26–30	27–30	23–36	34–41	30–35

continued.

	<i>mcguirei</i>	<i>monachorum</i>	<i>nigridia</i>	<i>nuicamensis</i>
Maximum SVL	65	32.9	75.5	47.5
Supralabials	7–9	7,8	10,11	7–9
Infralabials	7,8	5–7	9–11	6–7
Ventral scales keeled (1) or not (0)	1	0	1	0

continued next page

TABLE 1. (continued)

	<i>mcguirei</i>	<i>monachorum</i>	<i>nigridia</i>	<i>nuicamensis</i>
No. of precloacal pores	5–10	3	12–14	4–6
Precloacal pores continuous (1) or separated (0)	0	1	0	0
Precloacal pores elongate (1) or round (0)	0	0	0	0
No. of paravertebral tubercles	26–32	11–19	39–43	20–22
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	1
Tubercles present (1) or absent (0) on flanks	1	0	0	1
Caudal tubercles in lateral furrow (1) or not (0)	1	0	0	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	1	1
Lateral caudal tubercle row present (1) or absent (0)	1	ant	1	1
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0
Subcaudals keeled (1) or not (0)	1	0	0	0
Single median row of keeled subcaudals (1) or not (0)	0	0	0	weak
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0
Enlarged median subcaudal scale row (1) or not (0)	0	1	1	1
No. of postcloacal tubercles	2,3	1,2	2–4	2–4
Enlarged femoral scales present (1) or absent (0)	0	0	0	weak
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0
Subtibial scales keeled (1) or not (0)	1	0	1	0
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	1	0
No. of 4th toe lamellae	30–35	25–27	28,29	29–33

continued.

	<i>paripari</i>	<i>pemanggilensis</i>	<i>perhentianensis</i>	<i>pseudomcguirei</i>
Maximum SVL	50.7	76.0	47	42.5
Supralabials	12	10–13	8–10	9
Infralabials	10,11	10–14	7–8	8,9
Ventral scales keeled (1) or not (0)	1	1	0,1	1
No. of precloacal pores	2–6	0	6–8	1–5
Precloacal pores continuous (1) or separated (0)	0	/	1	1
Precloacal pores elongate (1) or round (0)	0	/	0	0
No. of paravertebral tubercles	26–31	30–37	22–27	26–32
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	0
Tubercles present (1) or absent (0) on flanks	0	1	1	1
Caudal tubercles in lateral furrow (1) or not (0)	0	0	0	1
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	1	0	0
Lateral caudal tubercle row present (1) or absent (0)	1	1	1	ant

continued next page

TABLE 1. (continued)

	<i>paripari</i>	<i>pemanggilensis</i>	<i>perhentianensis</i>	<i>pseudomcguirei</i>	
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0	
Subcaudals keeled (1) or not (0)	1	1	1	1	
Single median row of keeled subcaudals (1) or not (0)	0	1	0	0	
Caudal tubercles encircle tail (1) or not (0)	0	1	0	0	
Enlarged median subcaudal scale row (1) or not (0)	1	1	0	0	
No. of postcloacal tubercles	2	2	3–4	2,3	
Enlarged femoral scales present (1) or absent (0)	0	0	0	0	
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0	
Subtibial scales keeled (1) or not (0)	1	0	1	1	
Enlarged submetatarsal scales on 1st toe (1) or not (0)	1	0	0	0,1	
No. of 4th toe lamellae	26–31	27–31	28–31	23–25	
continued.					
	<i>psychedelica</i>	<i>roticanai</i>	<i>shahruli</i>	<i>siamensis</i>	<i>tucdupensis</i>
Maximum SVL	75.3	47	36.5	39.7	51
Supralabials	7,8	8,9	10,11	8,9	8–10
Infralabials	5–7	7,8	8–10	6–8	7,8
Ventral scales keeled (1) or not (0)	0	1	1	1	0
No. of precloacal pores	0	3–6	0	0	0
Precloacal pores continuous (1) or separated (0)	/	0	/	/	/
Precloacal pores elongate (1) or round (0)	/	0	/	/	/
No. of paravertebral tubercles	34–48	25–27	19–22	19–25	18–21
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	0	1
Tubercles present (1) or absent (0) on flanks	0	1	1	1	1
Caudal tubercles in lateral furrow (1) or not (0)	0	1	0	0	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	0	0	1
Lateral caudal tubercle row present (1) or absent (0)	0	0	1	1	0
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	1	0	0	0	1
Subcaudals keeled (1) or not (0)	0	1	1	1	0
Single median row of keeled subcaudals (1) or not (0)	1	1	0	weak	1
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0	0
Enlarged median subcaudal scale row (1) or not (0)	1	weak	0	1	1
No. of postcloacal tubercles	1,2	1,2	2,3	1,2	0–3
Enlarged femoral scales present (1) or absent (0)	1	0	0	0	0
Shield-like subtibial scales present (1) or absent (0)	1	0	0	0	0
Subtibial scales keeled (1) or not (0)	0	1	1	1	0
Enlarged submetatarsal scales on 1st toe (1) or not (0)	1	0	0	0	1
No. of 4th toe lamellae	25–28	26–29	21–30	24–26	27–30

continued.

	<i>chanardi</i>	<i>vandeventeri</i>	<i>kamolnorrathi</i>	<i>narathiwatensis</i>
Maximum SVL	40.1	44.7	37.8	43.2
Supralabials	8–10	8,9	8,9	9,10
Infralabials	7,8	7–9	7,8	7–9
Ventral scales keeled (1) or not (0)	1	1	0-weak	1
No. of precloacal pores	6–8	4	6,7	3–6
Precloacal pores continuous (1) or separated (0)	0	0	1	0
Precloacal pores elongate (1) or round (0)	0	0	1	0
No. of paravertebral tubercles	20–30	25–29	19–24	28,29
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0	0
Tubercles present (1) or absent (0) on flanks	1	0	1	1
Caudal tubercles in lateral furrow (1) or not (0)	0	0	0	1
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	0	1
Lateral caudal tubercle row present (1) or absent (0)	1	1	1	0
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	0	0	0
Subcaudals keeled (1) or not (0)	1	1	weak	1
Single median row of keeled subcaudals (1) or not (0)	weak	weak	weak	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0	0
Enlarged median subcaudal scale row (1) or not (0)	1	1	1	0
No. of postcloacal tubercles	1	1–3	1,2	2,3
Enlarged femoral scales present (1) or absent (0)	0	0	0	0
Shield-like subtibial scales present (1) or absent (0)	0	0	0	0
Subtibial scales keeled (1) or not (0)	1	1	0-weak	1
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	0	0
No. of 4th toe lamellae	25–30	24–28	24–28	24–26

continued.

	<i>huaseesom</i>	<i>punctatonuchalis</i>	<i>niyomwanae</i>
Maximum SVL	37.9	49.6	56.8
Supralabials	7–9	8	8–11
Infralabials	6–8	7,8	6–8
Ventral scales keeled (1) or not (0)	0	0	0
No. of precloacal pores	5,6	0	3
Precloacal pores continuous (1) or separated (0)	1	/	1,0
Precloacal pores elongate (1) or round (0)	0	/	0
No. of paravertebral tubercles	18–24	24–27	26–31
Tubercles of ventralmost row on flank linearly arranged and in contact or nearly so (1) or tubercles on flank widely spaced and more randomly distributed (0)	0	0	0

continued next page

TABLE 1. (continued)

	<i>huaseesom</i>	<i>punctatonuchalis</i>	<i>niyomwanae</i>
Tubercles present (1) or absent (0) on flanks	1	1	0
Caudal tubercles in lateral furrow (1) or not (0)	1	ant	0
Ventrolateral caudal tubercles anteriorly (1) or not (0)	0	0	0
Lateral caudal tubercle row present (1) or absent (0)	0	1	0
Caudal tubercles restricted to a single paravertebral row on each side (1) or not (0)	0	1	1
Subcaudals keeled (1) or not (0)	0	0	0
Single median row of keeled subcaudals (1) or not (0)	0	0	0
Caudal tubercles encircle tail (1) or not (0)	0	0	0
Enlarged median subcaudal scale row (1) or not (0)	0	1	1
No. of postcloacal tubercles	1,2	1–3	1,2
Enlarged femoral scales present (1) or absent (0)	0	0	0
Shield-like subtibial scales present (1) or absent (0)	0	0	0
Subtibial scales keeled (1) or not (0)	0	0	0
Enlarged submetatarsal scales on 1st toe (1) or not (0)	0	0	0
No. of 4th toe lamellae	21–31	29–31	31–34

TABLE 2. Diagnostic characteristics of color pattern of the *Cnemaspis* of Thailand. 1 = character state present; 0 = character state absent. / = character not evaluated.

	<i>biocellata</i>	<i>chanardi</i>	<i>chanthaburiensis</i>	<i>kamohorranathi</i>	<i>kumpoli</i>	<i>huaseesom</i>	<i>mcquirei</i>	<i>punctatonuchalis</i>	<i>narathiwatensis</i>	<i>siamensis</i>	<i>vandeventeri</i>
Eye spots on occiput	1	0	0	0	0	0	0	0	0	0	0
Black shoulder patch enclosing ocellus in males	1	0	0	0	1	0	1	0	1	0	0
Wide, yellow, nuchal loop in males	1	0	0	0	0	0	0	0	0	0	0
Black neck patch enclosing an ocellus	0	0	0	0	0	0	0	1	0	0	0
Head yellow in adult males	0	0	0	0	0	1	0	0	0	0	0
Light colored, prescapular crescent	0	1	0	0	0	0	0	0	0	0	1
Light colored, postscapular bar	0	0	0	0	0	0	1	0	1	0	0
Dark, longitudinal, gular markings	0	0	0	0	0	0	0	0	0	1	0
Red bands on limbs in males	0	0	0	0	1	0	0	0	0	0	0
Light colored, transverse bars on flanks	0	1	0	0	1	0	1	0	0	0	0
Venter red-orange in males	0	0	1	0	0	0	0	0	0	0	1

***Cnemaspis chanardi* sp. nov.**

Chan-ard's Rock Gecko

Djing Djok Niew Yaow Tanya

Figures 4,5,6,7,13

Gonatodes siamensis Smith, 1930:16,

Cnemaspis siamensis Smith, 1935:71

Cnemaspis siamensis (in part) Taylor, 1963:740

Holotype. Adult male (THNHM 6983) collected on 22 June 2005 at Ban Chong, Chong, Nayong District, Trang Province, Thailand. Squares represent type localities between 400 and 600 m a.s.l. by Tanya Chan-ard.

Paratypes. FMNH 176863 was collected on 10 May 1959 by Edward H. Taylor (EHT 390) at the same locality as the holotype. CUMZ-R-2009,6,24-6 was collected on 16 February 2007 at the Dad Fa Waterfall in Tai Rom Yen National Park, Ban Nasan District, Surat Thani Province (8°51.87'N 99°31.13'E) at 362 m a.s.l. by Thanin Kaewmanee. THNHM 12434 was collected at Khao Nor Chuchi, Khlong Thom, Khlong Thom District, Krabi Province during 1996 by Tanya Chan-nard. THNHM 1334-35 were collected on 8 May 2003 at Khao Luang National Park, Lan Saka District, Nakhon Si Thammarat Province between 200 and 300 m a.s.l. by Tanya Chan-ard and Yodchaiy Chuaynkern. THNHM 14111 was collected on 6 December 2003 at Khao Luang National Park, Lan Saka District, Nakhon Si Thammarat Province between 200 and 300 m a.s.l. by Tanya Chan-nard and Y. Chuaynkern. THNHM 10705 collected on 6 December 2006 from Krung Nang Waterfall in Khao Nan National Park, Nopphitam District, Nakhon Si Thammarat Province (08°46.219 N, 99°35.29.6 E) at 129 m a.s.l. by T. Chan-nard, S. Mekchai, S. Laoteaw, and M. Cota. THNHM 10115 was collected at Khao Nan National Park, Nakhon Si Thammarat Province on 22 October 2006 at approximately 300 m a.s.l. by Tanya Chan-ard, Sunchai Makchai, Michael Cota, Suttinee Laoteow, and Huay Lak. THNHM 10135 was collected at Khao Nan National Park, Tha Sala District, Nakhon Si Thammarat Province on 23 October 2006 at 255 m a.s.l. by Tanya Chan-ard, Sunchai Makchai, Michael Cota, and Suttinee Laoteow. LSUHC 9564 was collected at the Phuphaphet Cave, Muang District, Satun Province on 6 October 2009 at approximately 220 m a.s.l. by Kirati Kunya. THNHM 10383 was collected on 14 December 2003 at Ban Yod Leong, Nopphitham District, Nakhon Si Thammarat Province at 355 m a.s.l. by T. Chan-ard and Y. Chuaynkern.

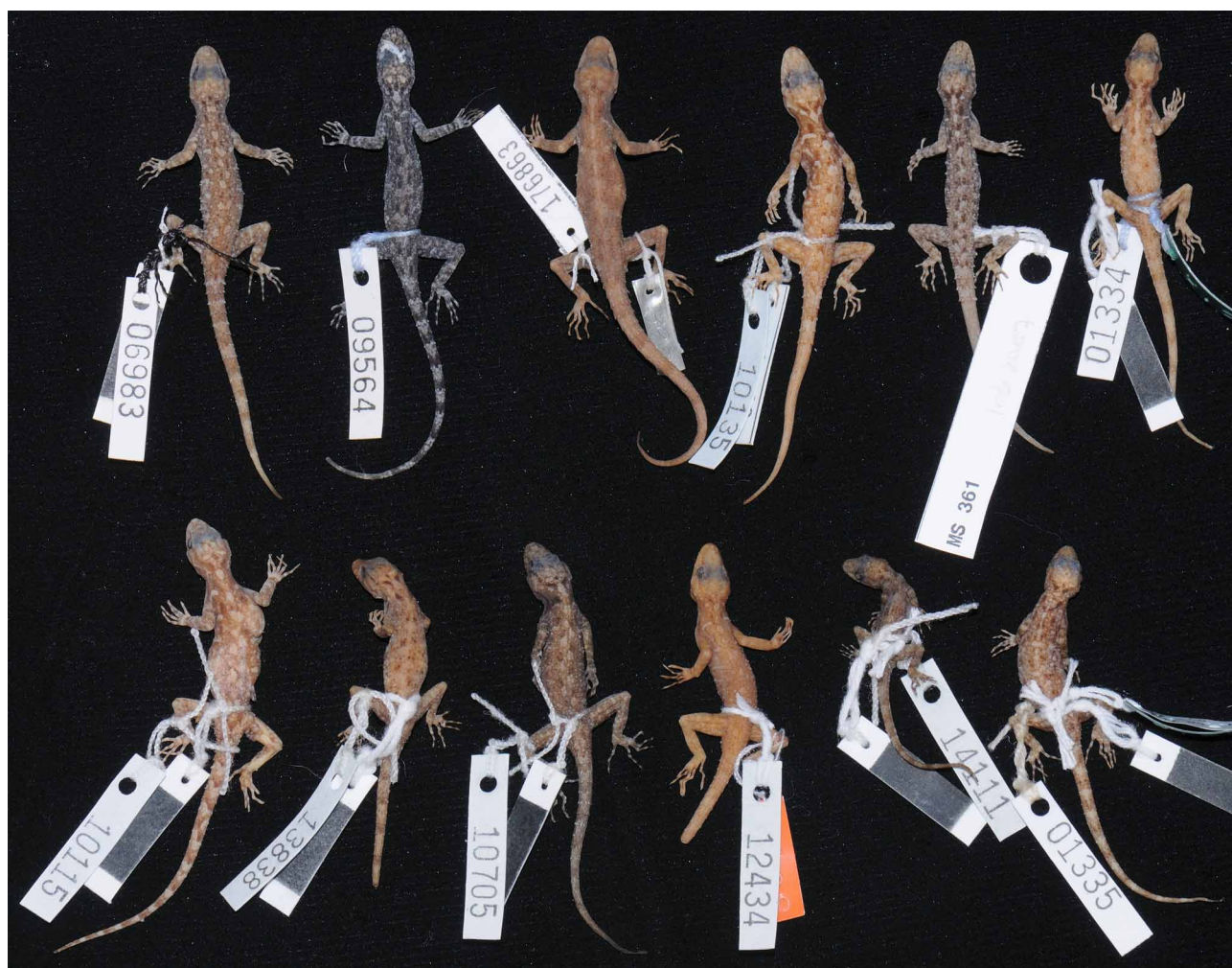


FIGURE 4. Type series of *Cnemaspis chanardi* sp. nov.



