

Descriptions of Seven New *Cyrtodactylus* (Squamata: Gekkonidae) with a Key to the Species of Myanmar (Burma)

Aaron M. Bauer¹

*Department of Biology, Villanova University
800 Lancaster Avenue, Villanova, Pennsylvania 19085
e-mail: aaron.bauer@villanova.edu*

Seven new species of the gekkonid lizard genus *Cyrtodactylus* are described on the basis of material collected by the Myanmar Herpetological Survey. These include four small to moderately sized species with relatively short digits and three larger species with long, slender digits. Among the smaller forms two are allied to *C. khasiensis*; one from the Ayeyarwady delta and adjacent lowlands, the other from higher elevations in the Chin Hills. The remaining small species, from Alaungdaw Kathapa National Park (Sagaing Division) and Rakhine Yoma Elephant Range (Rakhine State) are probably most closely allied to *C. consobrinoides*. The large-bodied forms include the apparent sister species of *C. slowinskii*, from far northwestern Myanmar, and two other, distinctive species from Mon State and Shan State, respectively. A dichotomous key to the sixteen species of *Cyrtodactylus* known from Myanmar is presented. The discovery of seven new species of the genus suggests that each hill range, as well as isolated peaks, may be expected to harbor endemic species of geckos. The collections of the Myanmar Herpetological Survey in areas to the west of the Ayeyarwady River complement historical collections derived chiefly from areas to the south (the former Lower Burma) and to the west of the central arid zone.

Myanmar has long been recognized as a bridge region connecting the largely herpetofaunally discrete areas of peninsular India and southeast Asia (Theobald 1868). Despite early collecting activity in central and northern Burma (e.g., by Leonardo Fea, see Hallermann et al. 2002) as well as in Tenasserim (Tanintharyi Division), along the Thai border the majority of the country has remained poorly documented herpetologically (Inger 1999; Slowinski and Wüster 2000). Although its reptile fauna has been recognized as being relatively rich, it is not noted for its endemism. The recent series of expeditions conducted by the Myanmar Herpetofaunal Survey, a joint program of the Myanmar Nature and Wildlife Conservation Division, Forest Department, the California Academy of Sciences, and the Smithsonian's National Museum of Natural History, with support from the National Science Foundation, has, however, revealed a variety of new species, many apparently endemic to Myanmar (e.g., Slowinski and Wüster 2000; Bauer 2002). Among the lizards, one of the most interesting groups in this regard appears to be "bent-toed" geckos of the genus *Cyrtodactylus*.

Despite the taxonomic revision and allocation of bent-toed geckos to a number of putatively monophyletic and geographically cohesive groups by previous authors (Underwood 1954; Szczerbak and Golubev 1977, 1984, 1986; Kluge 1983), *Cyrtodactylus* remains a large and

¹ Research Associate, Department of Herpetology, California Academy of Sciences

unwieldy group of approximately 70 species distributed from South Asia through the Indo-Australian Archipelago as far as the Solomon Islands (Bauer and Henle 1994). Kluge (1991, 1993, 2001) recognized two genera of tropical Asian bent-toed geckos: *Cyrtodactylus* and *Geckoella*, the latter occurring only in Peninsular India and Sri Lanka. This division has, however, not been uniformly accepted (e.g., Rösler 2000; Bauer 2002), and I here tentatively consider *Geckoella* as a subgenus of *Cyrtodactylus* pending a phylogenetic analysis of the group as a whole or, alternatively, evidence that *Geckoella* does not render remaining *Cyrtodactylus* paraphyletic.

Bauer (2002) reviewed the *Cyrtodactylus* of Myanmar and described two new taxa, bringing the number of species recorded for the country to ten. A record of *C. pulchellus* from Myanmar (Das and Lim 2000), however, has subsequently been revealed as unverified (I. Das, pers. commun., 28 June 2003), leaving nine *Cyrtodactylus* confirmed for the country. This includes *C. rubidus*, an Andaman Islands endemic, presumably present in the Cocos Group, the only part of the Andamans under the administration of Myanmar (*vide* Hundley 1964), and the mainland species *C. brevidactylus*, *C. consobrinoides*, *C. feae*, *C. khasiensis*, *C. oldhami*, *C. peguensis*, *C. slowinskii*, and *C. variegatus*. Bauer (2002) also signaled the existence of two additional, undescribed species based on unworked material from the Myanmar Herpetological Survey. Examination of this material, as well as specimens collected subsequently, reveals the existence of seven new species of *Cyrtodactylus* from Myanmar, for a total of 16 species. This is comparable to the 14 species now known from the much more intensively surveyed neighboring country of Thailand (Bauer et al. 2003).

MATERIALS AND METHODS

The following measurements were taken with Brown and Sharpe Digit-cal Plus digital calipers (to the nearest 0.1 mm): snout-vent length (SVL; from tip of snout to vent), trunk length (TrunkL; distance from axilla to groin measured from posterior edge of forelimb insertion to anterior edge of hindlimb insertion), crus length (CrusL; from base of heel to knee); tail length (TailL; from vent to tip of tail), tail width (TailW; measured at widest point of tail); head length (HeadL; distance between retroarticular process of jaw and snout-tip), head width (HeadW; maximum width of head), head height (HeadH; maximum height of head, from occiput to underside of jaws), ear length (EarL; longest dimension of ear); forearm length (ForeaL; from base of palm to elbow); orbital diameter (OrbD; greatest diameter of orbit), nares to eye distance (NarEye; distance between anteriormost point of eye and nostril), snout to eye distance (SnEye; distance between anteriormost point of eye and tip of snout), eye to ear distance (EyeEar; distance from anterior edge of ear opening to posterior corner of eye), internarial distance (Internar; distance between nares), and interorbital distance (Interorb; shortest distance between left and right supraciliary scale rows). Unless otherwise stated, counts and measurements made on right side of specimens.