FIGURE 5. Upper: flank of *Cnemaspis chanardi* **sp. nov.** (CUZM R-2009,6,24-9). Lower: flank of *C. vandeventeri* **sp. nov.** (THNHM 8261).

Diagnosis. Adult males reaching 40.1 mm SVL, adult females reaching 38.7 mm SVL; 7–10 supralabials; 6–8 infralabials; gulars smooth; forearm, subtibials, ventrals, subcaudals, and dorsal tubercles keeled; 20–30 paravertebral tubercles; tubercles on flanks not linearly arranged; ventrolateral caudal tubercles absent; caudal tubercles do not encircle tail; no lateral, caudal tubercles within lateral, caudal furrow; median row of subcaudals keeled, slightly enlarged; 6–8 precloacal, pore-bearing scales in adult males separated medially by

non-pore-bearing scales; pores round; one postcloacal tubercle; shield-like subtibials and enlarged, submetatarsals absent; 25–30 subdigital lamellae on fourth toe; no dark, longitudinal gular markings or blotches; head not yellow in adult males; no dark patch on shoulder or neck enclosing a white to yellow ocellus; yellow to white, prescapular crescent present. These differences are summarized across all species in TABLES 1 and 2.

Description of holotype. Adult male; SVL 37.7 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.28), somewhat narrow (HW/SVL 0.17), flat (HD/HL 0.39), distinct from neck; snout short (ES/HL 0.48), concave in lateral profile; postnasal region constricted medially; raised scales of rostrum keeled, larger than similarly shaped scales on occiput; low, supraorbital ridges; no frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.23); extra-brillar fringe scales small in general but largest anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 90% divided by longitudinal groove; rostral bordered posteriorly by two supranasals and two smaller azygous scales, bordered laterally by first supralabials and nostrils; 9R, 10L raised supralabials of similar size; 7R, L infralabials, decreasing gradually in size posteriorly; nostrils small, oblong, oriented dorsoposteriorly; bordered posteriorly by small, granular, postnasal scales; mental large, subpentagonal, medially concave, extending to level of second infralabials, bordered posteriorly by three postmentals; gular scales raised, smooth, somewhat pointed; throat scales larger, taller, smooth, juxtaposed.

Body slender, elongate (AG/SVL 0.45); small, weakly keeled, dorsal scales equal in size throughout body, intermixed with numerous, large, multi-keeled, semi-longitudinally arranged tubercles; tubercles extend from top of head to base of tail and are smallest anteriorly; 24 paravertebral tubercles; pectoral and abdominal scales slightly raised, subimbricate, weakly keeled; abdominal scales slightly larger than pectoral scales, much larger than dorsals; seven contiguous, pore-bearing, precloacal scales arranged in a 3-4 chevron, followed posteriorly by three more contiguous, pore-bearing scales all in contact; pores round; forelimbs moderately long, slender, dorsal scales keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, juxtaposed, raised; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at the digital inflections; interdigital webbing absent; fingers increase in length from first to fourth with fifth the same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales keeled, raised, juxtaposed; ventral scales of thigh, raised, weakly keeled; subtibials keeled, larger than dorsal tibials; plantar scales smooth, slightly raised, juxtaposed; slightly enlarged submetatarsal scales beneath first metatarsal; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 27 subdigital lamellae on fourth toe; caudal scales arranged in segmented whorls; dorsal, caudal scales raised, keeled, subimbricate anteriorly; moderate, middorsal furrow; deep, single, lateral furrow; median row of slightly enlarged, keeled, subcaudals with four scales per caudal segment; other subcaudals keeled; paravertebral, dorsolateral, and lateral rows of large, keeled, nearly spinose, caudal tubercles; tubercles of paravertebral and lateral rows largest; ventrolateral, caudal tubercles absent; caudal tubercles do not encircle tail, absent from lateral, caudal furrow; 2R, 1L postcloacal tubercles; tail approximately 1.1% times SVL; anterior 33.2 mm original, remainder regenerated.

Coloration (in alcohol). Dorsal ground color of head, body, limbs and tail pale brown; top of head bearing small, faint, brown markings and postorbital stripes; series of small, whitish, vertebral blotches extend from nape to level of hind limbs, becoming increasingly larger, separated, and irregular in shape posteriorly; from level of hind limbs to base of tail blotches become slightly offset and paravertebrally aligned, extending onto the tail to form lightly colored, caudal bands; three dark blotches on nape form a tripartite pattern, followed by paired dark, opposing blotches immediately anterior to shoulders which grade into small, diffuse, randomly arranged, darker markings on rest of body; thin, incomplete, light-colored, prescapular crescent preceded by whitish spot at base of head, followed by a series of thin, whitish to yellow, transverse bars on flanks; tubercles on anterior part of body tend to be white or black; posterior body tubercles tend to be yellow or black; enlarged, widely separated, white tubercles occur on flanks; limbs weakly mottled with diffuse, dark

markings; dark bands on digits; tail faintly banded; all ventral surfaces cream colored to yellowish white with faint stippling being darkest on tail.

Variation. Differences in squamation and morphometrics are presented in TABLE 3. The paratypes closely approach the holotype in most aspects of coloration and pattern (Fig. 4). The Surat Thani specimen (CUMZ-R-2009,6,24-6) has larger more spinose tubercles (Fig. 5) and in life (Fig. 6) a thin, dark, preorbital stripe and two postorbital stripes; the lower postorbital stripe extends onto upper portion of forelimb; the upper postorbital stripe is wider, incomplete, extending onto occiput where it is separated by opposing upper postorbital stripe by an elongate, medial, cream-colored marking; cream-colored marking bordered anteriorly by a dark, medial blotch producing a dark, tripartite, pattern on nape. The gular region is yellow, immaculate; throat, ventral portion of forelimbs, pectoral region beige, immaculate; belly, ventral portions of hind limbs, and subcaudal region yellow, immaculate (Fig. 6). This species appears to not be sexually dimorphic for dorsal color pattern. Ventral coloration in life for females is light yellow except for the hind limbs and tail which are somewhat beige (Fig. 6). The prescapular crescent is wider in THNHM 10135 but faint in THNHM 13838. Baring on the flanks is weak in THNHM 10135. The prescapular crescent is wider in THNHM 10115 and nearly absent in THNHM 1335. Baring on the flanks is weak in THNHM 10115. Figure 7 shows the color pattern variation between specimens from Satun and Nakhon Si Thammarat provinces.

TABLE 3. Descriptive measurements and scale counts of the type series of *Cnemaspis chanardi*. See materials and methods for abbreviations. / = character not evaluated.

	FMHN 176863 Paratype	THNHM 6983 Holotype	THNHM 12434 Paratype	THNHM 1334 Paratype	THNHM 1335 Paratype	THNHM 10115 Paratype	CUMZ R 2009,6,24-9 Paratype
SVL	40.1	37.7	35.1	33.5	34.6	38.6	37.2
Sex	m	m	m	m	f	f	m
Supralabials	10	9	9	8	8	9	8
Infralabials	8	7	8	7	7	7	8
Precloacal pores	7	4	6	3	0	0	6
Paravertebral tubercles	25	24	23	23	21	23	30
4th toe lamellae	26	27	27	30	26	30	25
TL	49.5	43	20.8	40.5	45.5	53.3	40.6
TW	4.7	4.2	4.2	3.7	3.9	4.0	3.8
FL	5.7	5.8	5.7	5.7	5.5	6.2	5.3
TBL	8.0	7.1	7.1	6.9	6.4	7.4	6.8
AG	19.6	16.8	14.6	13.8	18.8	12.6	13.9
HL	10.7	10.5	4.8	9.0	9.6	10.6	10.3
HW	7.4	6.7	6.6	5.9	5.7	6.5	6.5
HD	5.0	4.1	4.2	4.1	4.0	4.6	4.4
ED	2.3	2.4	2.0	2.0	2.2	2.4	2.1
EE	3.3	2.9	3.1	2.5	2.6	3.0	3.0
ES	5.3	5.0	4.6	4	4.6	4.8	4.7
EN	4.0	3.9	3.4	3.1	3.4	3.6	3.7
IO	3.0	2.8	2.5	2.2	2.5	2.8	2.4
EL	1.3	0.8	1.2	0.9	1.0	1.2	1.2
IN	1.1	1.0	0.9	0.8	0.8	1.1	0.7

Continued.

	LSUHC	THNHM	THNHM	THNHM	THNHM
	9564	14111	10135	10705	13838
	Paratype	paratype	paratype	paratype	paratype
SVL	39.5	23.5	38.7	37.6	36.4
Sex	f	m	f	f	f
Supralabials	9	8	8	7	8
Infralabials	8	8	7	6	8
Precloacal pores	0	0	0	0	0
Paravertebral tubercles	22	22	23	25	20
4th toe lamellae	25	25	25	26	29
TL	53.7	40.5	43.5	46.2	25
TW	4.3	3.7	4.5	4.4	3.6
FL	6.6	5.7	6.5	6.2	5.7
TBL	7.6	6.9	7.6	8.2	6.6
AG	17.9	13.8	15.8	15.5	16.1
HL	11	9.0	11.1	11.4	9.4
HW	6.3	5.9	6.9	6.6	9.6
HD	4.1	4.1	4.7	4.3	4.1
ED	2.1	2.0	2.4	2.2	2.2
EE	3.0	2.5	3.0	3.5	2.9
ES	5.8	4.0	5.4	5.0	4.7
EN	4.2	3.1	4	3.7	3.5
IO	2.4	2.2	2.5	2.8	2.3
EL	1.0	0.9	1.1	1.2	1.0
IN	0.9	0.8	1.1	1.1	1.0

Distribution. *Cnemaspis chanardi* **sp. nov.** occurs in the foothills of the Nakhon Si Thammarat and Sankalakhiri Mountains and lowland areas to the west, extending from the southern terminus of the Isthmus of Kra in Donsak District, Surat Thani Province, southward along the western foothills through Khao Chong and Nayong district, Trang Province to at least the Phuphaphet Cave, Satun Province in the south. It probably continues approximately 45 km further south to the Banjaran Nakawan mountains that form the physiographic barrier between Thailand and Peninsular Malaysia. It extends westward from the foothills through the lowlands to at least Khlong Thom District, Krabi Province (Fig. 1). It ranges from near sea level at Khlong Thom to just under 600 m at Khao Chong. Smith (1930) reported specimens from Khao Whip (=Khao Wang Hip), Nakhon Si Thammarat Province but the elevation is unknown. Currently, *C. chanardi* **sp. nov.** is not known to occur in the foothills or lowlands east of the crests of the Nakhon Si Thammarat and Sankalakhiri mountains (Fig. 1).

Its presence on Ko Tao Island, Surat Thani Province, approximately 85 km off the coast from Muang District, Chumphon Province, as opposed to the presence of *Cnemaspis siamensis* which is geographically closer to Ko Tao Island (Fig. 1), is consistent with the geological history of this part of Peninsular Thailand. The island chain consisting of Ko Tao and the intervening islands Ko Samui and Ko Phangan, are offshore extensions of the Nakhon Si Thammarat Mountains to which they were connected during the last glacial maximum (Sathiamurthy & Voris 2006) and lie to the east of the Isthmus of Kra (Fig. 1). It is likely that *C. chanardi* also occurs on Ko Samui and Ko Phangan.

Natural history. Taylor (1963) stated that at Khao Chong, Trang, *Cnemaspis chanardi* **sp. nov.** is primarily a rock dweller but can be found on the buttresses of trees and trunks in the general vicinity of rocks.

Taylor (1963) noted that lizards sought refuge in the crevices of boulders and moved across their rocky microhabitat with considerable speed. Taylor (1963) further noted that lizards were seen abroad during the morning hours, indicating this species is not strictly nocturnal. We made similar observations at the Phuphaphet Cave area in Satun (Fig. 8). Here lizards were collected and observed during the day on the buttresses of trees and within tree holes between 1.5–2 m above the ground along a foot path in old, secondary forest. All the trees upon which the lizards were observed had holes into which the lizards would retreat upon provocation (Fig. 8). Several rock outcrops were nearby but no lizards were observed on them. At the Dad Fa Waterfall, Surat Thani Province, lizards were found at 20:30 hrs beneath rocks 30 m from the nearest stream. Specimens at Khao Luang were found during the day on the ground beneath small rocks on forested hillsides between 200 and 300 m in elevation. There were no large outcrops of rock nearby. These observations indicate *C. chanardi* **sp. nov.** is a diurnal, scansorial species that utilizes large, open, above-ground substrates (*i.e.* tree trunks and boulders) and does not occupy habitats that do not contain both trees and rocks. A gravid female carrying two eggs was found near the Phuphaphet cave on 7 October 2009. THNHM 10115 from near Khao Nan National Park contains two eggs. USNM 76144 from Ko Tao Island and THNHM 13838 collected on 14 December from Bad Yod Leong also contain two eggs.



FIGURE 6. Left and lower right: *Cnemaspis chanardi* **sp. nov.** (male; CUZM R-2009,6,24-9) from Dad Fa Waterfall in Tai Rom Yen National Park, Surat Thani Province. Upper right: *C. chanardi* **sp. nov.** (female; PSUZC-RT 2010.53) from Thum Thong Panra, Thum Panra District, Nakhon Si Thammarat (photos by M. Sumontha).

Etymology. The specific epithet *chanardi*, a masculine name in the genitive case, is in reference to Mr. Tanya Chan-ard of the Thailand Natural History Museum, National Science Museum, Bangkok for his extensive contributions to the herpetology of Thailand, his gracious assistance with this project, and for collecting much of the material used in this study.

Comparisons. *Cnemaspis chanardi* **sp. nov.** is most similar to *C. kamolnorranathi* **sp. nov.**, *C. roticanai* Grismer & Chan 2010, *C. siamensis*, and *C. vandeventeri* **sp. nov.** of Peninsular Thailand (*C. roticanai* is biogeographically considered a Thai species owing to the geological history that Pulau Langkawi shares with the mountains of Peninsular Thailand despite the fact that it is politically a Malaysian island). In fact, *C. chanardi* **sp. nov.**, *C. siamensis*, and *C. vandeventeri* **sp. nov.** were at one time considered conspecific (Smith 1925, 1930, 1935; Taylor 1963). *Cnemaspis chanardi* **sp. nov.** can be differentiated from all Southeast Asian species of *Cnemaspis* (TABLE 1) except *C. roticanai* and *C. vandeventeri* **sp. nov.** on its having a lightly colored, prescapular crescent (Fig. 4). It is differentiated from *C. roticanai* and *C. vandeventeri* **sp. nov.** by being much smaller (maximum SVL 40.1 mm vs. 44.7 mm for *C. vandeventeri* and 47.0 mm for *C. roticanai*) and from *C. vandeventeri* **sp. nov.** in having, as opposed to lacking, tubercles on the flanks (Fig. 5). It differs further from *C. siamensis* in having, as opposed to lacking precloacal pores in males and from *C. siamensis* in lacking, as opposed to having, dark, longitudinal, gular markings. From *C. kamolnorranathi* **sp. nov.** it can be separated further in having keeled as opposed to smooth ventral and subtibial scales. *Cnemaspis chanardi* **sp. nov.** is easily diagnosed from all other species of Southeast Asian *Cnemaspis* on the basis of several aspects of squamation (TABLE 1).



FIGURE 7. Upper: *Cnemaspis chanardi* **sp. nov.** (LSUHC 9565) from Phuphaphet Cave area, Satun Province (photo by M. Sumontha). Middle: *C. chanardi* **sp. nov.** (THNHM 1335; gravid female) from Khao Luang, Nakhon Si Thammarat Province (photo by M. Cota). Lower: uncataloged specimen of *C. chanardi* **sp. nov.** from Khao Nan Yai, Nakhon Si Thammarat Province (photo by T. Sarimanon).



FIGURE 8. General habitat (left) and tree hole microhabitat (right) of *Cnemaspis chanardi* **sp. nov.** at the Phuphaphet Cave area, Satun Province (photos by M. Sumontha).

Remarks. The precloacal pores of juvenile and subadult male *Cnemaspis chanardi* **sp. nov.** are difficult to discern. THNHM 14111, a juvenile (SVL 23.5 mm), has one pigmentless, poorly developed, precloacal pore that appears to have just erupted through the surface of the enclosing scale. Contiguous, under-developed, pigmentless scales with glandular secretions that have not yet erupted through the scale surface, flank the pore-bearing scale. THNHM 1334, a subadult (SVL 33.5 mm), has three, nearly fully developed, precloacal pores flanked by pigmentless, contiguous, under-developed scales. The remaining adult males (SVL 35.1–40.1 mm) have 4–8, small but fully developed precloacal pores that are not flanked by under-developed, pigmentless scales. Nonetheless, the precloacal pores in adults of this species are generally much smaller and harder to see than precloacal pores in most other species of *Cnemaspis* (Fig. 13).