Scale counts and external observations of morphology were made using a Nikon SMZ-10 dissecting microscope. Preserved specimen photographs were taken with a Nikon CoolPix 990 digital camera. Radiographic observations were made using a Faxitron closed cabinet x-ray system. Comparisons were made with museum material in the collections of the California Academy of Sciences (CAS), National Museum of Natural History (USNM), Museum of Comparative Zoology (MCZ), Institut Royal des Sciences Naturelles de Belgique (IRSNB), and Chulalongkorn University Museum of Zoology (CUMZ), as well as original published descriptions and descriptions provided in broader faunal and taxonomic treatments (e.g., Annandale 1913; Smith 1935; Szczerbak and Golubev 1986; Hikida 1990; Ulber 1993; Darevsky and Szczerbak 1997; Das 1997; Das and Lim 2000; Bauer 2002; Bauer et al. 2002).

Geographic coordinates and elevation were recorded by the original collectors from a Garmin 12 GPS (datum WGS 84).

SYSTEMATICS

Reptilia: Squamata: Gekkonidae

Cyrtodactylus annandalei Bauer, sp. nov.

Figs. 1–2

HOLOTYPE.— California Academy of Sciences (CAS) 215722 (Field number JBS 4995), adult male; Gon Nyin Bin Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°14'51.1"N, 94°37'19.3"E); collected by Thin Thin, San Lwin Oo, Hla Tun, Z.T. Aung, and T.T. Soe, 6 July 2000.

PARATYPES.— USNM 559840 (Field number JBS 5066), adult female; Pwint Kyi Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°14'39.8"N, 94°37'49.8"E); same collectors as holotype, 11 July 2000. CAS 215757 (Field number JBS 5077), adult female; Pwint Kyi Camp, Alaungdaw Kathapa National Park, Monywa District, Sagaing Division, Myanmar (22°14'39.8"N, 94°37'49.9"E); same collectors as holotype, 12 July 2000.

ETYMOLOGY.— The specific epithet is a patronym honoring Thomas Nelson Annandale (1876–1924), founder and director of the Zoological Survey of India. Annandale described numerous reptiles, including geckos from tropical Asia, especially India and Burma. In particular, he (Annandale 1905b) described *Gymnodactylus consobrinoides*, the species most closely resembling *C. annandalei*, from Tavoy (Tavai). The name is masculine and is formed in the genitive case.

DEFINITION.— A small sized *Cyrtodactylus*, snout-vent length 49–55 mm; body relatively slender, limbs, and especially digits, short; one pair of enlarged postmental scales in broad contact behind mental; dorsum relatively smooth textured, with 16–18 rows of small, keeled tubercles; 43 ventral scales across mid-body; no precloacal groove, 11–12 precloacal pores in a single series in both males and females, 10–11 femoral pores in males, separated from precloacal series by a diastema. Ten subdigital lamellae beneath 4th toe of pes distal to digital inflection. Subcaudal scalation of original tail with alternating rows forming wide transverse plates. Dorsal pattern of 6 dark bands (one each on occiput and nape, four on trunk and sacrum) or rows of transversely arranged spots, with narrow whitish borders. Dorsum of head patternless. Tail with alternating light and dark banding.

DESCRIPTION (based on holotype, CAS 215722).— Adult male with midventral incision from tissue removal. Snout-vent length 49.0 mm. Head relatively long (HeadL/SVL ratio 0.28), moderately wide (HeadW/HeadL



FIGURE 1. Holotype of *Cyrtodactylus annandalei*, sp. nov. (CAS 215722) from Alaungdaw Kathapa National Park, Myanmar. Note the relatively short digits, patternless head dorsum, and distinct dorsal pattern. Scale bar = 10 mm.

ratio 0.61), not depressed (HeadH/HL ratio 0.42), distinct from neck. Lores and interorbital region inflated, canthus rostralis not particularly prominent. Snout moderately short (SnEye/HeadL ratio 0.39); longer than eye diameter (OrbD/SnEye ratio 0.60); scales on snout and forehead rounded, granular, flattened to slightly conical, becoming heterogeneous posteriorly; scales on snout larger than those on occipital region. Eye small (OrbD/HeadL ratio 0.23); pupil vertical with crenelated margins; supraciliaries short, without projecting spines. Ear opening oval, moderately large (EarL/HeadL ratio 0.07); eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.32). Rostral approximately half as deep (1.2 mm) as wide (2.4 mm), incompletely divided dorsally by weakly developed rostral groove; two enlarged supranasals separated by two much smaller internasals; rostral in contact with supralabial I, supranasals, and internasal; nostrils circular, each surrounded by supranasal, rostral, first supralabial, and three postnasals, rostral contact of narial border extensive; narial flap partially occludes posterior third of nostril; two to three rows of scales separate orbit from supralabials. Mental subtriangular, much wider (2.2 mm) than deep (1.6 mm); one pair of enlarged postmentals, each 60% size of mental, in broad contact with one another medially, bordered anterolaterally by first infralabial, posterolaterally by enlarged lateral chinshield, and posteriorly by 2–3 chin granules. Infralabials bordered medially by 1–3 rows of enlarged scales. Supralabials (to midorbital position) 7 (left) –8 (right); enlarged supralabials to angle of jaws 10; infralabials 9; interorbital scale rows across narrowest point of frontal 12.

Body relatively slender, relatively short (TrunkL/SVL ratio 0.40) with ventrolateral folds indistinct. Dorsal scales small, granular, conical, with regularly arranged small tubercles extending from posterior border of orbits and temporal region on to tail base; each tubercle rounded, bearing a single prominent keel; tubercles becoming smaller and less prominently keeled on flanks; largest keeled tubercles in approximately 16 regular rows at midbody. Ventral scales much larger than dorsal, smooth, subimbricate laterally, strongly imbricate across midventer; somewhat larger than elsewhere along ventral midline of chest and abdomen, and especially in precloacal region; midbody scale rows across belly to edge of flanks (as demarcated by dorsal color pattern) 43; gular region with homogeneous scalation. Precloacal pores in a single continuous series of 11; bordered posteriorly by a row of greatly enlarged poreless scales. Femoral pores present in continuous rows of 10 (left) – 11 (right), separated from precloacal pores by a diastema of 5 scales; no precloacal groove. Scales on palm and sole smooth, rounded; scales on dorsal aspects of limbs smooth, subimbricating, heterogeneous but without tubercles.