Cnemaspis chanardi **sp. nov.** is superficially similar to *C. kamolnorranathi* **sp. nov.** and the two species may actually be sympatric in Tai Rom Yen National Park where the former occurs at the Dad Fa Water Fall and the latter approximately 10 km to the northeast at the Petchphanomwat Water Fall. They can be differentiated on the basis of *C. chanardi* **sp. nov.** having well-developed, transversely elongate, precloacal pores that do not form a continuous row as opposed to having poorly developed precloacal pores that form a continuous row (Fig. 13). Additionally, *C. chanardi* **sp. nov.** has large tubercles on its flanks (Fig. 5) and *C. kamolnorranathi* **sp. nov.** does not. *Cnemaspis chanardi* **sp. nov.** utilizes both rocks and tree trunks whereas *C. kamolnorranathi* **sp. nov.** may be more restricted to rocks. A molecular analysis (Grismer *et al.*, in prep.) will provide additional data to further test the hypothesis that these nominal taxa are separate species as is suggested by their morphology, ecology, and distribution.

Additional material examined. Krabi Province: Khlong Thom THNHM 12439–40. Nakhon Si Thammarat Province: Khao Luang National Park THNHM 14111; Thum Panra District; Thum Thong Panra, PSUZC-RT 2010.53-54. Satun Province: Muang District, Phuphaphet Cave LSUHC 9565. Surat Thani Province: Donsak District, near Donsak Pier MS 395; Kanchanadit District, Petphanomwung Cave ZMKU Rep-000313, KZM 009; Ko Tao Island USNM 76143–44.

Cnemaspis vandeventeri* **sp. nov.*

VanDeventer's Rock Gecko

Djing Djok Niew Yaow VanDeventer

Figures 5,9,10

Gonatodes siamensis Smith, 1925:22

Cnemaspis siamensis Smith, 1935:72; Taylor, 1963:743.

Cnemaspis siamensis (?) Pauwels *et al.*, 2000:129

Holotype. Adult male (THNHM 8261) collected from Khlong Naka Wildlife Sanctuary (9° 26.0N, 98° 35.0E), Kapur District, Ranong Province; Thailand.

Paratype. THNHM 8260 has the same collection data as the holotype.

Diagnosis. Adult males reaching 44.7 mm SVL, adult females reaching 40.5 mm SVL; eight or nine supralabials; 7–9 infralabials; gulars, forearm, subtibials, ventrals, subcaudals, and dorsal tubercles keeled; 25–29 paravertebral tubercles; tubercles small, not linearly arranged, absent from lower flanks (Fig. 6); no ventrolateral, caudal tubercles; caudal tubercles do not encircle tail; no tubercles within lateral, caudal furrow; median row of subcaudals keeled, slightly enlarged; four precloacal, pore-bearing scales in males separated medially by non-pore-bearing scales; pores round; 1–3 postcloacal tubercles; shield-like subtibials absent; 24–29 subdigital lamellae on fourth toe; no dark, longitudinal gular markings or blotches; head not yellow in adult males; no dark patch on shoulder or neck enclosing a white to yellow ocellus; no yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.



FIGURE 9. Type series of *Cnemaspis vandeventeri* sp. nov.

Description of holotype. Adult male; SVL 44.7 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.24), somewhat narrow (HW/SVL 0.17), flat (HD/HL 0.44), distinct from neck; snout short (ES/HL 0.47), concave in lateral profile; postnasal region constricted medially; raised scales of rostrum keeled, larger than similarly shaped scales on occiput; prominent, supraorbital ridges; no frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.23); extra-brilliar fringe scales small in general but largest anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 75% divided by longitudinal groove; rostral bordered posteriorly by two supranasals, one smaller azygous scale; bordered laterally by first supralabials and nostrils; 9R,L raised supralabials of similar size, posterior two supralabials

bearing a large keel; 9R,8L infralabials, decreasing gradually in size posteriorly; nostrils small, oblong, oriented dorsoposteriorly; bordered posteriorly by small, granular, postnasal scales; mental large, triangular, medially concave, extending to level of second infralabials, bordered posteriorly by three postmentals, lateral postmentals largest; gular scales raised, keeled, pointed; throat scales same as gular scales except larger.

Body slender, elongate (AG/SVL 0.35); small, weakly keeled, dorsal scales equal in size throughout body, intermixed with multi-keeled, semi-longitudinally arranged tubercles; tubercles extend from top of head to base of tail, smallest anteriorly, absent from flanks; large section of skin absent from pelvic region; 29 paravertebral tubercles; pectoral and abdominal scales raised, subimbricate, strongly keeled; abdominal scales slightly larger than pectorals, much larger than dorsals; four poorly developed, pore-bearing, precloacal scales arranged in a 2–2 chevron separated by two non-pore-bearing precloacal scales; pores round; forelimbs moderately long, slender, dorsal scales keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, juxtaposed, raised; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at digital inflections; interdigital webbing absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales keeled, raised, juxtaposed; ventral scales of thigh, raised, keeled; subtibials keeled, larger than dorsal tibials; plantar scales smooth, slightly raised, imbricate; slightly enlarged submetatarsal scales beneath first metatarsal; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 26 subdigital lamellae on fourth toe; only 8.7 mm of tail present; caudal scales arranged in segmented whorls; dorsal, caudal scales raised, keeled, subimbricate anteriorly; moderate, middorsal, caudal furrow; single, lateral, caudal furrow; no ventrolateral caudal tubercles present anteriorly; caudal tubercles do not encircle tail; one postcloacal tubercle on lateral surfaces of hemipenial swellings at base of tail.

Coloration (in alcohol). Holotype very faded; dorsal ground color of head, body, limbs and tail brown; top of head bearing small, faint, brown markings and postorbital stripes; series of small, lighter colored, vertebral blotches extend from nape to level of hind limbs; light-colored, prescapular crescent followed by a series of irregularly shaped lightly colored blotches on flanks; limbs faintly mottled with diffuse dark markings; darker bands on digits; all ventral surfaces cream colored, immaculate except for small, individual stipples in each scale.

Variation. Differences in squamation and morphometrics is presented in TABLE 4. The paratype (THNHM 8260) is also faded but its dorsal pattern is more vivid than that of the holotype (Fig. 9). A lightly colored, elongate marking edged in darker coloration occurs on the nape and is followed by lightly colored, butterfly-shaped, vertebral markings extending onto the base of the tail and then continuing posteriorly as caudal bands. The lightly colored, prescapular crescent is more obvious as are the irregularly shaped bars on the flanks. THNHM 8260 also has a complete, non-regenerated tail bearing the following characteristics: median row of slightly enlarged, keeled, subcaudals with four scales per caudal segment; all other subcaudals keeled; paravertebral, dorsolateral, and lateral rows of large, keeled, almost spinose, caudal tubercles; tubercles of paravertebral and lateral rows largest; tubercles absent from lateral, caudal furrow. A contorted, shriveled specimen (CUMZ R-2009,6,24–11, female, ca. 32.8 mm SVL) from Khlong Had Sompen, Ranong Province, approximately 58 km to the south of the type locality also bears the diagnostic scale and color pattern characteristics of the holotype. Voucher photograph LSUDPC 5271 of a living adult male near the type locality in Ranong shows that the overall, dorsal ground color is brown and the tail is yellowish. The gular region, throat, and ventral surfaces of the upper arm are orangish (Fig. 10).

Distribution. *Cnemaspis vandeventeri* **sp. nov.** appears to be restricted to the west side of the Tenasserim and the contiguous Phuket Mountains along the west coast of central Peninsular Thailand. At present, it ranges from the Khlong Naka Wildlife Sanctuary in the north, southward approximately 58 km to Khlong Had Sompen, Ranong (Fig. 1). Pauwels *et al.* (2000) collected two specimens (MNHN 1999.7707–08) from Phang-Nga Wildlife Breeding Station, Phang-Nga located west of the Phuket Mountains that they referred to as *C. siamensis* which could have also been *C. vandeventeri* **sp. nov.** Unfortunately, the specimens could not

be located (P. David, *in lit.* 2009). A photograph of a living specimen taken *in situ* from Phuket Island bears a lightly colored, prescapular crescent; irregularly shaped, lightly colored markings on its flank (as opposed to bars); and an orangish, gular and abdominal region (Fig. 10). We believe these diagnostic characters indicate that the specimen is *C. vandeventeri*. It is quite likely that *C. vandeventeri* **sp. nov.** ranges further north along the western flanks of the Tenasserim Mountains into Myanmar (Fig. 1).

TABLE 4. Descriptive measurements and scale counts of the type series of *Cnemaspis vandeventeri*. See materials and methods for abbreviations. / = character not evaluated.

	CUMZ R	THNHM	THNHM
	2009,6,24-11	8260	8261
	paratype	paratype	holotype
SVL	32.8	40.5	44.7
Sex	f	f	m
Supralabials	8	8	9
Infralabials	8	7	9
Precloacal pores	0	0	4
Paravertebral tubercles	25	29	29
4th toe lamellae	28	24	26
TL	37.6	/	36.9
TW	3.3	4.2	4.0
FL	5.6	7.1	6.5
TBL	7.4	.08	7.5
AG	14.0	20.1	15.8
HL	9.6	11.9	10.8
HW	5.8	7.8	7.8
HD	4.1	4.8	4.8
ED	2.1	2.6	2.5
EE	2.4	3.6	3.1
ES	4.4	5.5	5.1
EN	3.3	4.4	4.0
IO	2.4	2.7	2.5
EL	1.1	1.3	1.1
IN	0.8	1.1	1.1

Natural history. Pauwels *et al.* (2000) reported finding what may be *Cnemaspis vandeventeri* **sp. nov.** at Phang-Nga Wildlife Breeding Station beneath a decaying stump in an evergreen forest. CUMZ R-2009,6,24-11 was found on a vine along a rocky stream. This would suggest this species may not be a rocky microhabitat specialist.

Etymology. The specific epithet *vandeventeri*, a masculine name in the genitive case, is a patronym honoring Mr. Ryan J. VanDeventer of the Department of Biology at La Sierra University, Riverside, California. Mr. VanDeventer's passion for, and commitment to the study of biology has been a continual source of enlightenment and inspiration. His heroic efforts to keep La Sierra University's herpetology laboratory and its occupants "up and running smoothly" for the last 16 years goes beyond description.

Comparisons. *Cnemaspis vandeventeri* **sp. nov.** is most similar to *C. chanardi* **sp. nov.**, *C. kamolnorranathi* **sp. nov.**, *C. roticanai*, and *C. siamensis* of Peninsular Thailand and was considered conspecific with *C. chanardi* **sp. nov.**, and *C. siamensis* by Smith (1925, 1930, 1935) and (Taylor 1963).



FIGURE 10. Upper: Captive specimen of *Cnemaspis vandeventeri* **sp. nov.** (male) from Ranong Province (photo by M. Sumontha). Lower: male *C. vandeventeri* **sp. nov.** photographed *in situ* on Phuket Island, Phuket province (photo by H. Bringsøe).

Cnemaspis vandeventeri **sp. nov.** can be differentiated from all Southeast Asian species of *Cnemaspis* (TABLE 2) except *C. chanardi* **sp. nov.**, and *C. roticanai* by having a lightly colored, prescapular crescent. It is differentiated from *C. chanardi* **sp. nov.**, and *C. roticanai* by lacking, as opposed to having, tubercles on the flanks. It differs further from *C. siamensis* in having, as opposed to lacking precloacal pores in males; lacking, as opposed to having, dark, longitudinal, gular markings; and having a greater number of paravertebral tubercles (25–29 vs. 19–25). From *C. chanardi* **sp. nov.** it differs further in having a larger maximum SVL (44.7 mm vs. 40.1 mm) and lacking, as opposed to having, lightly colored, transverse bars on the flanks. From *C. kamolnorranathi* **sp. nov.** it differs further in having keeled, as opposed to smooth ventral and subtibial scales and round, as opposed to transversely elongate precloacal pores. *Cnemaspis vandeventeri* **sp. nov.** is easily diagnosed from all other species of Southeast Asian *Cnemaspis* on the basis of several aspects of squamation (TABLE 1).

Additional material examined. Ranong Province: Khlong Had Sompen, Muang District, CUMZ-R-2009,6,24–11.

Cnemaspis kamolnorranathi* **sp. nov.*

Kamolnorranath's Rock Gecko

Djing Djok Niew Yaow Sumet

Figures 11,12,13

Cnemaspis siamensis Grismer, Chan, Nurolhuda, & Sumontha, 2008:54

Holotype. Male (THNHM 15908) from Petchphanomwat Waterfall, in Tai Rom Yen National Park, Ban Nasan District, Surat Thani Province (8°56.88'N 99°31.82'E) collected by Thanin Kaewmanee on 17 December 2004.

Paratypes. PSUZC-RT 2010.52 and KZM 006 have the same collection data as the holotype. CUMZ-R 2009,6,24-3 is from Tham Khao Sonk hill, Thachana District, Surat Thani Province, Thailand (9°34'N 99°10'E) collected on 27 June 2003 by Montri Sumontha.

Diagnosis. Males reaching 37.8 mm SVL, females reaching 36.8 mm SVL; eight or nine supralabials; seven or eight infralabials; gular scales smooth; forearm scales keeled; subtibials keeled or smooth; ventrals smooth to weakly keeled; dorsal tubercles keeled; 19–24 paravertebral tubercles; six or seven, contiguous, pore-bearing, precloacal scales; pores transversely elongate (Fig. 13); one or two postcloacal tubercles; shield-like subtibials and enlarged, submetatarsal scales absent; 24–28 subdigital lamellae on fourth toe; no dark, longitudinal, gular markings or blotches; head not yellow in adult males; no dark neck or shoulder patch enclosing a white to yellow ocellus; no prominent, yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.

Description of holotype. Adult male, SVL 37.8 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.28), somewhat narrow (HW/SVL 0.17), flat (HD/HL 0.43), distinct from neck; snout short (ES/HL 0.46), concave in lateral profile; postnasal region constricted medially; scales of rostrum low, rounded, juxtaposed, weakly keeled, larger than similarly shaped scales on occiput; weak, supraorbital ridges; shallow frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.20); extra-brillar fringe scales small in general but slightly larger anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 90% divided by longitudinal groove; rostral bordered posteriorly by two supranasals, a similarly sized, azygous postrostral, and nostrils; bordered laterally by first supralabials; 8R,L raised supralabials of similar size, but smallest posteriorly; 7R,L infralabials, decreasing gradually in size posteriorly; nostrils small, oblong, oriented dorsoposteriorly; bordered posteriorly by small, granular, postnasal scales; mental large, triangular, concave extending to level of second infralabials, bearing an obliquely oriented suture, bordered posteriorly by three postmentals, lateral postmentals largest; gular scales smooth, rounded, juxtaposed; throat scales smooth, flat, subimbricate.

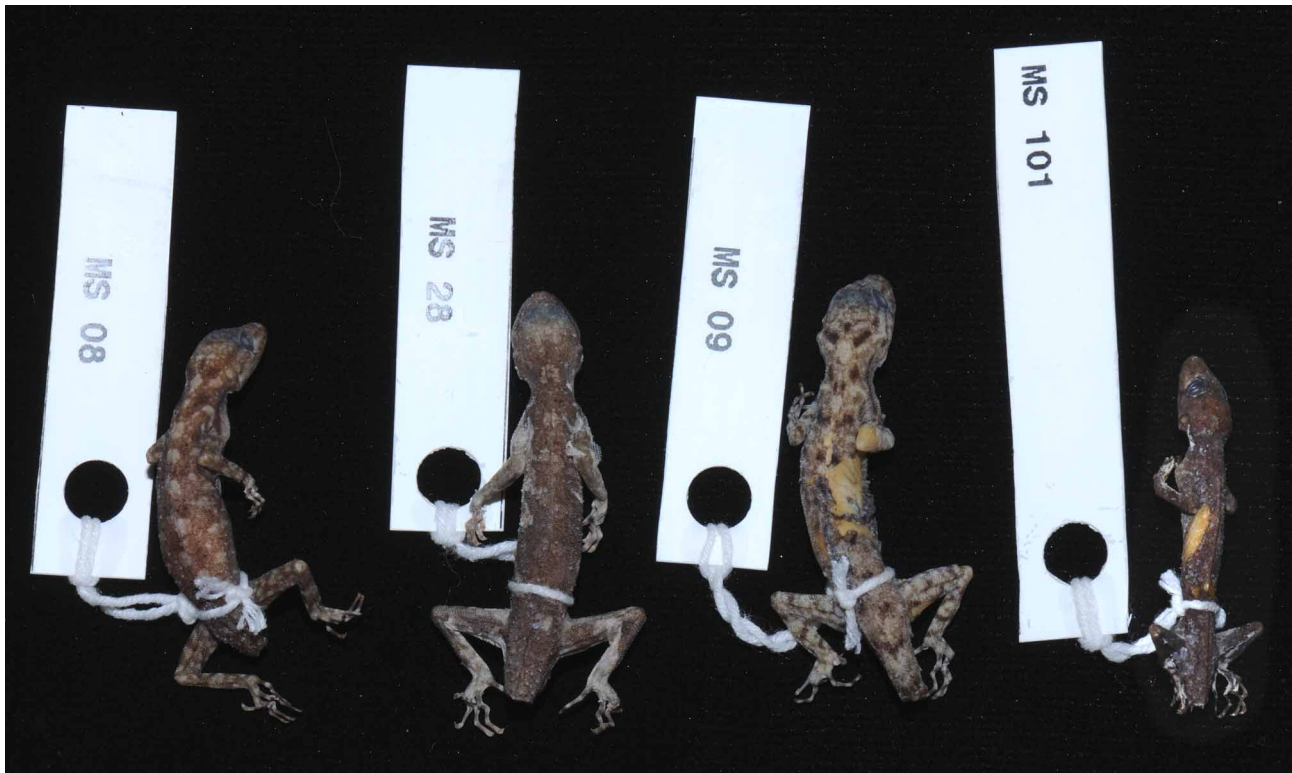


FIGURE 11. Type series of *Cnemaspis kamolnorranathi* sp. nov.



FIGURE 12. *Cnemaspis kamolnorranathi* sp. nov. (male; KZM 006) from Petchphanomwat Waterfall, in Tai Rom Yen National Park, Surat Thani Province (photo by M. Sumontha).

Body slender, elongate (AG/SVL 0.43); small, raised, smooth, dorsal scales generally equal in size throughout body, intermixed with numerous, larger, multi-keeled, semi-longitudinally arranged tubercles; tubercles extend from top of head to base of tail and are smallest anteriorly; 28 paravertebral tubercles; pectoral and abdominal scales smooth, flat, imbricate; abdominal scales slightly larger than pectoral scales and much larger than dorsals; seven contiguous, pore-bearing, precloacal scales forming a 4L,3R chevron;

pores transversely elongate; forelimbs moderately long, slender, dorsal scales keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, raised, subimbricate; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at digital inflections; interdigital webbing generally absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales of thigh, keeled, raised, juxtaposed; dorsal scales of foreleg keeled, subimbricate; ventral scales of hind limb smooth, imbricate; plantar scales smooth, raised, subimbricate; no enlarged submetatarsal scales beneath first metatarsal; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 28R,26L subdigital lamellae on fourth toe; tail missing; two postcloacal tubercles on lateral surfaces of hemipenial swellings at base of tail.



FIGURE 13. Left: precloacal pores of *Cnemaspis kamolnorranathi* **sp. nov.** (holotype THNHM 15908). Right: precloacal pores of *C. chanardi* (CUZM R-2009,6,24-9).

Coloration (in alcohol). Dorsal ground color of head, body, limbs and tail dark pale yellow; rostrum bearing dark and light irregular markings; occiput darker than top of head; postorbital stripping faint; light vertebral blotch on nape followed by four, lightly colored, butterfly-shaped, vertebral blotches on body which fade immediately anterior to level of axilla; white markings weakly edged in darker coloration; no white bars on flanks; no light prescapular crescent; limbs bearing dark mottling faintly resembling bands; digits bearing dark bands; ventral surfaces uniformly beige with faint, black stippling in all scales.

Variation. Differences in meristic and morphometrics within the type series are presented in TABLE 5. The paratypes approach the holotype in general aspects of coloration and pattern (Fig. 11). PSUZC-RT 2010.52 and KZM 006 from Petchphanomwat Waterfall have a more boldly marked dorsal pattern with more conspicuous light, vertebral, butterfly markings bearing thicker, dark edging. CUMZ-R 2009,6,24-3 from Tham Khao Sonk hill is a dried out, somewhat shriveled specimen. In life, however, its coloration was even more similar to that of the holotype than that of PSUZC-RT 2010.52 and KZM 006 (Fig. 12). PSUZC-RT 2010.52 is the only specimen with an original tail. The tail has paravertebral, dorsolateral, and lateral rows of tubercles and lacks ventrolateral rows. It has a middorsal and lateral, caudal furrows with tubercles in the latter. All subcaudal scales are keeled and there is a median row of slightly enlarged subcaudals. The caudal scales are arranged in segmented whorls with four or five scales per segment and the anterior, dorsal caudals are smooth, flat, and juxtaposed. PSUZC-RT 2010.52 and KZM 006 have weakly keeled, ventral scales as opposed to the smooth scales seen in the holotype. The paratypes have keeled subtibials as opposed to the smooth subtibials of the holotype.

Distribution. *Cnemaspis kamolnorranathi* **sp. nov.** is known only from the type locality at Petchphanomwat Waterfall, in Tai Rom Yen National Park, Kanchanadid District, Surat Thani Province and Tham Khao Sonk hill, Thachana District, Surat Thani Province, Thailand (9°34'N 99°10'E), approximately 110 km to the north (Fig. 1).

TABLE 5. Descriptive measurements and scale counts of the type series of *Cnemaspis kamolnorranathi*. See materials and methods for abbreviations. / = character not evaluated.

	CUMZ-R 2009,6,24-3 paratype	THNHM 15908 holotype	PSUZC-RT 2010.52 paratype	KZM 006 paratype
SVL	30.9	37.8	35.7	36.8
Sex	m	m	f	f
Supralabials	8	8	9	8
Infralabials	7	7	8	8
Precloacal pores	6	7	0	0
Paravertebral tubercles	22	19	24	/
4th toe lamellae	26	28	24	28
TL	/	/	49.5	/
TW	3.3	4.0	2.8	3.7
FL	5.0	6.5	5.9	6.2
TBL	5.6	7.3	7.0	7.6
AG	12	16.2	17.4	16.1
HL	8.6	10.5	9.6	9.5
HW	5.1	6.3	5.8	6.4
HD	3.5	4.5	3.9	5.0
ED	1.8	2.1	2.0	2.3
EE	2.2	3.0	2.5	3.1
ES	4.1	4.8	4.8	4.7
EN	3.1	3.5	3.4	3.8
IO	2.1	2.9	2.4	2.8
EL	0.9	1.3	0.9	1.1
IN	0.8	0.9	0.8	0.9

Natural history. Tham Khao Sonk is a small hill approximately 5 m in elevation situated on the eastern coastline of Peninsular Thailand within the Isthmus of Kra. The basement rock of the hill is karst and its steep hillsides are forested. A single specimen of *Cnemaspis kamolnorranathi* **sp. nov.** was found on a vine near a limestone formation. At Petchphanomwat Waterfall, Tai Rom Yen National Park, *C. kamolnorranathi* **sp. nov.** were found on rocks near a stream between 17:30–20:00 hrs. Other lizards were observed on buildings near the stream, indicating this species' wide range of substrate utilization. Paratype KMZ 006 was found at 20:30 hrs beneath a rock 30 m from the nearest stream. These observations suggest this species is a nocturnal rock dweller that may use other surfaces opportunistically.

Etymology. The specific epithet *kamolnorranathi* **sp. nov.**, a masculine name in the genitive case, honors Dr. Sumate Kamolnorranath, Director of Research and Conservation Division, Zoological Park Organization of Thailand who supported Mr. Kirati's herpetological surveys and research that resulted in the discovery of several new species.

Comparisons. *Cnemaspis kamolnorranathi* **sp. nov.** is most similar to *C. chanardi* **sp. nov.**, *C. siamensis*, *C. roticanai*, and *C. vandeventeri* **sp. nov.** of Peninsular Thailand. Although *Cnemaspis kamolnorranathi* occurs in sympatry with *C. siamensis* and *C. chanardi* **sp. nov.**, it is easily diagnosed from these species. Having precloacal pores and lacking dark, gular markings separates it from *C. siamensis*. Lacking a lightly colored, prescapular crescent and a series of transverse bars on the flanks and having transversely elongate as opposed to round, precloacal pores (Fig. 13) separates it from *C. chanardi* **sp. nov.**. Having transverse

precloacal pores also separates it from all other pore-bearing species of *Cnemaspis* (TABLE 1) including *C. vandeventeri* **sp. nov.** and *C. roticanai*. Its small maximum SVL (37.8 mm) also separates it from the larger *C. roticanai* (SVL 47.0 mm) and *C. vandeventeri* **sp. nov.** (SVL 44.7 mm). *Cnemaspis kamolnorranathi* **sp. nov.** is easily diagnosed from all other species of Southeast Asian *Cnemaspis* on the basis of several aspects of squamation (TABLE 1).

Remarks. The relatively wide separation (~110 km) between the Petchphanomwat Waterfall and Tham Khao Sonk suggests there are probably undiscovered, geographically intervening populations of *Cnemaspis kamolnorranathi* **sp. nov.** in the appropriate habitat separating these two localities. Unlike other species of *Cnemaspis*, *C. kamolnorranathi* **sp. nov.** shows intrapopulational variation in the degree of keeling of the ventral and subtibial scales. Had this variation been interpopulational and of a discrete nature (*i.e.*, present or absent) as opposed one of degree, we would have considered lineage separation. However, this variation occurs between three specimens (PSUZC-RT 2010.52, KZM 006 and CUMZ-R 2009,6,24-3: TABLE 5) which were syntopic at the Petchphanomwat Waterfall.

***Cnemaspis huaseesom* sp. nov.**

Orange-headed Rock Gecko

Djing Djok Niew Yaow Hua See Som

Figures 14,15,16

Holotype. Adult male (THNHM 15909) from Sai Yok National Park, Kanchanaburi Province, Thailand (14°20.09N 98°51.35E) collected on 7 July 2007 by Saranon Charoensuk.

Paratypes. The collection data for the paratypes PSUZC-RT 2010.55 and CUMZ-R 2009,6,24-4 are the same as the holotype.

Diagnosis. Adult males reaching 37.7 mm SVL, adult females reaching 37.9; 7–9 supralabials; 6–8 infralabials; forearm scales weakly keeled; gulars, subtibials, ventrals, and subcaudals smooth; dorsal tubercles keeled; tubercles on flanks; 21–24 paravertebral tubercles; ventrolateral caudal tubercles absent anteriorly; caudal tubercles do not encircle tail; caudal tubercles absent from lateral, caudal furrow; no median row of enlarged subcaudals; five or six contiguous, pore-bearing, precloacal scales; pores round; one or two postcloacal tubercles; shield-like subtibials and enlarged, submetatarsal scales absent; 25–31 subdigital lamellae on fourth toe; no dark, longitudinal, gular markings or blotches; head and tail yellow in adult males; no dark patches enclosing white to yellow ocelli on neck or shoulder; no prominent, yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.

Description of holotype. Adult male; SVL 37.7 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.28), somewhat narrow (HW/SVL 0.16), flat (HD/HL 0.40), distinct from neck; snout short (ES/HL 0.46), concave in lateral profile; postnasal region constricted medially; scales of rostrum low, rounded, juxtaposed, smooth, larger than similarly shaped scales on occiput; weak, supraorbital ridges; no frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.22); extra-brillar fringe scales small in general but slightly larger anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 90% divided by longitudinal groove; rostral bordered posteriorly by two supranasals, an azygous postrostral of similar size, and nostrils; bordered laterally by first supralabials; 7R,8L raised supralabials of similar size, but smallest posteriorly; 7R,L infralabials, decreasing gradually in size posteriorly; nostrils small, elongate, oriented dorsoposteriorly; bordered posteriorly by small, granular, postnasal scales; mental large, triangular, concave, extending to level of second infralabials, bordered posteriorly by three postmentals, medial postmental smaller than laterals; gular scales smooth, rounded, juxtaposed; throat scales smooth, flat, subimbricate.

Body slender, elongate (AG/SVL 0.42); small, raised, smooth, dorsal scales generally equal in size throughout body, intermixed with numerous, larger, multi-keeled, longitudinally arranged tubercles; tubercles extend from top of head to base of tail and are smallest anteriorly; tubercles on flanks; 18 paravertebral

tubercles; pectoral and abdominal scales smooth, flat, imbricate, same size; abdominal scales larger than dorsals; six contiguous, pore-bearing, precloacal scales; pores round; forelimbs moderately long, slender, dorsal scales smooth; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, raised, subimbricate; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at digital inflections; interdigital webbing generally absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales weakly keeled, subimbricate; ventral scales smooth, imbricate; plantar scales smooth, slightly raised, subimbricate; no enlarged submetatarsal scales beneath first metatarsal; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits; enlarged scales at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 31 subdigital lamellae on fourth toe; caudal scales arranged in segmented whorls; four scales per caudal segment; dorsal, caudal scales flat, juxtaposed anteriorly; middorsal and lateral, caudal furrows present; no median row of enlarged, subcaudal scales; subcaudals smooth; paravertebral, dorsolateral, and lateral rows of large, keeled, caudal tubercles extend length of tail; caudal tubercles do not encircle tail and absent from lateral furrow; two postcloacal tubercles; tail approximately 1.2% times SVL.



FIGURE 14. Type series of *Cnemaspis huaseesom* sp. nov.



FIGURE 15. Upper right: uncataloged adult male *Cnemaspis huaseesom* **sp. nov.** from the Sai Yok National Park, Kanchanaburi Province (photo by N. Panitvong). Upper middle: adult male *Cnemaspis huaseesom* **sp. nov.** (holotype THNHM 15909) in the light color phase (photo by M. Sumontha). Upper left: adult female *C. huaseesom* **sp. nov.** (paratype PSUZC-RT 2010.55) in light color phase (photo by M. Sumontha). Lower: microhabitat of *C. huaseesom* **sp. nov.** at type locality of *C. huaseesom* **sp. nov.** (photo by L. Grismer).