Fore- and hindlimbs relatively short, stout; forearm short (ForeaL/SVL ratio 0.14); tibia moderate (CrusL/SVL ratio 0.17); digits short, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae rounded, smooth, without scansorial surfaces; lamellae distal to much enlarged scale at basal digital inflection and not including ventral claw sheath: 6–7–8–8–8 (manus), 8–8–10–10–10 (pes), proximal 1–2 fragmented on most digits; enlarged basal lamellae (\geq twice size of palmar scales) to and including enlarged scale at basal inflection: 3–4–5–5–4 (manus), 3–5–6–7–5 (pes); interdigital webbing absent. Relative length of digits (manus; measurements in mm in parentheses): III (3.4) \simeq IV (3.4) > V (2.7) \simeq II (2.6) > I (2.4); (pes): IV (4.5) > V (4.2) > III (3.8) > II (3.3) > I (2.3).

Tail original, slightly longer than body (TailL/SVL ratio 1.04), slender, tapering; divided into indistinct segments, each approximately 7 dorsal scale rows in length; two rows of enlarged, keeled tubercles positioned paravertebrally on tail base only, remaining dorsal caudal scales small, smooth, rectangular; subcaudal scales larger, smooth, imbricate; subequal basally, distally with alternating midventral scales enlarged into transverse plates. Two enlarged, smooth, conical postcloacal spurs on each side of tailbase.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for

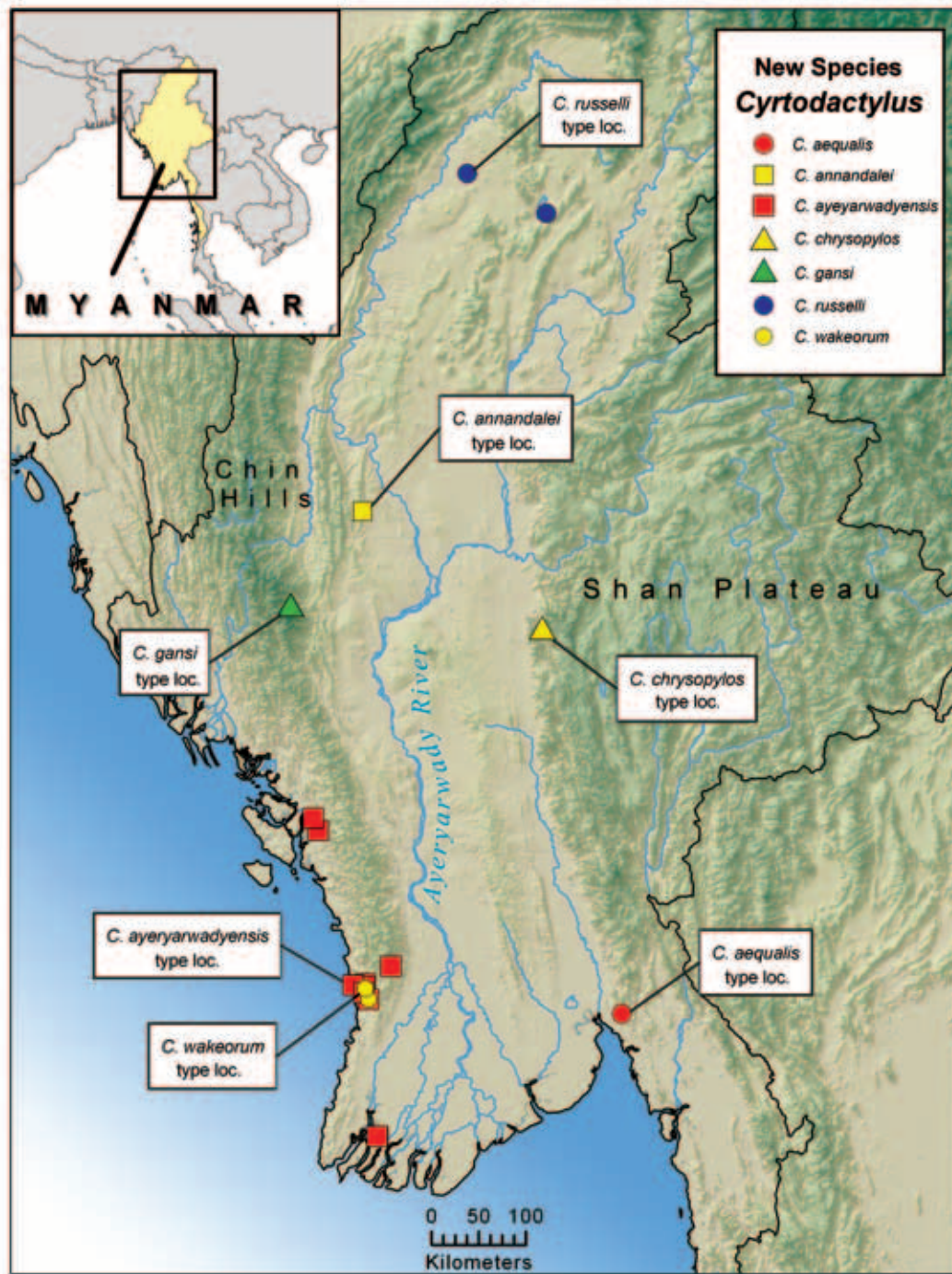


FIGURE 3. Map of Myanmar illustrating the distribution of seven new species of *Cyrtodactylus*: *C. aequalis* (red circle), *C. annandalei* (yellow square), *C. ayeyarwadyensis* (red square), *C. chrysopylos* (yellow triangle), *C. gansi* (green triangle), *C. russelli* (blue circle), and *C. wakeorum* (yellow circle). Map prepared by Michelle S. Koo, California Academy of Sciences.

manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 32 post pygal caudal vertebrae in original tail in holotype (32 in larger paratype; 5.5 in smaller paratype with regenerate tail). One pair of slender, crescentic cloacal bones in male holotype (absent in female paratypes). Endolymphatic sacs not enlarged extracranially. Subadult female with significant areas of incomplete ossification at joints of long bones.

Coloration (in preservative). Base color a pale brown. Boldly marked with chocolate brown bands, each outlined by a thin cream to whitish border 1–2 scale widths in thickness. Occipital band extending anteriorly to orbit and under eye to loreal region; continues indistinctly to rostral. Dorsum of head patternless. Nuchal collar extending anteriorly to posterior border of ear. Four additional bands between shoulders and sacrum. Ventrolateral pale brown spaces between body bands with large, chocolate brown spots. Pattern bilaterally symmetrical on head and nape, somewhat asymmetrical more posteriorly. Forelimbs mottled, with an indistinct dark line along preaxial surface of humerus; hindlimbs boldly marked with spots and oblong markings like those on flanks. Hindlimb insertions with large chocolate brown blotches at posterior border of thighs. Venter cream tinged by the light brown speckling of individual scales. Tail mottled gray-brown with darker irregular transverse markings, except on enlarged imbricate median scales. Tail with alternating chocolate brown and light brown to cream banding. Paler bands wider than darker, 12 dark bands from cloaca to tail tip. Tail venter with scattered dark pigmentation, especially distally. Dorsal color pattern extends onto ventrum only at tail tip.

In life, dorsum distinctly darker than flanks. Pale borders of dark spots yellowish-cream (Fig. 2).

VARIATION.— Comparative mensural data for the holotype and paratypes are presented in Table 1. Both paratypes similar to holotype in most respects except as noted. CAS 215757: adult female with midventral incision from tissue removal. 18 rows of keeled tubercles across midbody. 12 tiny precloacal pores and 4 (left) and 10 (right) weakly developed femoral pores. Nuchal collar fragmented anteriorly; dark markings present above forelimb insertions, diffuse dark line absent from preaxial border of humerus; 11 dark bands on original tail. CAS 215749: subadult female with midventral incision from tissue removal. 18 rows of keeled tubercles across midbody. Broken row of 8 tiny precloacal pores and 7 weakly developed femoral pores on each side. Dorsal pattern highly fragmented into spots rather than bands; 4 spots in a transverse row representing each posterior body band; hindlimbs with only a few small spots; infralabials brownish; regenerated tail mottled, without banding.

DIAGNOSIS.— *Cyrtodactylus annandalei* may be distinguished from all congeners on the basis of its relatively short digits, series of 8–12 precloacal pores separated by a diastema from 4–12 femoral pores on each thigh, no precloacal groove or enlarged femoral scales, dorsal tubercles small, in 16–18 longitudinal rows, ventral scales in 43 rows, alternate subcaudal scales enlarged transversely, and dorsal color pattern, including occipital, nape, and four additional dark body bands (or series of spots), and patternless head dorsum.

The new species is superficially most similar to *C. consobrinoides* (Annandale, 1905a;



FIGURE 2. Living specimen (paratype) of *Cyrtodactylus annandalei* (CAS 215757). Photo by Hla Tun.

TABLE 1. Mensural data for the type series of *Cyrtodactylus annandalei*, sp. nov. Abbreviations as in Materials and Methods section; all measurements in mm.

| | CAS 215722 <i>Holotype</i> | CAS 215757 <i>paratype</i> | CAS 215749 <i>paratype</i> |
|------------------------------------|-------------------------------|-------------------------------|-------------------------------|
| <i>Sex</i> | male | female | female |
| <i>SVL</i> | 49 | 55.3 | 51.1 |
| <i>ForeaL</i> | 7 | 8.2 | 6.7 |
| <i>CrusL</i> | 8.4 | 9.5 | 8.6 |
| <i>TailL (entire)</i> | 50.8 | 55.5 | 36.4 |
| <i>TailL (portion regenerated)</i> | — | — | 22.8 |
| <i>TailW</i> | 4 | 5.4 | 4.3 |
| <i>TrunkL</i> | 19.7 | 22.6 | 22.9 |
| <i>HeadL</i> | 13.5 | 16.2 | 13.8 |
| <i>HeadW</i> | 8.3 | 9.4 | 8.1 |
| <i>HeadH</i> | 5.6 | 6 | 4.7 |
| <i>OrbD</i> | 3.2 | 3.5 | 3.2 |
| <i>EyeEar</i> | 4.2 | 4.6 | 3.9 |
| <i>SnEye</i> | 5.3 | 5.6 | 5.2 |
| <i>NarEye</i> | 3.6 | 3.9 | 3.3 |
| <i>Interorb</i> | 5.5 | 5.2 | 4.5 |
| <i>EarL</i> | 1 | 1.3 | 1.3 |
| <i>Internar</i> | 2.2 | 2 | 1.9 |

Annandale 1905b), from which it differs in having a smaller number of thicker dark crossbands (6–7 vs. 8–9), no enlarged femoral scales, femoral pores present and separated from preloacal scales by a diastema, a larger number of ventral scale rows (43 vs. 20–30, although this count is somewhat arbitrary in the absence of ventrolateral folds as lateral landmarks for such counts), and a patternless head dorsum. It also lacks the light borders around the dorsal markings illustrated by Annandale (1913) in his redescription of the holotype of *C. consobrinoides*. A specimen from Molmein (Mawlamyine), provisionally referred to *C. consobrinoides* by Smith (1935) has 40 ventral scale rows and only six dorsal bands and may be referable to *C. annandalei*, although the huge distance (ca. 680 km) between Mawlamyine and the type locality make this unlikely. Comparisons with other species are provided following the description of all new taxa.

DISTRIBUTION.— *Cyrtodactylus annandalei* is known only from Alaungdaw Kathapa National Park in the Sagaing Division of north central Myanmar (Fig. 3). The most similar species to this form, *C. consobrinoides* is known only from southern Myanmar, with records from Tavoy (Dawei, Tanintharyi State) (Annandale 1905a, 1905b, 1913) and Molmein (Mawlamyine, Mon State) (Smith 1935; but see above). The species is sympatric with the much larger and recently described *C. slowinskii* as well as an unidentified species related to *C. khasiensis* (USNM 548140). The type locality is in the central dry zone of Myanmar, between the Rakhine Yoma (Arakan Yoma) of the Indo-Burman Range in the west and the extensive montane areas east of the Sittaung River.