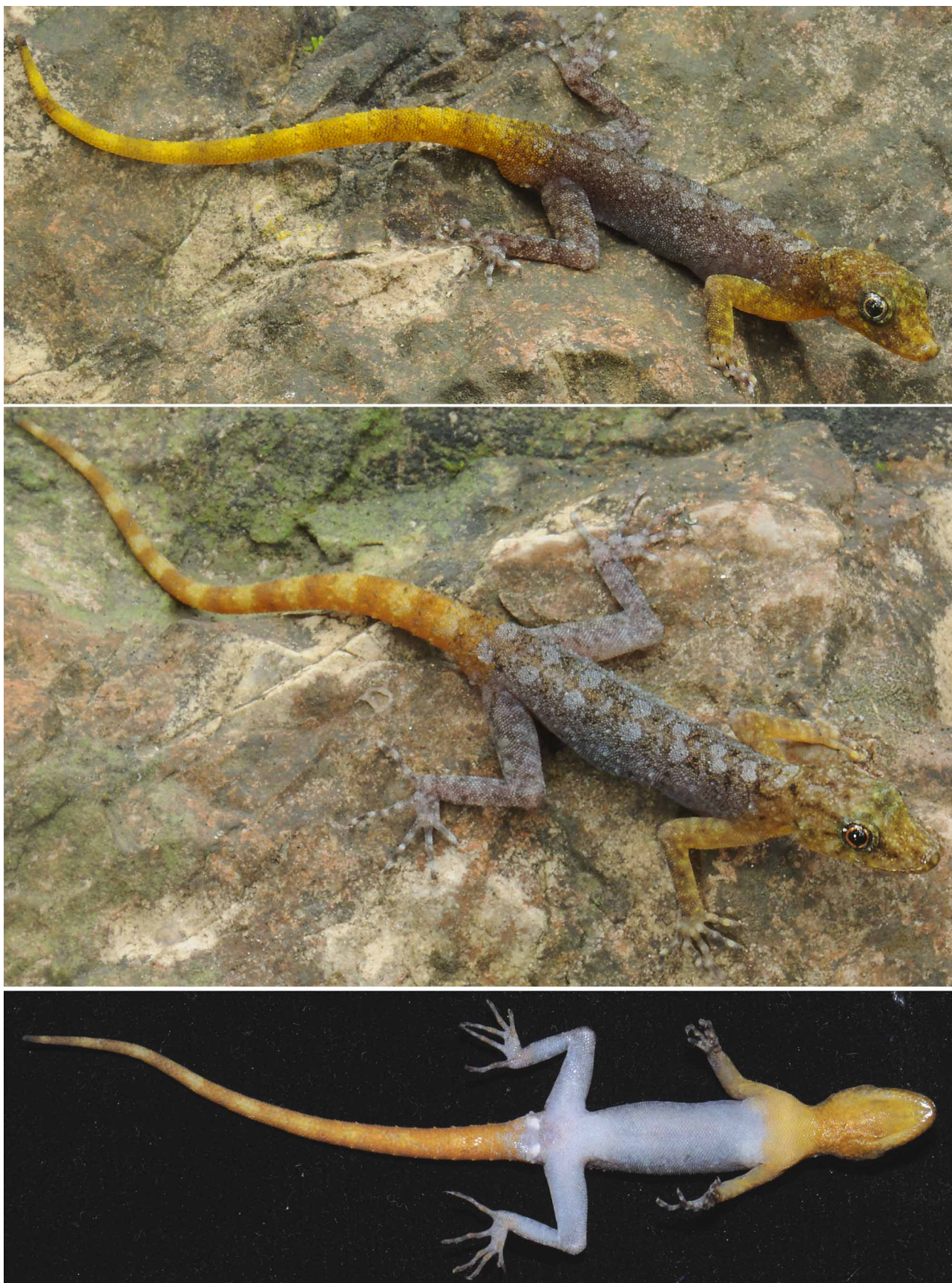


FIGURE 16. Upper and middle: uncatalogued adult males of *Cnemaspis huaseesom* **sp. nov.** from the type locality at Sai Yok National Park, Kanchanaburi Province showing the dark color phase. Lower: ventral view of uncatalogued adult male from type locality. Photos by L. Grismer.

Coloration (in life; Fig. 15). Dorsal ground color of head, body, forelimbs and tail yellow; dorsal ground color of trunk and hind limbs gray; top of head bearing small, diffuse, faint, darker colored markings giving it a somewhat mottled appearance; dark postorbital stripes faint; large, round, whitish markings on nape; trunk uniformly gray; tubercles on body lightly colored; forelimbs generally uniform yellow bearing a slight banding pattern; digits white bearing thin, dark bands; ventral surface of gular region, throat, pectoral and subcaudal region yellow; belly pale gray; ventral surface of limbs gray; fine, dark stippling on all ventral surfaces, most dense on belly.

Variation. Differences in squamation and morphometrics are presented in TABLE 6. Male *Cnemaspis huaseesom* **sp. nov.** are capable of considerable change in coloration from a light to darker phase (Figs. 15,16). The description that follows is of the darker phase: dorsal ground color of head, forelimbs and tail yellow, with faint banding on tail; dorsal ground color of trunk and hind limbs dark gray and bearing large, light gray, paravertebral spots extending from occiput to base of tail; dorsal surface of hind limbs bearing large, light gray spots; dorsal surface of forelimbs bearing small, yellow markings; all ventral surfaces darker. Sexual dimorphism of color pattern is marked in this species with females lacking the yellow head, forelimbs, and tail of adult males (Fig. 15). PSUZC-RT 2010.55 has the same general trunk color pattern as the holotype in the dark phase. The overall ground color of the head, body, limbs, and tail is light brown; large, lighter, paravertebral markings extend from the nape to the base of the tail where they continue posteriorly to form lightly colored, caudal bands; the flanks are densely stippled with cream colored markings and bear faint, gray bars; the limbs are mottled; all ventral surfaces beige with faint stippling that is most dense on the belly and tail. Some adult males may have a gray, as opposed to yellow, tail (Fig. 15).

TABLE 6. Descriptive measurements and scale counts of the type series of *Cnemaspis huaseesom*. See materials and methods for abbreviations. / = character not evaluated.

	THNHM 15909 holotype	PSUZC-RT 2010.55 paratype	CUMZ-R 2009,6,24-4 paratype
SVL	37.7	37.9	32.9
Sex	m	f	m
Supralabials	7	7	7
Infralabials	7	6	7
Precloacal pores	6	0	5
Paravertebral tubercles	18	21	21
4th toe lamellae	31	31	26
TL	46.9	46.1	28
TW	4.4	4.3	3.4
FL	6.2	6.2	5.6
TBL	7.0	6.2	6.3
AG	15.8	15.9	14.3
HL	10.4	10.0	14.1
HW	6.1	6.1	5.5
HD	4.2	4.3	3.6
ED	2.3	2.0	2.1
EE	2.7	3.0	2.6
ES	4.8	4.9	4.2
EN	3.9	3.9	3.1
IO	0.9	1.1	0.9
EL	1.0	1.2	0.9
IN	0.8	0.8	0.7

Distribution. *Cnemaspis huaseesom* **sp. nov.** is known only from Sai Yok National Park, Sai Yok District, Kanchanaburi Province, Thailand (Fig. 1).

Natural history. *Cnemaspis huaseesom* **sp. nov.** is most commonly found on hillsides with karst boulders in semideciduous, dipterocarp forest amongst thick vegetation including bamboo. Lizards are generally active at night on karst boulders but may be found on vine-like vegetation near the boulders (Fig. 15). This species is fast, wary, and flees into deep cracks and crevices at the slightest provocation. More than one lizard is usually found on a given outcropping. Gravid females carrying two eggs were observed on 5 October 2009.

Etymology. The specific epithet *huaseesom* is derived from the Thai words *hua* meaning head, *see* meaning color, and *som* meaning orange in reference to the orangish yellow head of this species.

Comparisons. *Cnemaspis huaseesom* **sp. nov.** is differentiated from all other species of Southeast Asian *Cnemaspis* in that adult males have a yellow head, forearms, and original tail. In this regard it is similar to *C. paripari* Grismer & Chan 2009 although adult male *C. paripari* lack yellow limbs and only the regenerated tail is yellow (Grismer & Chan 2009). The presence of smooth ventral scales in *C. huaseesom* **sp. nov.** distinguishes it from *C. argus* Dring 1979, *C. bayuensis* Grismer, Grismer, Wood & Chan 2008, *C. biocellata* Grismer, Chan, Nurolhuda & Sumontha 2008, *C. dringi* Das & Bauer 1998, *C. flavolineata* (Nicholls 1949), *C. karsticola* Grismer, Grismer, Wood & Chan 2008, *C. kendallii* (Gray 1845), *C. limi* Das & Grismer 2003, *C. mcguirei* Grismer, Grismer, Wood & Chan 2008, *C. nigridia* (Smith 1925), *C. paripari*, *C. pemangilensis* Grismer & Das 2006, *C. pseudomcguirei* Grismer, Norhayati, Chan, Belabut, Muin, Wood & Grismer 2009, *C. siamensis* (Smith 1925), *C. chanardi* **sp. nov.**, *C. vandeventeri* **sp. nov.**, *C. narathiwatensis* **sp. nov.**, and *C. roticanai* Grismer & Chan 2010. *Cnemaspis huaseesom* **sp. nov.** is separated from *C. affinis* (Stoliczka 1870), *C. aurantiacopes* Grismer & Ngo 2007, *C. baueri* Das & Grismer 2003, and *C. perhentianensis* Grismer & Chan 2008 by having smooth as opposed to keeled subcaudals. The presence of precloacal pores in male *C. huaseesom* **sp. nov.** differentiates it from *C. boulengeri* Strauch 1887, *C. psychedelica* Grismer, Ngo & Grismer 2010, *C. tucdupensis* Grismer & Ngo 2007, and *C. punctatonuchalis* **sp. nov.** **sp. nov.** The smaller maximum SVL (37.9 mm) of *C. huaseesom* **sp. nov.** separates it from the larger *C. caudanivea* Grismer & Ngo 2007 (SVL 47.1 mm), *C. flavigaster* Chan & Grismer 2008, *C. kumpoli* Smith 1963 (SVL 63.0 mm), and *C. nuicamensis* Grismer & Ngo 2007 (SVL 47.5 mm) although it is much larger than *C. monachorum* Grismer, Norhayati, Chan, Belabut, Muin, Wood & Grismer 2009 (SVL 32.9 mm). *Cnemaspis huaseesom* **sp. nov.** is differentiated from *C. chanthaburiensis* Bauer & Das 1998 in lacking as opposed to having tubercles in the lateral, caudal furrow and is differentiated from *C. kamolnorranathi* **sp. nov.** by lacking as opposed to having an enlarged median row of subcaudals. Other differences in squamation are scored across all species in TABLE 1.

Additional material examined. Kanchanaburi Province: Sai Yok National Park ZMKU Rep-000316, KZM 007.

Cnemaspis punctatonuchalis **sp. nov.**

Spotted-neck Rock Gecko

Djing Djok Niew Yaow Khor Joot

Figures 17,18

Holotype. Adult male (THNHM 2001) from Thap Sakae District, Prachuap Khirikhan Province, Thailand. Exact locality, collector, and date of collection unknown.

Paratypes. THNHM 1899 is from the same locality as the holotype and no other data are known. ZMKU Rep-000314 was collected from Hauy Yang, Thap Sakae District, Prachuap Khirikhan Province on 1 Mar 2010 by Parinya Pawangkhanant and Komson Hongphattharakeeree.

Diagnosis. Adult males reaching 49.6 mm SVL, adult females reaching 43.8 mm; eight supralabials; seven or eight infralabials; gulars smooth; forearm scales keeled; subtibials, ventrals, subcaudals smooth; dorsal tubercles keeled; 24–27 paravertebral tubercles; enlarged, elongate pairs or trios of isolated tubercles on flanks; dorsolateral, lateral, and ventrolateral caudal tubercles present only anteriorly; caudal tubercles do

not encircle tail; caudal tubercles absent from lateral, caudal furrow; middorsal caudal furrow absent; median row of smooth, enlarged subcaudals; no pore-bearing, precloacal scales; 1–3 postcloacal tubercles; shield-like subtibials and enlarged, submetatarsals absent; 29–31 subdigital lamellae on fourth toe; no dark, longitudinal, gular markings or blotches; head not yellow in adult males; black neck patch enclosing a white to yellow ocellus present in adult males; no dark shoulder patch enclosing white to yellow ocellus; no prominent, yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.



FIGURE 17. Type series of *Cnemaspis punctatonuchalis* sp. nov.

Description of holotype. Adult male; SVL 45.8 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.26), somewhat narrow (HW/SVL 0.16), flat (HD/HL 0.42), distinct from neck; snout short (ES/HL 0.49), concave in lateral profile; postnasal region constricted medially; scales of rostrum low, rounded,

juxtaposed, weakly keeled, larger than similarly shaped scales on occiput; weak, supraorbital ridges; no frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.17); extra-brillar fringe scales small in general but slightly larger anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 80% divided by longitudinal groove; rostral bordered posteriorly by two supranasals, an azygous postrostral of similar size, and nostrils; bordered laterally by first supralabials; 8R,9L raised supralabials of similar size, but smallest posteriorly; 7R,L infralabials, decreasing gradually in size posteriorly; nostrils small, oblong, oriented dorsolaterally; bordered posteriorly by small, granular, postnasal scales; mental large, triangular, flat, extending to level of second infralabials, bordered posteriorly by three postmentals of similar size; gular scales smooth, rounded, juxtaposed; throat scales smooth, flat, subimbricate. Body slender, elongate (AG/SVL 0.45); small, raised, smooth, dorsal scales generally equal in size throughout body, intermixed with numerous, large, multi-keeled, semi-longitudinally arranged tubercles becoming spinose laterally and grouped in pairs or trios; tubercles extend from occiput to base of tail and are smallest anteriorly; 24–27 paravertebral tubercles; pectoral and abdominal scales smooth, flat, imbricate; abdominal scales larger than pectoral scales and dorsals; no pore-bearing, precloacal scales; forelimbs moderately long, slender, dorsal scales smooth; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, flat, subimbricate; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at digital inflections; interdigital webbing generally absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales of thigh, smooth, raised, juxtaposed; dorsal scales of foreleg weakly keeled, subimbricate; ventral scales of hind limb smooth, imbricate; plantar scales smooth, flat, subimbricate; no enlarged subtibials or submetatarsals; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 29 subdigital lamellae on fourth toe; dorsal, caudal scales arranged in segmented whorls; caudal scales low, weakly keeled, juxtaposed anteriorly; middorsal furrow absent; lateral, caudal furrow weak; median row of enlarged, smooth, subcaudal scales; four scales per caudal segment; other subcaudals smooth; paravertebral rows of large, keeled, caudal tubercles extend length of tail; dorsolateral, lateral, and ventrolateral rows of tubercles present only anteriorly; caudal tubercles do not encircle tail, absent from lateral, caudal furrow; 1–3 postcloacal tubercles; tail approximately 1.2% times SVL.

Coloration (in alcohol). Dorsal ground color of head, body, limbs and tail light brown; top of head bearing large, diffuse, light and darker colored markings giving it a mottled appearance; postorbital stripes absent; large, whitish markings on side of head forming a reticulum that extends ventrally onto throat; three, radiating, elongate blotches on occiput bordering the anterior margin of a large, white spot; lower sides of neck black, enclosing a large, white ocellus (Fig. 18); black neck patch edged posteriorly by white antebrachial and brachial marking; five lightly colored, paravertebral, butterfly-shaped markings between forelimb insertions and base of tail; markings continue onto tail to form lightly colored bands; patches of enlarged tubercles on flanks white; other tubercles on body dark or lightly colored; limbs generally uniform brown bearing elbow and knee patches; digits white bearing thin, dark bands; all ventral surfaces uniform beige with fine, dark stippling in some scales.

Variation. Differences in squamation and morphometrics are presented in TABLE 7. The enlarged, paired, tubercles on the flanks are reduced in females. Some scale counts are missing because the paratype (THNHM 1899) had apparently been partially eaten by arthropods. THNHM 1899 generally approaches the holotype in all aspects of coloration and pattern in alcohol (Fig. 17). The reticulum on the throat, however, is not as obvious. THNHM 1899 has only 11 mm of tail. In life sexual dimorphism in color is distinct (Fig. 18). Adult males have a brownish-green head with a yellow neck which accentuates the black neck patch bearing the cream colored ocelli. The body and limbs are grayish green and the body bears a series of alternating dark and light paravertebral blotches. The ground color of the tail is deep yellow and overlain with lighter, yellow bands. The adult female (ZMKU Rep-000314) has a greyish dorsal ground color overall that is overlain by a prominent series of light and dark blotches on the head and a large light central nape blotch. Alternating dark

and light paravertebrals blotches occur on the body that transform into a light banding pattern on the tail. The limbs are somewhat banded distally and spotted proximally.