***Cyrtodactylus ayeerwadyensis* Bauer, sp. nov.**

Figs. 4–6

HOLOTYPE.— CAS 226154 (Field number JBS 8689), adult male; Khoko Gwe Creek,

Rakhine Yoma Elephant Range, Gwa Township, Rakhine State, Myanmar (17°43'48.3"N, 94°39'02.7"E); collected by J.B. Slowinski, G.O.U. Wogan, Kyi Soe Lwin and Hla Tun, 28 April 2001.

PARATYPES (8 specimens).— CAS 226153 (Field number JBS 8688), adult male; same data as for holotype. CAS 226147 (Field number JBS 8346), adult female; Kanthaya, Gwa Township, Rakhine State, Myanmar (17°43'24.9"N, 94°32'08.3"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 22 April 2001. CAS 226149 (Field number JBS 8519), adult male; Kyat Stream, Rakhine Yoma Elephant Range, Gwa Township, Rakhine State, Myanmar (17°42'14.0"N, 94°38'54.3"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 26 April 2001. USNM 559837 (Field number JBS 8635), adult male; locality and collectors as for CAS 226149, 27 April 2001. CAS 226152 (Field number JBS 8638), adult female; data as for CAS 226150; USNM 559838 (Field number JBS 8637), adult female; data as for CAS 226150. CAS 226156 (Field number JBS 8782), adult female; Kanthaya, Gwa Township, Rakhine State, Myanmar (17°43'14.6"N, 94°32'04.9"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 2 May 2001. CAS 216506 (Field number JBS 7467), adult male; Elephant Camp, Rakhine Yoma Elephant Range, Gwa Township, Than Dawe District, Rakhine State, Myanmar (17°39'01.1"N, 94°38'39.2"E); collected by J.B. Slowinski and Htun Win, 30 November 2000.

ADDITIONAL MATERIAL (16 specimens).— All specimens from Myanmar. CAS 226146 (Field number JBS 8342); Kanthaya, Gwa Township, Rakhine State (17°43'24.9"N, 94°32'08.3"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 22 April 2001. CAS 226151 (Field number JBS 8636); Kyat Stream, Rakhine Yoma Elephant Range, Gwa Township, Rakhine State (17°42'14.0"N, 94°38'54.3"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 27 April 2001. CAS 221934 (Field number JBS 8946); Rakhine Yoma Elephant Range, Gwa, Gwa Township, Rakhine State (17°35'02.4"N, 94°40'44.2"E); collected by Htun Win, Thin Thin, Kyi Soe Lwin and Awan Khwi Shein, 2 June 2001. CAS 221985 (Field number JBS 9296); Kyauk Win Gyi Camp, Gwa Township, Rakhine State (17°53'59.9"N, 94°53'36.8"E); collected by Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 9 June 2001. CAS 226155 (Field number JBS 8781), CAS 226157 (Field number JBS 8783), CAS 226158–226159 (Field numbers JBS 8792, 8794); Kanthaya, Gwa Township, Rakhine State (17°43'14.6"N, 94°32'04.9"E); collected by J.B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 2 May 2001. CAS 216526 (Field number JBS 7496); Elephant Camp, Rakhine Yoma Elephant Range, Gwa Township, Than Dawe District, Rakhine State (17°38'58.3"N, 94°38'14.8"E); collected by J.B. Slowinski and Htun Win, 1 December 2000. CAS 216446 (Field number JBS 7363); vicinity of Kanthaya Beach, Gwa Township, Rakhine State (no coordinates recorded); collected by J.B. Slowinski and Htun Win, 27 November 2000. CAS 212459 (Field number JBS 4647); vicinity of Mwe Hauk Village, Myaung Mya Township, Ayeyarwady Division (16°16'29.4"N, 94°46'04.0"E); collected by J.B. Slowinski, G.R. Zug, R.S. Lucas and J.V. Vindum, 22 April 2000. CAS 222812 (Field number JBS 11012); Mwe Hauk Village, Myaung Mya Township, Ayeyarwady Division (16°16'34.8"N, 94°45'46.8"E); collected by G.O.U. Wogan, Htun Win, Awan Khwi Shein, Kyi Soe Lwin and Hla Tun, 20 January 2002.

In addition, the following specimens, although differing in minor aspects of coloration from the types of *C. ayeyarwadyensis*, appear to be referable to this species. Further collecting in intervening areas, however, may necessitate the reevaluation of these northern populations: CAS 223044 (Field number JBS 11324); Sa Byin Village, Taung Gok Township, Rakhine State

(19°11'56.1"N, 94°11'56.1"E, 61 ft.); collected by G.O.U. Wogan, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 27 January 2002. CAS 223285 (Field number JBS 11691); Tha Byut Stream, Ma Ei Ywa Ma Village, Taung Gok Township, Rakhine State (19°18'51.0"N, 94°09'06.5"E); collected by G.O.U. Wogan, R.S. Lucas, Htun Win, Awan Khwi Shein and Kyi Soe Lwin, 2 February 2002. CAS 223289 (Field number JBS 11698); Tha Byut Stream, Ma Ei Ywa Ma Village, Taung Gok Township, Rakhine State (19°18'49.2"N, 94°09'08.8"E); collected by G.O.U. Wogan, R.S. Lucas, Htun Win, Awan Khwi Shein and Kyi Soe Lwin, 2 February 2002. CAS 223339 (Field number JBS 11724); Tha Byut Stream, Ma Ei Ywa Ma Village, Taung Gok Township, Rakhine State (19°18'51.7"N, 94°09'07.8"E); collected by G.O.U. Wogan, R.S. Lucas, Htun Win, Awan Khwi Shein and Kyi Soe Lwin, 2 February 2002.

ETYMOLOGY.— The specific epithet is derived from the Ayeyarwady (Irrawaddy) River which runs through Myanmar. The range of the species includes parts of the Ayeyarwady delta.

DEFINITION.— A moderate sized *Cyrtodactylus*, snout-vent length to 78 mm; body relatively slender, limbs moderately long and digits relatively short; one pair of enlarged postmental scales, in broad contact with one another behind mental; 22–24 rows of keeled, oblong dorsal tubercles; 32–37 ventral scales between ventrolateral folds; no precloacal groove, 10–28 precloacal pores in a single series (or with scattered gaps of one poreless scale) in males only. Six widened subdigital lamellae beneath basal phalanx of 4th toe of pes, 10 narrow lamellae beneath more distal phalanges of same toe (in holotype). Subcaudal scalation without enlarged midventral plates. Dorsal pattern of 9–11 (usually 10) transverse rows of rectangular brown blotches from occiput to sacrum. Posterior border of each row usually marked by white punctations or a narrow white band; tail with alternating brown and white bands.

DESCRIPTION (based on holotype, CAS 226154).— Adult male, SVL 63.4 mm. Head moderately long (HeadL/SVL ratio 0.28), relatively wide (HeadW/HeadL ratio 0.61), somewhat depressed (HeadH/HeadL ratio 0.35), distinct from neck. Lores and interorbital region weakly inflated, canthus rostralis not well developed. Snout moderately long (SnEye/HeadL ratio 0.41); much longer than eye diameter (OrbD/SnEye ratio 0.55); scales on snout and forehead rounded, granular, intermixed with scattered small tubercles posteriorly; scales on snout much larger than those on occipital region. Eye small (OrbD/HeadL ratio 0.22); pupil vertical with crenelated margins; supraciliaries short, blunt. Ear opening oval, obliquely oriented, large (EarL/HeadL ratio 0.09); eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.21). Rostral approximately 55% as deep (1.5 mm) as wide (2.8 mm), divided dorsally by rostral groove; two enlarged supranasals separated by a single, somewhat smaller, roughly hexagonal internasal; rostral in contact with supralabial I, supranasals, and internasal; nostrils oval, laterally oriented, each in broad contact with rostral and also surrounded by supranasal, first supralabial, and three postnasals; pigmented narial flap partially occludes posterior 2/3 of nostril; 3–4 rows of scales



FIGURE 4. Holotype of *Cyrtodactylus ayeyarwadyensis*, sp. nov. (CAS 226154) from Rakhine Yoma Elephant Range, Gwa Township, Rakhine State, Myanmar. Note the relatively short digits, paired rectangular dorsal markings and white punctuations. Scale bar = 10 mm.

separate orbit from supralabials. Mental triangular, wider (2.8 mm) than deep (2.0 mm); one pair of greatly enlarged postmentals, each approximately 30–35% size of mental; left and right postmentals in broad medial contact with no intervening granules, each member of pair bordered laterally by first infralabial and an enlarged lateral chinshield, the pair bordered posteriorly by 5 somewhat enlarged chin scales. Infralabials bordered by 1–3 rows of enlarged scales, largest anteriorly and laterally. Throat scales small, rounded, granular. Supralabials (to midorbital position) 8 (left) – 10 (right); enlarged supralabials to angle of jaws 12 (left)–11 (right); infralabials 10; interorbital scale rows across narrowest point of frontal bone 17.

Body moderately slender, relatively short (TrunkL/SVL ratio 0.40) with very weakly denticulate ventrolateral folds. Dorsal scales heterogeneous, mostly rounded to weakly conical granules with pitted or rugose surfaces, intermixed with regularly arranged small (4–6 times granule size), keeled, oblong tubercles extending from occipital region on to back and base of tail; tubercles on nape more strongly conical and without keels; tubercles in approximately 22 longitudinal rows at midbody; 50 tubercles in paravertebral row from occiput to mid sacrum. Ventral scales much larger than dorsal, cycloid, imbricate to subimbricate; not enlarged under thighs or between precloacal pores and vent; midbody scale rows across belly between ventrolateral folds 34; scales on throat minute, granular, grading into larger scales on chest. Precloacal pores in a single series of 21, with a gap of one poreless scale separating the distalmost two pores of the right side; no femoral pores; no precloacal groove. Scales on palm and sole smooth, flattened; scales on dorsal aspects of hindlimbs granular, conical, similar to dorsal scales, with larger, conical tubercles interspersed. Dorsal scales of proximal forelimbs imbricate, without tubercles; scales of forearms heterogeneous with scattered conical tubercles.

Fore and hindlimbs relatively slender; forearm (Foreal/SVL ratio 0.16) and tibia (CrusL/SVL ratio 0.18) relatively long; digits relatively short, strongly inflected at each joint, all bearing robust, recurved claws; subdigital lamellae widened beneath basal phalanx; lamellae from first proximal scensor greater than twice largest palm scale to basalmost digital inflection: 4–5–5–5–4 (manus) and 3–5–5–6–5 (pes); lamellae from basalmost digital inflection to toe tip, not including ventral claw sheath: 7–8–8–7–7 (manus) and 7–10–8–10–10 (pes); one to several rows of small, non-lamellar granules between basal and distal lamellar series; interdigital webbing present but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): IV (5.5) > III (5.4) > II (4.7) > V (4.6) > I (3.5); (pes): V (7.0) > IV (6.6) > III (5.4) > II (5.0) > I (2.8).

Original tail longer than body (TailL/SVL ratio 1.11), slender, cylindrical in cross section. Scales arranged in regular segments; ventral scales rectangular, dorsal scales rounded at free margins. Eight circumferential rows per segment; basal segment with one row of 6 enlarged keeled tubercles, each tubercle separated from next by 1–4 smaller scales; more distally tubercles are unkeeled; tubercles absent on distal 3/4 of tail; posteriormost caudal scales narrow and elongate. Subcaudal scales larger, 6 rows per segment; segments not strongly demarcated ventrally or posteriorly; no enlarged median plates. Cloacal spurs with 3 enlarged, smooth, rounded scales on each side of tail base.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 32 post pygal caudal vertebrae in original tail in holotype (32–34 in paratypes with complete tails, 0.5–21.5 in those with regenerated tails). One pair of slender, crescentic cloacal bones in males at level of first to second pygal vertebrae (absent in females). Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color a medium brown marked by 10 transverse rows of roughly rectangular dark brown patches from occiput to sacrum, each row consisting of a pair of