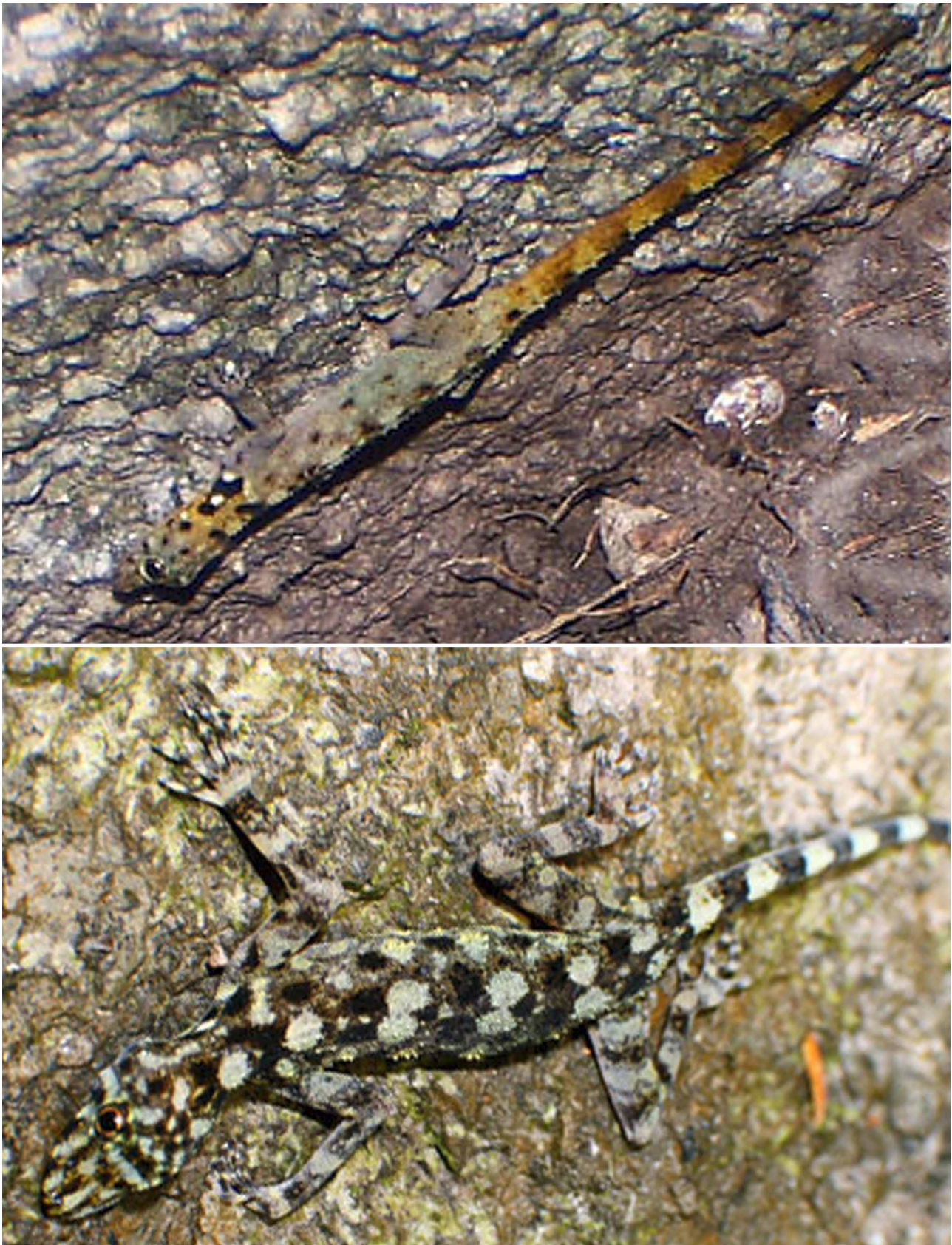


FIGURE 18. Upper: uncataloged adult male *Cnemaspis punctatonuchalis* **sp. nov.** Lower: uncataloged adult female *C. punctatonuchalis* **sp. nov.** Photos by K. Hongphattharakeeree.

TABLE 7. Descriptive measurements and scale counts of the type series of *Cnemaspis punctatonuchalis*. See materials and methods for abbreviations. / = character not evaluated.

	THNHM 1899 paratype	THNHM 2001 holotype	ZMKU Rep 000314 Paratype
SVL	49.6	45.8	43.8
Sex	m	m	f
Supralabials	8	8	8
Infralabials	8	7	8
Precloacal pores	0	0	0
Paravertebral tubercles	24	27	25
4th toe lamellae	/	29	31
TL	11	55.8	/
TW	5.0	4.5	3.0
FL	8.5	9.2	8.6
TBL	10.3	11.1	10.2
AG	20.5	20.4	18.7
HL	13.1	11.9	11.6
HW	8.1	7.2	7.1
HD	5.3	5.0	4.7
ED	2.7	2.0	2.4
EE	3.4	3.6	3.2
ES	6.0	5.8	5.9
EN	4.9	4.4	4.6
IO	2.9	2.9	2.8
EL	1.1	0.8	0.9
IN	/	1.0	1.2

Distribution. *Cnemaspis punctatonuchalis* **sp. nov.** is known only from the district of Thap Sakae, Prachuap Khiri Khan Province, Thailand (Fig. 1).

Natural history. Specimens have only been observed at night on granite boulders.

Etymology. The specific epithet *punctatonuchalis*, is derived from the Latin adjective *punctatus*, meaning spotted and the Latin noun *nuchalis*, meaning neck and is in reference to the large, white ocellus on the side of the throat.

Comparisons. *Cnemaspis punctatonuchalis* **sp. nov.** can be diagnosed from all other Southeast Asian *Cnemaspis* in having pairs or trios of enlarged, elongate, isolated tubercles on the flanks and a black, neck patch enclosing a white to yellow ocellus. Its lack of precloacal pores in males further separates it from *C. affinis*, *C. argus*, *C. bayuensis*, *C. biocellata*, *C. caudanivea*, *C. chanthaburiensis*, *C. dringi*, *C. flavigaster*, *C. flavolineata*, *C. karsticola*, *C. kumpoli*, *C. mcguirei*, *C. monachorum*, *C. nigridia*, *C. nuicamensis*, *C. paripari*, *C. perhentianensis*, *C. pseudomcguirei*, *C. chanardi* **sp. nov.**, *C. vandeventeri* **sp. nov.**, *C. kamolnorranathi* **sp. nov.**, *C. narathiwatensis* **sp. nov.**, *C. huaseesom* **sp. nov.**, and *C. roticanai*. Other differences in squamation are scored across all species in TABLE 1.

***Cnemaspis narathiwatensis* sp. nov.**

Narathiwat Rock Gecko

Djing Djok Niew Yaow Narathiwat

Figures 19,20

Holotype. Adult male (THNHM 1436) from Waeng District, Narathiwat Province, Thailand. Exact locality, collector, and date of collection unknown.

Paratypes. Paratype THNHM 1338 is from the same locality as the holotype and no other data are known. Paratype THNHM 12435 was collected at Bang Lang National Park, Bannang Sata District, Yala Province on 17 June 2002 by Tanya Chan-ard and Yodchaiy Chuaynkern.



FIGURE 19. Type series of *Cnemaspis narathiwatensis* sp. nov.

Diagnosis. Adult males reaching 43.2 mm SVL, adult females reaching 37.3 mm SVL; nine or 10 supralabials; 7–9 infralabials; gulars weakly keeled; forearm, subtibials, ventrals, subcaudals, and dorsal tubercles keeled; tubercles on body linearly arranged; 28 or 29 paravertebral tubercles; no ventrolateral caudal tubercles; caudal tubercles do not encircle tail; caudal tubercles within lateral, caudal furrow; no keeled or enlarged median row of subcaudals; 3–6 pore-bearing, precloacal scales arranged in a chevron and separated by a single, non-pore-bearing, precloacal scale; pores round; two or three postcloacal tubercles; shield-like subtibials and enlarged, submetatarsal scales absent; 24–26 subdigital lamellae on fourth toe; no dark, longitudinal, gular markings or blotches; head not yellow in adult males; no dark neck patch enclosing a white to yellow ocellus; dark shoulder patch enclosing white ocellus; no prominent, yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.

Description of holotype. Adult male; SVL 43.2 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.29), somewhat narrow (HW/SVL 0.19), flat (HD/HL 0.43), distinct from neck; snout short (ES/HL 0.46), concave in lateral profile; postnasal region constricted medially; raised scales of rostrum raised, keeled, larger than similarly shaped scales on occiput; moderate, supraorbital ridges; shallow frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.22); extra-brilliar fringe scales small in general but slightly larger anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 75%

divided by longitudinal groove; rostral bordered posteriorly by two supranasals, an azygous postrostral of similar size, and nostrils, bordered laterally by first supralabials; 9R,10L raised supralabials of similar size, but smallest posteriorly; 9R,L infralabials, decreasing gradually in size posteriorly; nostrils small, elongate, oriented posteriorly, bordered posteriorly by small, granular, postnasal scales; mental large, triangular, medially concave, extending to level of second infralabials, bordered posteriorly by four postmentals, lateral two largest; gular and throat scales raised, weakly keeled, somewhat pointed, juxtaposed.



FIGURE 20. Upper: ocellus in shoulder region of *Cnemaspis narathiwatensis* **sp. nov.** (male; THNHM 1436). Lower: uncatalogued female from Hala-Bala, Narathiwat Province showing no ocellus in the shoulder region (photo by Siriporn Tong-Aree).

Body slender, elongate; small, weakly keeled, dorsal scales equal in size throughout body, intermixed with numerous, large, multi-keeled, longitudinally arranged tubercles; tubercles extend from nape to base of tail and are smallest anteriorly; 28 or 29 paravertebral tubercles; tubercles on flanks; pectoral and abdominal scales slightly raised, subimbricate, keeled; abdominal scales same size as pectoral scales, larger than dorsals; six pore-bearing, precloacal scales arranged in a chevron (3-3) separated by a single, non-pore-bearing scale; pores round; forelimbs moderately long, slender, dorsal scales keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, flat, subimbricate; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger

scale at digital inflections; interdigital webbing generally absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales keeled, raised, juxtaposed; ventral scales of thigh weakly keeled; subtibials strongly keeled, larger than dorsal tibials; plantar scales smooth, flat, subimbricate; no enlarged submetatarsal scales beneath first metatarsal; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 24–26 subdigital lamellae on fourth toe; caudal scales arranged in segmented whorls; dorsal, caudal scales low, weakly keeled, juxtaposed anteriorly; moderate, middorsal, caudal furrow; moderate, lateral, caudal furrow; no median row of slightly enlarged, subcaudal scales; four scales per caudal segment; subcaudals keeled; paravertebral, dorsolateral, and lateral rows of large, keeled, caudal tubercles of equal size; caudal tubercles do not encircle tail, present in lateral, caudal furrow; two postcloacal tubercles; tail approximately 1.2% times SVL; anterior 23.9 mm original, remainder regenerated.

Coloration (in alcohol). Dorsal ground color of head, body, limbs and tail light brown; top of head bearing small, brown markings with two dark, diffuse, postorbital stripes; lower postorbital stripe extends onto upper portion of forelimb; upper postorbital stripe wider, incomplete, extending onto occiput and nearly meeting opposing, upper, postorbital stripe; shoulder region dark, enclosing a whitish ocellus composed of large tubercles followed posteriorly by a lightly colored, postscapular marking in turn followed by a series of light markings on flanks which fade posteriorly; five faint, pairs of small, dark, paravertebral markings on trunk between forelimb insertion and base of tail; tubercles on base of tail light-colored, forming rings; limbs generally uniform brown bearing small, randomly arranged, diffuse markings; prominent, dark band on wrist; digits bearing dark bands; all ventral surfaces uniform beige with fine, dark stippling in each scale; throat darker; subcaudal region bearing whitish rings.

Variation. Differences in squamation and morphometrics are presented in TABLE 8. The paratypes (THNHM 1338) generally approach the holotype in all aspects of coloration and pattern (Fig. 19). THNHM 1338 is a female and lacks the dark, shoulder patches and yellow to white ocelli; the white, postscapular marking; and the light markings on flanks. The lack of postscapular markings and the markings on the flanks may be due to the extremely faded nature of the color pattern of this specimen or sexual dimorphism. A living, uncataloged female from Hala-Bala, Narathiwat Province (Fig. 20) also lacks a dark shoulder patch enclosing a white ocellus. This indicates that this species is sexually dimorphic for this character. The color pattern of the male (THNHM 12435; Fig. 20) is well preserved and bears all the diagnostic characters of the holotype. It also shows an additional white spot on the lower, lateral region of the nape and more prominently displays the white rings in the subcaudal region. Darker banding on the tail is also more prominent.

Distribution. *Cnemaspis narathiwatensis* **sp. nov.** is known only from the district of Waeng, Narathiwat Province and Bang Lang National Park, Bannang Sata District, Yala Province, Thailand (Fig. 1).

Natural history. Specimens have been observed at night sheltering in rocky crevices between 200–500 m in elevation (Siriporn Tong-aree, *in lit.* 2010). This may indicate this species is a diurnal rocky microhabitat specialist.

Etymology. The specific epithet *narathiwatensis* is named after the Thai Province, Narathiwat in reference to the type locality.

Comparisons. *Cnemaspis narathiwatensis* **sp. nov.** is differentiated from all species of *Cnemaspis* except *C. affinis*, *C. biocellata*, *C. kumpoli*, *C. mcguirei*, and *C. pseudomcguirei* in having a black shoulder patch enclosing a white to yellow ocellus. Its smaller maximum SVL (43.2 mm) clearly separates it from the larger *C. kumpoli* (SVL 63.0 mm) and *C. mcguirei* (SVL 65.0 mm). It is separated from *C. affinis* by having, as opposed to lacking, tubercles in the lateral caudal furrow; from *C. biocellata* by having keeled, as opposed to smooth subtibials and subcaudals; and from *C. pseudomcguirei* by having pore-bearing, precloacal scales separated into two series as opposed to being continuous. Other differences in squamation and color pattern are scored across all species in TABLES 1 and 2.

TABLE 8. Descriptive measurements and scale counts of the type series of *Cnemaspis narathiwatensis*. See materials and methods for abbreviations. / = character not evaluated.

	THNHM 1338 paratype	THNHM 1436 holotype	THNHM 12435 paratype
SVL	37.3	43.2	34.1
Sex	f	m	m
Supralabials	10	9	9
Infralabials	9	9	7
Precloacal pores	0	6	3
Paravertebral tubercles	29	28	28
4th toe lamellae	26	24	24
TL	48.5	53.7	20
TW	4.3	5.0	3.6
FL	5.8	7.7	5.5
TBL	7.4	8.7	6.7
AG	16	20.3	14.5
HL	10.4	12.7	19.3
HW	6.0	8.0	5.8
HD	4.2	5.5	4.0
ED	2.3	2.8	1.9
EE	2.8	3.4	2.8
ES	4.9	5.9	4.5
EN	3.7	4.8	3.4
IO	2.2	3.0	2.2
EL	0.9	0.9	0.7
IN	1.2	0.9	1.0

***Cnemaspis niyomwanae* sp. nov.**

Niyomwan's Rock Gecko

Djing Djok Niew Yaow Niyomwan

Figure 21

Holotype. Adult female (THNHM 15910) from Thum Khao Ting, Paeon District, Trang Province, Thailand (07°09.943N 99°48.142E) at 28 m in elevation. Collected by M. Sumontha on 26 December 2009.

Paratypes. Adult male (ZMKU Rep-000315), adult female (PSUZC-RT 2010.56), subadult males (CUMZ R-2009,6,24-10, KZM 008) from Baan Nam Pud, La-ngu District, Satun Province (07°05.688N 99°54.732E) at 38–46 m in elevation. ZMKU Rep-000315, CUMZ R-2009,6,24-10 and KZM 008 were collected by Siriwat Dangsi on 6 and 7 October 2009. PSUZC-RT 2010.56 was collected by Thanin Kaewmanee on 24 December 2009.

Diagnosis. Adult males reaching 45.9 mm SVL, adult females reaching 56.8 mm SVL; 8–11 supralabials; 6–8 infralabials; gulars smooth; forearm scales keeled; subtibials, ventrals, subcaudals smooth; dorsal tubercles keeled; 26–31 paravertebral tubercles; enlarged, elongate, laterally compressed, white, isolated tubercles on sides of neck, shoulders, and flanks; dorsolateral, lateral, and ventrolateral caudal tubercles usually present only anteriorly; caudal tubercles do not encircle tail; caudal tubercles absent from lateral, caudal furrow; middorsal caudal furrow absent; median row of smooth, enlarged subcaudals; three pore-bearing, precloacal scales in males; one or two postcloacal tubercles; shield-like subtibials and enlarged,

submetatarsals absent; 31–34 subdigital lamellae on fourth toe; yellow and orange alternating bands on forearms and forelimbs in subadult and adult males; paired, yellow, rostral stripes in subadult and adult males; paired, cream to white, circular, occipital blotches; large, cream to white, paravertebral butterfly-shaped dorsal blotches; no dark, longitudinal, gular markings or blotches; head not yellow in adult males; no black neck patch enclosing a white to yellow ocellus; no dark shoulder patch enclosing white to yellow ocellus; no prominent, yellow to white, prescapular crescent or transverse bars on flanks. These differences are summarized across all species in TABLES 1 and 2.