bold paravertebral markings and a pair of less well defined lateral markings. Each marking bolder and more well-defined posteriorly and more diffuse anteriorly. Occipital markings fused to form a complete band. Posterior border of each transverse row of rectangular patches marked by a series of tiny white punctuations, each one to several scales in extent. Top of head medium brown with a diffuse set of dark brown marks forming a semicircle between posterodorsal corners of orbits. Canthal region crossed by a diffuse dark bar. A brown streak, bordered by cream, running from behind orbit onto neck, bordered above and below by white punctuations. White punctuations also scattered from insertion of forelimb to corner of mouth and along lower flanks. Limbs more-or-less strongly barred, with alternating light and dark markings extending on to digits, lighter bands with scattered white punctuations. Paravertebral marks fusing on tail base to form complete dark bars, 12 such bands along length of tail, including tail tip. First four bands bordered posteriorly by white punctuations and alternating with narrower light bands. More posteriorly wide dark bands alternate with continuous narrow white bands. Tail patterning extends on to venter, but bands weakly demarcated anteriorly. Venter beige with scattered dark pigment on all surfaces, darkest at lateral margins of flanks, on neck, limbs, and around cloaca. Palms and soles of feet dark.

Color in life similar to that in preservative but with medium brown of body ranging from straw to pinkish brown in some specimens. Venter white with a pale pinkish suffusion on flanks. Iris olive to greenish-gold. (Figs. 5–6)

VARIATION.—Comparative mensural data for the holotype and paratypes are presented in Table 2. Paratypes similar to holotype in most respects except as noted. Scale rows between ventrolateral folds at midbody 32–37. Rows of dorsal tubercles at midbody 22–24. Precloacal pores 10–28, generally continuous, but with a single poreless scale dividing the series into 24 (left) and 4 (right) pored scales in CAS 216506; pores absent in females. First supralabial scales excluded from nostril in some specimens (CAS 216506, CAS 226156), nostril contacted by one postnasal and a large crescentic nasal (CAS 216506, 226147, 226149, 226152), two postnasals and a crescentic nasal (CAS 226156, USNM JBS 8637), or by an asymmetrical number of postnasals (3 left, 4 right in CAS 226150, 4 left, 5 right in 226153). The largest of the paratypes, CAS 226152, is a gravid female with two eggs clearly visible through the abdominal wall. Among the additional specimens referred to *C. ayeyarwadyensis*, sizes range from 34.4 mm (CAS 212459, juvenile) to 78.3 mm (CAS 221985, adult female).

Color pattern highly variable. Among the paratype series the number of pairs of dorsal markings was 10, as in the holotype, for most specimens, but ranged from 9 (CAS 216506, 226150, 226156) to 11 (CAS 226147). These markings may be evenly paired or partly phase shifted between the left and right sides of the animal. The dark dorsal markings are especially strongly contrasting with respect to background color in CAS 216506 and 226149. The white punctuations may



FIGURE 5. Living specimen of *Cyrtodactylus ayeyarwadyensis*, sp. nov. (CAS 226158) illustrating life coloration. Photo by Hla Tun.



FIGURE 6. Head and forebody of living paratype of *Cyrtodactylus ayeyarwadyensis*, sp. nov. (CAS 216506) illustrating greenish iris and the relatively short, kinked digits of the manus. Photo by Hla Tun.

TABLE 2. Mensural and meristic data for the type series of *Cyrtodactylus ayeyarwadyensis*, sp. nov.
Abbreviations as in Materials and Methods section; all measurements in mm.

| | CAS 226154 | CAS 216506 | CAS 226147 | USNM JBS8637 | CAS 226156 | CAS 226149 | CAS 226150 | CAS 226153 | CAS 226152 |
|--------------------|---------------|---------------|---------------|-----------------|---------------|---------------|---------------|---------------|---------------|
| | Holotype | Paratype | Paratype | Paratype | Paratype | Paratype | Paratype | Paratype | Paratype |
| Sex | male | male | female | female | female | male | male | male | female |
| SVL | 63.4 | 67.6 | 64.1 | 65.9 | 65.5 | 66.6 | 62.1 | 65.4 | 71.8 |
| ForealL | 9.8 | 10 | 9.4 | 9.8 | 9.5 | 10.1 | 9.9 | 9.6 | 11.8 |
| CrusL | 11.6 | 12 | 11.5 | 11.7 | 12.1 | 12.3 | 11.5 | 10.7 | 13.1 |
| TailL (total) | 70.1 | 53.2 | 64.6 | 73.3 | 70.7 | 73.7 | 71 | 71.5 | 6.1 |
| TailL (regen) | — | 43.3 | 13 | — | — | — | — | 25.5 | (broken) |
| TailW | 6.9 | 6.3 | 5.3 | 5.4 | 5.4 | 5.6 | 5.7 | 5.8 | 6.8 |
| TrunkL | 25.5 | 28.5 | 28.8 | 29 | 28 | 27.7 | 28.3 | 26.7 | 34.2 |
| HeadL | 18 | 18.5 | 18.8 | 18.1 | 19 | 18.9 | 17.1 | 18.6 | 20.7 |
| HeadW | 11 | 12.5 | 11.9 | 11.6 | 11.3 | 11.1 | 11.2 | 11.4 | 12.8 |
| HeadH | 6.3 | 6.8 | 6.4 | 6.9 | 7.3 | 6.9 | 6.3 | 6.9 | 8.5 |
| OrbD | 4 | 4.8 | 4.1 | 4.6 | 4.9 | 4.6 | 4.2 | 4.4 | 5 |
| EyeEar | 4.9 | 5.4 | 4.8 | 5.4 | 5.3 | 5 | 4.7 | 4.6 | 5.5 |
| SnEye | 7.3 | 7.6 | 7 | 6.9 | 7.4 | 7.3 | 7 | 7 | 8.2 |
| NarEye | 5.1 | 4.8 | 4.9 | 5 | 4.9 | 5.1 | 4.5 | 4.9 | 5.8 |
| Interorb | 6.2 | 6.9 | 5.8 | 6.5 | 6.4 | 6.2 | 5 | 7.1 | 7.6 |
| EarL | 1.6 | 2.1 | 2.1 | 1.6 | 1.6 | 1.9 | 1.8 | 2.3 | 2.1 |
| Internar | 2 | 2.1 | 2.4 | 1.7 | 2 | 1.8 | 1.8 | 1.9 | 2.1 |
| Tubercle Rows | 22 | 24 | 22 | 22 | 22 | 22 | 22 | 24 | 22 |
| Ventral Scale Rows | 34 | 34 | 34 | 36 | 34 | 37 | 34 | 32 | 36 |
| Precloacal Pores | 21 | 28 | — | — | — | 13 | 10 | 10 | — |

be greatly reduced or lacking almost all together (CAS 216506). Among the additional material referred to this taxon pattern was even more variable, with several specimens from Rakhine State (CAS 223285, 223289, 223339) with the white markings coalescent, forming distinct transverse bands.