Description of holotype. Adult female; SVL 56.8 mm; head oblong in dorsal profile, moderate in size (HL/SVL 0.25), somewhat narrow (HW/SVL 0.16), flat (HD/HL 0.44), distinct from neck; snout short (ES/HL 0.51), concave in lateral profile; postnasal region constricted medially; scales of rostrum low, rounded, juxtaposed, smooth, larger than similarly shaped scales on occiput; distinct, supraorbital ridges; shallow frontonasal sulcus; canthus rostralis smoothly rounded; eye large (ED/HL 0.21); extra-brillar fringe scales small in general but larger anteriorly; pupil round; ear opening oval, taller than wide; rostral concave dorsally, dorsal 75% divided by longitudinal groove; rostral bordered posteriorly by two supranasals contacting medially, and nostrils; bordered laterally by first supralabials; 8R,L raised supralabials of similar size, but smallest posteriorly; 7R,L infralabials, decreasing gradually in size posteriorly; nostrils small, oblong, oriented dorsoposteriorly; bordered posteriorly by small, granular, postnasal scales; mental large, triangular, slightly concave, extending to level of second infralabials, bordered posteriorly by three postmentals, lateral postmentals much larger than center postmental; gular and throat scales smooth, raised, juxtaposed.

Body slender, elongate (AG/SVL 0.45); small, raised, smooth, dorsal scales generally equal in size throughout body, intermixed with numerous, moderately sized, keeled, randomly arranged tubercles; enlarged, isolated tubercles on sides of neck, shoulders, and flanks; tubercles extend from occiput to base of tail and are smallest anteriorly; 31–34 paravertebral tubercles; pectoral and abdominal scales smooth, flat, imbricate; abdominal scales larger than pectoral scales and dorsals; no pore-bearing, precloacal scales; forelimbs moderately long, slender, dorsal scales keeled; ventral scales of forearm smooth, juxtaposed to subimbricate; palmar scales smooth, raised, juxtaposed; digits long with an inflected joint; claws recurved; subdigital lamellae unnotched; subdigital lamellae wide throughout length of digits, bearing a larger scale at digital inflections; interdigital webbing generally absent; fingers increase in length from first to fourth with fifth same length as fourth; hind limbs longer and thicker than forelimbs; dorsal scales of thigh, keeled, raised, juxtaposed; dorsal scales of foreleg rugose, subimbricate; ventral scales of hind limb smooth, imbricate; plantar scales smooth, flat, subimbricate; no enlarged subtibials or submetatarsals; digits elongate with an inflected joint; claws recurved; subdigital lamellae unnotched; lamellae wide throughout length of digits except at base where scales are more granular; enlarged scale at digital inflections; interdigital webbing absent; toes increase in length from first to fourth with fourth and fifth nearly equal in length; 33R,L subdigital lamellae on fourth toe; caudal scales arranged in segmented whorls, low, smooth, juxtaposed anteriorly; middorsal furrow absent; lateral, caudal furrow weak; median row of enlarged, smooth, subcaudal scales; four scales per caudal segment; other subcaudals smooth; paravertebral rows of large, keeled, caudal tubercles extend length of tail, becoming smaller and smooth posteriorly; dorsolateral row of tubercles present only anteriorly, all other rows absent; caudal tubercles do not encircle tail, absent from lateral, caudal furrow; one or two postcloacal tubercles; tail approximately 1.3% times SVL.

Coloration (in life; Fig. 21). Dorsal ground color of head, body, and tail faded green; dorsal ground color of limbs faded brown; top of head bearing a pair of yellow, rostral stripes beginning in interorbital region and terminating in postnasal region; diffuse, light occipital blotches present; postorbital striping absent; faint, light mottling on sides of head; whitish, medial blotch on nape followed posteriorly by five lightly colored, paravertebral, butterfly-shaped markings between forelimb insertions and base of tail; markings continue onto tail to form lightly colored bands; enlarged, white tubercles on sides of neck, shoulders and flanks; other tubercles on body dark or lightly colored; upper regions of limbs bearing diffuse, light mottling; lower limbs bearing diffuse yellowish and brownish band; digits white bearing broad, brown bands; all ventral surfaces except subcaudal region of uniform beige with fine, dark stippling in some scales; subcaudal region grayish.



FIGURE 21. Upper: adult male *Cnemaspis niyomwanae* **sp. nov.** (CUMZ R-2009,6,24-10). Middle: adult female *C. niyomwanae* **sp. nov.** (holotype THNHM 15910). Lower: ventral view of uncatalogued female *C. niyomwanae* **sp. nov.** (photos by M. Sumontha).

Variation. Differences in squamation and morphometrics are presented in TABLE 9. *Cnemaspis niyomwanae* **sp. nov.** shows significant sexual dimorphism with males being more colorful than females. MS 399 has well-defined, light colored dorsal markings and occipital blotches as compared to the more diffuse blotches seen in females. Males also have bright yellow, rostral stripes and alternating bright red-orange and yellow bands on the forelimbs. These markings are much more drab in females. This species also shows a marked light color phase at night (Fig. 21) where the colors of both males and females become more faded and much less contrasting.

TABLE 9. Descriptive measurements and scale counts of the type series of *Cnemaspis niyomwanae*. See materials and methods for abbreviations. / = character not evaluated.

	ZMKU Rep 000315 paratype	PSUZC-RT 2010.56 paratype	THNHM 15910 holotype	CUMZ R 2009,6,24-10 paratype	KZM 008 paratype
SVL	45.9	46.6	56.8	38.4	41.1
Sex	m	f	f	m	M
Supralabials	8	11	8	9	9
Infralabials	7	8	6	7	7
Precloacal pores	3	/	/	3	3
Paravertebral tubercles	26	28	31	27	28
4th toe lamellae	34	31	33	31	33
TL	70.0	55.7	73.6	/	62.0
TW	4.6	4.0	5.8	3.9	4.3
FL	8.6	7.0	11.1	7.6	7.9
TBL	9.8	8.8	12.5	9.3	9.3
AG	21.1	18.8	25.7	17.5	18.8
HL	12.4	10.4	14.4	10.7	10.9
HW	7.0	6.1	8.9	6.4	6.3
HD	5.0	4.0	6.4	4.4	4.0
ED	2.6	2.5	3.1	2.5	2.3
EE	3.3	2.5	4.0	2.8	2.6
ES	5.9	5.1	7.4	5.2	5.4
EN	4.5	4.1	5.7	3.8	4.9
IO	2.5	1.9	3.2	2.4	1.8
EL	2.2	0.8	1.5	0.8	0.8
IN	1.3	1.0	1.7	1.1	/

Distribution. *Cnemaspis niyomwanae* **sp. nov.** is known only from the border regions of Trang and Satun Provinces, Thailand (Fig. 1).

Natural history. *Cnemaspis niyomwanae* **sp. nov.** is a karst, microhabitat specialist that is abroad at night. During the day, lizards retreat into crevices and caves. All slizards were taken from karst regions in the vicinity of small streams.

Etymology. This species is named in honor of Ms. Piyawan Niyomwan, Thai herpetologist who has worked for many years making significant contributions to our knowledge of the distribution of the amphibians and reptiles of Thailand.

Comparisons. *Cnemaspis niyomwanae* **sp. nov.** can be diagnosed from all other Southeast Asian *Cnemaspis* in having males bearing alternating red-orange and yellow bands on the forelimbs and enlarged,

white, isolated tubercles on the sides of the neck, shoulder and flanks. Its lack of white ocelli in a black shoulder or neck patch separates it from *C. affinis*, *C. biocellata*, *C. kumpoli*, *C. mcguirei*, *C. pseudomcguirei*, *C. puntatonucalis* **sp. nov.** Its presence of precloacal pores in males further separates it from all other species except *C. affinis*, *C. argus*, *C. bayuensis*, *C. biocellata*, *C. caudanivea*, *C. chanthaburiensis*, *C. dringi*, *C. flavigaster*, *C. flavolineata*, *C. karsticola*, *C. kumpoli*, *C. mcguirei*, *C. monachorum*, *C. nigridia*, *C. nuicamensis*, *C. paripari*, *C. perhentianensis*, *C. pseudomcguirei*, *C. chanardi* **sp. nov.**, *C. vandeventeri* **sp. nov.**, *C. kamolnorranathi* **sp. nov.**, *C. narathiwatensis* **sp. nov.**, *C. huaseesom* **sp. nov.**, and *C. roticanai*. Other differences in squamation are scored across all species in TABLE 1.



FIGURE 22. Upper left: adult male *Cnemaspis biocellata*. Upper right: adult male *C. aurantiacopes*. Middle left: adult male *C. kumpoli*. Middle right: adult male *C. mcguirei*. Lower left: adult male *C. psychedelica*. Lower right: adult male *C. paripari* (photos by L. Grismer).

Discussion

The discovery of seven new species of *Cnemaspis* in western and Peninsular Thailand is consistent with numerous, recent discoveries in adjacent Peninsular Malaysia (Chan & Grismer, 2008; Chan *et al.*, Das &

Grismer 2003; Grismer & Chan, 2008; Grismer & Das, 2006; Grismer *et al.* 2008a,b; 2009, 2010b) and continues this group's upward trajectory of increasing species diversity on the Malay Peninsula. The division of the relatively wide ranging, non-microhabitat specialist *C. siamensis* into four species is not surprising given that the rocky, microhabitat specialists that dominate this genus are restricted in distribution (usually being known only from their type localities) and are easily diagnosed by a series of unique characters, many of which concern their remarkable color patterns (e.g. *C. aurantiacopes*, *C. biocellata*, *C. kumpoli*, *C. mcguirei*, *C. paripari*, *C. psychedelica*; Fig. 22). Populations of the more wide ranging, forest generalists such as *C. chanthaburiensis*, *C. flavolineata*, *C. kendallii* and *C. siamensis* on the other hand, are more drab in color and much more similar in appearance (Fig. 23). As such, they garner less interest and workers are often inclined to group them on the basis of geography rather than character analysis, resulting in numerous synonymies (see discussion in Grismer *et al.*, 2008b).



FIGURE 23. Upper left: adult female *Cnemaspis siamensis*. Upper right: adult male *C. flavolineata*. Lower left: adult male *C. kendallii*. Lower right: adult male *C. chanthaburiensis* (photos by L. Grismer).

The diversity of *Cnemaspis* on the Malay Peninsula (25 of 37 species representing 68% of the genus) as opposed to Indochina and Borneo (with significantly more karst habitat and land mass) is, in part, a collecting artifact. Given the numerous, isolated mountain ranges of various sizes throughout central Thailand and the vast amount of karst formations still to be explored in Peninsular Thailand, it is expected that additional populations will be discovered, some of which are certain to be new species. As more field work is being conducted in Laos, Vietnam and Cambodia, new species continue to emerge from there as well (J. Grismer *et al.* 2010; Grismer 2010; Grismer & Ngo 2007; Grismer *et al.* 2010a). Similarly, Grismer & Chan (2009) recently described *C. paripari* from Borneo bringing the total number of species on the Malay Archipelago's largest island to a paltry four. There are still no confirmed records for *Cnemaspis* from Sumatra or Myanmar. These observations suggest that the diversity within this genus is still greatly underrepresented.

The distribution of the 25 species of *Cnemaspis* on the Malay Peninsula and its associated archipelagos generally mirrors the intricate, topographical complexity of this region and the seemingly unlimited opportunities for speciation in this group. Under these biogeographical circumstances, speciation is likely to be exacerbated in a group such as *Cnemaspis* where a conserved morphology and life style across a broad size

range (e.g., maximum SVL 32.9 mm in *C. monachorum* vs. 88.2 mm SVL in *C. limi*) may drive these species' proclivities for niche separation (see Grismer *et al.*, 2008a; Grismer *et al.*, 2010b) and microhabitat specialization. Only two, possibly three, species (*C. kendallii*, and *C. siamensis* and possibly *C. flavolineata*) have distributions that extend more than 400 km. The range of the remaining continental species (22) is much less and most (13 of 22 representing 59%) are known only from their type localities. This low vagility is reflected in species being restricted to reasonably well-circumscribed, geographical regions. In Peninsular Thailand, *C. siamensis* occurs only in the hilly lowlands east of the Tenasserim and Phuket Mountains and no farther south than the southern edge of the Isthmus of Kra (Fig. 1). *Cnemaspis vandeventeri* **sp. nov.** on the other hand, occurs in similar habitats but on the west side of the Tenasserim and Phuket Mountains (Fig. 1). *Cnemaspis siamensis* is parapatric to, or possibly narrowly sympatric with, *C. chanardi* **sp. nov.** which occupies the hilly regions of the Isthmus of Kra and western flanks of the Nakhon Si Thammarat and Sankalakhiri Mountains, likely extending south to the Thai-Malay border (Fig. 1). The extremely localized distribution of rocky, microhabitat specialists in Peninsular and western Thailand, such as *C. biocellata*, *C. huaseesom* **sp. nov.**, *C. niyomwanae* **sp. nov.**, perhaps *C. punctatonuchalis* **sp. nov.**, and *C. narathiwatensis* **sp. nov.**, mirrors that of rocky, microhabitat specialists in Peninsular Malaysia (Chan & Grismer, 2008; Dring, 1979; Grismer *et al.*, 2008a,b). A preliminary molecular phylogeny of *Cnemaspis* (Grismer *et al.* in prep.) indicates that most species in close geographic proximity are closely related whereas only a few others and clades of others, show relationships across more extensive, biogeographical boundaries throughout Southeast Asia. This suggests *Cnemaspis* is a relatively old group and the major geological events that sculpted the unique geographic architecture of the Sunda Region had a significant effect on the diversification of *Cnemaspis* as well.

Acknowledgements

We wish to thank Thanin Kaewmanee who collected specimens of *C. kamolnorranathi* **sp. nov.**, *C. chanardi* **sp. nov.** and *C. niyomwanae* **sp. nov.** and for taking MS to many collecting localities. Saranon Charoensuk for collecting *C. huaseesom*; Siritwat Dangsri for specimens of *C. niyomwanae* **sp. nov.**; Parinya Pawangkhanant and Komson Hongphattharakeeree for specimens and providing photographs of *C. punctatonuchalis* **sp. nov.**; Nonn Panitvong for providing a photograph of *C. huaseesom* **sp. nov.** and data on this population; Thaworn Sarimanon who provided photographs of living *C. chanardi* **sp. nov.** from its natural habitat; Siriporn Tong-Aree from Hala-Bala Wildlife Sanctuary who provided a photograph and ecological data for *C. narathiwatensis* **sp. nov.**; Nopnarong Paisanwattana who supported us during our surveys in Surat Thani; Lawan Chanhome of Queen Savabha Memorial Institute, Bangkok for working facilities. We also would like to thank Siamensis.org's members for their support during our surveys and for useful information used in this paper. Last but not least, we would like to thank late Wirot Nutaphand and Dr. Jarujin Nabhitabhata, our (MS and KK) mentor, who passed away unexpectedly. Their kindness and the knowledge they shared with us over the years will always be in our memories. We thank the BMNH (E. N. Arnold and C. J. McCarthy), CAS (A. E. Leviton and J. Vindum), FMNH (H. K. Voris, R. F. Inger, and A. Resetar), MCZ (J. E. Cadle and J. P. O. Rosado), MSNG (R. Poggi and G. Doria), UF (D. Auth and F. W. King), USDZ (ZRC in Leviton *et al.*, 1985); K. K. P. Lim, P. K. L. Ng, H. H. Tan, and C. M. Yang; USNM (R. I. Crombie, W. R. Heyer, and G. R. Zug), ZMA (A. Groenvelde and L. van Tuijl), G. L. Lenglet of the Institut Royal des Sciences naturelles de Belgique; and ZSI (J. R. B. Alfred, S. K. Chanda, B. Dattagupta and N. C. Gayen) for permitting us to examine material under their care. Lastly we are most thankful to Tanya Chan-ard of the Thailand Natural History Museum, National Science Museum (THNHM), Associate Professor Dr. Kumthorn Thirakhupt of the Chulalongkorn University Museum of Zoology (CUMZ), Dr. Sansareeya Wangkulangkul of the Prince of Songkhla University Zoological Collection (PSUZC), Wut Taksinthum of the Zoological Museum of Kasetsart University (ZMKU), Apirat Taokratok of the Nakhonratchasima Zoo Museum, ZPO (KZM) whose generous and expeditious loan of material made this project possible. We thank P. David (MNHN) for useful information and H. Bringsøe who provided a picture of *C. vandeventeri*. This research was supported in part by a grant to LLG from the College of Arts and Sciences, La Sierra University, Riverside, California.

References

- Bauer, A.M. & Das, I. (1998) A new *Cnemaspis* (Reptilia: Gekkonidae) from Southeastern Thailand. *Copeia*, 1998, 439–444.
- Bauer, A.M., De Silva, A., Greenbaum, E. & Jackman, T. (2007) A new species of day gecko from high elevation in Sri Lanka, with a preliminary phylogeny of Sri Lankan *Cnemaspis* (Reptilia: Squamata: Gekkonidae). *Mitteilungen aus dem Museum für Naturkunde, Berlin, Zoologische Reihe*, 83, 22–32.
- Chan, K.O. & Grismer, L.L. (2008) A new species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Selangor, Peninsular Malaysia. *Zootaxa*, 1877, 49–57.
- Chan, K.O., Grismer, L.L., Shahrul, A., Quah, E., Mohd, A.M., Savage, A.E., Grismer, J.L., Norhayati, A., Remegio, A.-C. & Greer, L.F. III¹ (2010) A New Endemic Rock Gecko *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Gunung Jerai, Kedah, northwestern Peninsular Malaysia. *Zootaxa*, 2576, 59–68.
- Cox, M.J., van Dijk, P.P., Nabhitabhata, J. & Thirakhupt, J. (1998) A Photographic Guide to Snakes and Other Reptiles of Peninsular Malaysia, Singapore and Thailand. New Holland Publishers, London, England, pp. 1–144.
- Das, I. & Bauer, A.M. (1998) Systematics and biogeography of Bornean geckos of the genus *Cnemaspis* Strauch, 1887 (Sauria: Gekkonidae), with the description of a new species. *Raffles Bulletin of Zoology*, 46, 11–28.
- Das, I. & Grismer, L.L. (2003) Two new species of *Cnemaspis* Strauch, 1887 (Squamata: Gekkonidae) from the Seribuat Archipelago, Pahang and Johor States, West Malaysia. *Herpetologica*, 59, 544–552.
- Dring, J.C. (1979) Amphibians and reptiles from northern Trengganu, Malaysia, with descriptions of two new geckos: *Cnemaspis* and *Cyrtodactylus*. *Bulletin of the British Museum of Natural History (Zoology)*, 34, 181–241.
- Grismer, J.L., Grismer, L.L. & Thou, C. (2010) A new species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from southwestern Cambodia. *Journal of Herpetology*, 44, 28–36.
- Grismer, L.L. (2010) The first record of the genus *Cnemaspis* Strauch (Squamata: Gekkonidae) from Laos with the description of a new species. *Zootaxa*, 2475, 55–63.
- Grismer, L.L. & Chan, K.O. (2008) A new species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Pulau Perhentian Besar, Terengganu, Peninsular Malaysia. *Zootaxa*, 1771, 1–15.
- Grismer, L.L. & Chan, K.O. (2009) A new species of karst dwelling *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Sarawak, Borneo. *Zootaxa*, 2246, 21–31.
- Grismer, L.L. & Chan, K.O. (2010) Another new rock gecko (genus *Cnemaspis* Strauch 1887) from Pulau Langkawi, Kedah, Peninsular Malaysia. *Zootaxa*, 2419, 51–62.
- Grismer, L.L., Chan, K.O., E. Quah, Mohd, A.M., A.E. Savage, J.L. Grismer, Norhayati A., L.F. Greer III¹, A.-C. Remegio (2010b) Another new, diminutive Rock Gecko (*Cnemaspis* Strauch) from Peninsular Malaysia and a discussion of resource partitioning in sympatric species pairs. *Zootaxa*, 2569, 55–66.
- Grismer, L.L., Chan, K.O., Nurolhuda, N. & Sumontha, M. (2008a) A new species of karst dwelling gecko (genus *Cnemaspis* Strauch 1887) from the border region of Thailand and Peninsular Malaysia. *Zootaxa*, 1875, 51–68.
- Grismer, L.L. & Das, I. (2006) A new species of gekkonid lizard of the genus *Cnemaspis* Strauch 1887 from Pulau Pemanggil, Johor, West Malaysia. *Herpetological Natural History*, 10, 1–7.
- Grismer, L.L., Grismer, J.L., Wood, Jr., P.L. & Chan, K.O. (2008b) The distribution, taxonomy, and redescription of the geckos *Cnemaspis affinis* (Stoliczka 1887) and *C. flavolineata* (Nicholls 1949) with descriptions of a new montane species and two new lowland, karst-dwelling species from Peninsular Malaysia. *Zootaxa*, 1931, 1–24.
- Grismer, L.L. & Ngo, V.T. (2007) Four new species of the gekkonid genus *Cnemaspis* Strauch 1887 (Reptilia: Squamata) from southern Vietnam. *Herpetologica*, 63, 482–500.
- Grismer, L.L., Ngo, V.T. & Grismer, J.L. (2010a) A colorful new species of insular rock gecko (*Cnemaspis* Strauch 1887) from southern Vietnam. *Zootaxa*, 2352, 46–58.
- Grismer, L.L., Norhayati, A., Chan, K.O., Belabut, D., Muin, M.A., Wood, P.W., Jr. & Grismer, J.L. (2009) Two new diminutive species of *Cnemaspis* Strauch 1887 (Squamata: Gekkonidae) from Peninsular Malaysia. *Zootaxa*, 2019, 40–56.
- Leviton, A.E., Anderson, S.C., Gibbs, R.H., Heal, E. & Dawson, C.E. (1985) Standards in herpetology and ichthyology. Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia*, 1985, 802–832.
- Manthey, U. & Grossmann, W. (1997) *Amphibien & Reptilien Südasiens*. Natur und Tier-Verlag, Munster, Germany. 512 pp.
- Pauwels, O.S.G., David, P., Chimsunchart, C. & Thirakhupt, K. (2003) Reptiles of Phetchaburi Province, western Thailand: a list of species, with natural history notes, and a discussion on the biogeography at the Isthmus of Kra. *Natural History Journal of Chulalongkorn University*, 3, 23–53.
- Pauwels, O.S.G., Laohawat, O.-A., David, P., Bour, R., Dangsee, P., Puangjit, C. & Chimsunchart, C. (2000) Herpetological investigations in Phang-Nga Province, southern peninsular Thailand, with a list of reptile species and notes on their biology. *Dumerilia*, 4, 123–154.

- Rösler, H. (2000) Kommentierte Liste der rezent, subrezent und fossil bekannten Geckotaxa (Reptilia: Gekkonomorpha). *Gekkota*, 2, 28–153.
- Sathiamurthy, E. & Voris, H.K. (2006) Maps of Holocene sea level transgression and submerged lakes on the Sunda Shelf. *The Natural History Journal of Chulalongkorn University, Supplement*, 2, 1–43.
- Smith, M.A. (1916) On a collection of reptiles and batrachians from peninsular *Siamese Journal of the Natural History Society of Siam*, 2, 148–171.
- Smith, M.A. (1925) IV.—Contributions to the herpetology of Borneo. *Sarawak Museum Journal*, 8, 15–34.
- Smith, M.A. (1930) The Reptilia and Amphibia of the Malay Peninsula from the Isthmus of Kra to Singapore including the adjacent islands. *Bulletin of the Raffles Museum*, 3, 1–149.
- Smith, M.A. (1935) *The Fauna of British India, including Ceylon and Burma*, including the whole of the Indo-Chinese sub-region. Reptilia and Amphibia. Vol. II.—Sauria. Taylor and Francis, London, England, pp. 1–440.
- Taylor, E.H. (1963) The lizards of Thailand. *University of Kansas Science Bulletin*, 44, 687–1077.

Appendix

The following specimens were examined.

- Cnemaspis affinis* (Stoliczka 1877): LSUHC 6695, 6758–59, 6773, 6788, 8975, Pulau Penang, Penang, Malaysia.
- Cnemaspis aurantiacopes* Grismer & Ngo 2007: LSUHC 9528–29, 9531, 9535, 9539, Kien Giang Prov., Hon Dat Dist., Hon Dat Hill, Vietnam.
- Cnemaspis baueri* Das and Grismer, 2003: ZRC 2.5291 (holotype), ZRC 2.5292–99, LSUHC 3921–24, 4700–01, 4717–29, 4744, 4808, 7272–74, 7301–03, 7319, Pulau Aur, Johor, Malaysia.
- Cnemaspis bayuensis* Grismer, Grismer, Wood, & Chan 2009: LSUHC 9070–74, Gua Bayu, Kelantan, Malaysia.
- Cnemaspis biocellata* Grismer, Chan, Nurolhuda & Sumontha, 2008: ZRC 2.6693–98, Kulau Perlis, Perlis Malaysia; MS 30, Khao Tohphayawang, Muang Satun, Satun Province, Thailand.
- Cnemaspis boulengeri* Strauch, 1887: CAS 73745, LSUHC 9542, 9578–79, MCZ 39014–23, Pulo Condore (= Con Dao), Vietnam.
- Cnemaspis caudanivea* Grismer & Ngo 2007: LSUHC 9544–48, Kien Giang Province, Kien Hai District, Hon Tre Island, Vietnam.
- Cnemaspis chanthaburiensis* Bauer and Das, 1998: FMNH 215979 (holotype) and FMNH 191479 (paratype), Khao Soi Daouw (Dao) Wildlife Sanctuary, Pongnomron (Pong Nam Ron) District, Chanthaburi Province, Thailand; BMNH 1917.5.14.4 (paratype), Chanthaburi Province, Thailand; FMNH 215978 (paratype), Khao Khiew (Khieo) Wildlife Sanctuary, Chon Buri Province, Thailand; FMNH 215980 (paratype), Suan Kaset, Muang District, Chanthaburi Province, Thailand; LSUHC 7882, Phnom Samkos, Pursat Province, Cardamom Mountains, Cambodia.
- Cnemaspis dringi* Das and Bauer, 1998: FMNH 148588 (holotype), Labang Camp (03° 20' N; 113° 29' E), Bintulu District, Fourth Division, Sarawak, Malaysia; FMNH 221478 (paratype), Sungai Segaham, Belaga District, Seventh Division, Sarawak, Malaysia.
- Cnemaspis flavigaster* Chan & Grismer, 2008: HC 0082, 0086, ZRC 2.6708–11, LSUHC 8835–36, Forest Research Institute Malaysia, Kepong, Selangor, Malaysia; BM 1898.9.22.216, Batu Caves, Selangor, Malaysia.
- Cnemaspis flavolineata* (Nicholls 1949): LSUHC 8097, Frazer's Hill, Pahang, West Malaysia; LSUHC 9110, 9159–60, HC 303, Cameron Highlands, Pahang, West Malaysia.
- Cnemaspis karsticola* Grismer, Grismer, Wood, & Chan 2008: LSUHC 9053–56, Gunung Reng, Kelantan, Malaysia.
- Cnemaspis kendallii* (Gray, 1845): BMNH XXII.92a (lectotype, designated by Dring, 1979), Malaysia; FMNH 223201, MCZ 157158–59, Bako National Park, Sarawak, Malaysia; FMNH 223201; MCZ 157158–59, Bidi, Sarawak, Malaysia; FMNH 184424, Bukit Lanjan, Selangor, Malaysia; BMNH 1902.12.12.12, Bidi, Sarawak, Malaysia; BMNH 1911.1.20.7–9, Bau, Sarawak, Malaysia; BPBM 7494, Alag Sungei Ayer, Pulau Tioman, Pahang, Malaysia; ZRC 2.1101, Jerantut, Pahang, Malaysia; ZRC 2.1102, Gunung Rokan, Pulau Tioman, Pahang, Malaysia; ZRC 2.1103, Sedagong, Pulau Tioman, Pahang, Malaysia; ZRC 2.3014, Bukit Timah, Singapore; ZRC 2.3015, Gunung Ladang, Melaka, Malaysia; UF 78463, ZSI 14767, 19637 Malaysia; LSUHC 3773–75, 3797, 3811, 3820, 3841, 3878–88, 4659, 4666, 6213–15, 6218, 6224, Pulau Tioman, Pahang, Malaysia; LSUHC 3894, 5056–58, Pulau Tulai, Pahang, Malaysia; LSUHC 4707, 4756–57, 4765–67 Pulau Tinggi, Johor, Malaysia; LSUHC 4954, 4958 Sungai Lembing, Pahang, Malaysia; LSUHC 5184–87, 5198, 5211 Pulau Seribu, Johor, Malaysia; LSUHC 5244 Pulau Sembilan, Johor, Malaysia; LSUHC 5523–24, 5731–34 Pulau Babi Besar, Johor, Malaysia; LSUHC 5532 Pulau Sibul, Johor, Malaysia; LSUHC 5703, 5711 Pulau Aceh, Pahang, Malaysia; LSUHC 5749–52 Pulau Babi Hunjung, Johor, Malaysia; LSUHC 6380–83 Pulau Ibol, Johor, Malaysia; LSUHC 6562 Kepong, Selangor, West Malaysia; LSUHC 7691, 8122, 8126, 8191, 8210, Endau-Rompin, Johor, Malaysia; ZRC 2.1109–10, Pulau Siantan, Anamba, Riao Archipelago, Indonesia; ZRC 2.1112–13, Sungei Ulu, Great Natuna, Riao Archipelago, Indonesia; USNM 26573, Pulau Bunoa, Tambelan Islands, Indonesia; USNM 26555, St. Barbe Island, Indonesia; USNM 26547–49,

- Bunguran, Natunas, Riao Archipelago, Indonesia; USNM 28145, Pulau Lingung, Natuna, Riao Archipelago, Indonesia; USNM 28149, Sirhassen, Natuna, Riao Archipelago, Indonesia.
- Cnemaspis kumpoli* Taylor 1963: LSUHC 8846–49, 8990–91, Wang Kelian, Perlis, Malaysia; MS 393–94, near the Ton Nga Chang Waterfall, Had Yai District, Songkhla Province (this is a new locality for this species).
- Cnemaspis limi* Das and Grismer, 2003: ZRC 2.5289 (holotype), ZRC 2.3504–06, 2.5290 (paratypes), LSUHC 3801–02, 3859, 3902, 3904, 4410, 4425, 4480–83, 4485–88, 4563–64, 4596, 4604, 4616, 4629, 4655, 5053, 5424, 5441, 5510, 5515, 5518, 5521, 6203, 6206–07, 6210, 6212, 6267 Pulau Tioman, Pahang, Malaysia.
- Cnemaspis mcguirei* Grismer, Grismer, Wood, & Chan 2008: LSUHC 8853–58, 8878, 8896, 8898, 9028–33, 9140, 9209, Bukit Larut, Perak, Malaysia; DWNP 1239, Gunung Bubu, Perak, Malaysia.
- Cnemaspis monachorum* Grismer, Norhayati, Chan, Belabut, Muin, Wood, & Grismer 2009: LSUHC 9113–19, Wat Wanararm, Kedah, Pulau Langkawi, Malaysia.
- Cnemaspis nigridius* (Smith, 1925): BMNH 1946.8.22.90 (formerly BMNH 1925.9.1.8; holotype), MCZ 39024 and ZRC 2.1114–115, Mt. Gadin (= Gunung Gading), Sarawak, Malaysia; MCZ 15250, Lundu, Sarawak, Malaysia; BMNH 1925.9.1.9–10, Mt. Pueh, Sarawak, Malaysia.
- Cnemaspis nuicamensis* Grismer & Ngo 2007: LSUHC 9549–50, 9552–93, 9555, An Giang Prov., Tinh Bien Dist., Nui Cam Hill, Vietnam.
- Cnemaspis paripari* Grismer & Chan 2009: ZRC 2.6812, Gua Pari-pari, Bau District, Sarawak, Malaysia; LSUHC 9185, ZRC 2.6813–14, Gua Angin, Bau District, Sarawak, Malaysia.
- Cnemaspis pemanggilensis* Grismer and Das, 2006: ZRC 2.6043 (holotype), ZRC 2.6044–51 (paratypes), LSUHC 4457–58, 4460, 4464, 4470–76, 4495–96, 8011–16, Pulau Pemanggil, Johor, Malaysia.
- Cnemaspis perhentianensis* Grismer & Chan 2008: LSUHC 8697, 8699, 9060, 9412, Pulau Perhentian Besar, Terengganu, Malaysia.
- Cnemaspis pseudomcguirei* Grismer, Norhayati, Chan, Belabut, Muin, Wood, & Grismer 2009: LSUHC 9047, 9145–47, Bukit Larut, Perak, Malaysia.
- Cnemaspis psychedelica* Grismer, Grismer, & Ngo 2010: LSUHC 9182–85, Hon Khoai Island, Ngoc Hien District, Ca Mau Province, Vietnam.
- Cnemaspis roticanai* Grismer & Chan 2010: LSUHC 9430–31, 9439, 9453, Gunung Raya, Pulau Langkawi, Kedah, Malaysia.
- Cnemaspis tucdupensis* Grismer & Ngo 2007: LSUHC 8248, 9560–63, An Giang Prov., Tri Ton Dist., Tuc Dup Hill, Vietnam.