DIAGNOSIS.— *Cyrtodactylus ayeyarwadyensis* may be distinguished from all congeners on the basis of its possession of short digits, a single series of precloacal pores (10–28) in males only, absence of femoral pores and precloacal groove, 22–24 longitudinal rows of dorsal tubercles; 32–37 ventral scales between ventrolateral folds, subcaudal scalation without enlarged midventral plates, and dorsal pattern of 9–11 (usually 10) transverse rows of rectangular brown blotches from occiput to sacrum, usually bordered posteriorly by white punctations or a narrow white band.

Among other species from Myanmar it is most similar to *C. khasiensis* and a new species from Chin State, described below. All are similar in size and bear a series of dark dorsal markings. *Cyrtodactylus ayeyarwadyensis* differs from *C. khasiensis*, however, in having (in some specimens) a greater number of precloacal pores (maximum 28 vs 14), rectangular dorsal blotches (vs a more variegated pattern of alternating irregular light and dark bands, or even stripes; Hora 1926), white dorsal punctuations or lines bordering dorsal blotches (in most cases), and narrow white tail

bands (vs subequal light and dark bands in *C. khasiensis*). It differs from the other new species in both color pattern (rectangular dark markings and white punctuations vs narrow transverse bands) and preloacal pore configuration (strongly angled and recessed into a shallow groove in the Chin State species). Comparisons with other species are provided after the new species descriptions.

DISTRIBUTION.— Typical specimens of *Cyrtodactylus ayeyarwadyensis* are known from low elevation in extreme southwestern Myanmar, west of the main channel of the Ayeyarwady (Irrawaddy) River, specifically from Gwa Township in Rakhine State and Myaung Mya Township in the Ayeyarwady Division. Additional specimens tentatively referred to *C. ayeyarwadyensis* derive from Taung Gok Township, Rakhine State. This locality is considerably north of the Ayeyarwady delta, but is also low-lying, to the west of the southern chain of the Rakhine Yoma (Arakan Yoma) (Fig. 3).

***Cyrtodactylus gansi* Bauer, sp. nov.**

Figs. 7–9

HOLOTYPE.— CAS 222414 (Field number JBS 8300); Che Stream, Min Dat Township, Min Dat District, Chin State (21°21'15.5"N, 93°56'13.3"E, 780 m.); collected by Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 3 April 2001.

PARATYPES.— CAS 222411 (Field number JBS 8234); Che Stream, Min Dat Township, Min Dat District, Chin State (21°21'14.9"N, 93°56'08.3"E, 750 m.); collected by Awan Khwi Shein, 29 March 2001. USNM 559839 (Field number JBS 8258), CAS 226145 (Field number JBS 8260); same locality as CAS 222411; collected by Htun Win, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 31 March 2001. CAS 222412–222413 (Field numbers JBS 8240–41); Che Stream, Min Dat Township, Min Dat District, Chin State (21°21'14.9"N, 93°56'08.3"E, 1298 m.); collected by Htun Win, Thin Thin, Kyi Soe Lwin and Awan Khwi Shein, 30 March 2001.

ETYMOLOGY.— The specific epithet is a patronym honoring Carl Gans (born 1923), who has made substantial contributions to the herpetology of tropical Asia and who has been a strong influence on my own professional career and that of many other herpetologists and vertebrate morphologists around the world. The name is masculine and is formed in the genitive case.

DEFINITION.— A moderate sized *Cyrtodactylus*, snout-vent length to 63 mm; body relatively slender, limbs and digits relatively short; one pair of enlarged postmental scales, in broad contact with one another behind mental; 20–25 rows of rounded, conical dorsal tubercles; 36–40 ventral scales between lowest rows of dorsal tubercles; no discrete ventrolateral folds; shallow preloacal groove in males, 16–29 large preloacal pores in a single, strongly angled series (pores smaller and not recessed in females). Seven widened subdigital lamellae beneath basal phalanx of 4th toe of pes, 11 narrow lamellae beneath more distal phalanges of same toe (in holotype). Subcaudal scalation without enlarged midventral plates. Dorsal pattern of approximately 10 narrow, dark brown transverse bands from occiput to sacrum. Tail with alternating brown and white bands.

DESCRIPTION (based on holotype, CAS 222414).— Adult male, SVL 60.8 mm. Head moderately long (HeadL/SVL ratio 0.28), relatively narrow (HeadW/HeadL ratio 0.58), not depressed (HeadH/HeadL ratio 0.40), distinct from neck. Lores and interorbital region inflated, canthus rostralis not well developed. Snout short (SnEye/HeadL ratio 0.36); much longer than eye diameter (OrbD/SnEye ratio 0.66); scales on snout and forehead rounded, granular to weakly conical, intermixed with scattered small tubercles behind level of orbits; scales on snout much larger than those on occipital region. Eye relatively small (OrbD/HeadL ratio 0.24); pupil vertical with crenelated margins; supraciliaries short, blunt. Ear opening round, moderately large (EarL/HeadL ratio 0.07); eye to ear approximately equal to diameter of eyes (EyeEar/OrbD ratio 1.03). Rostral approximately 75% as deep (1.9 mm) as wide (2.5 mm), divided dorsally by rostral groove; two enlarged

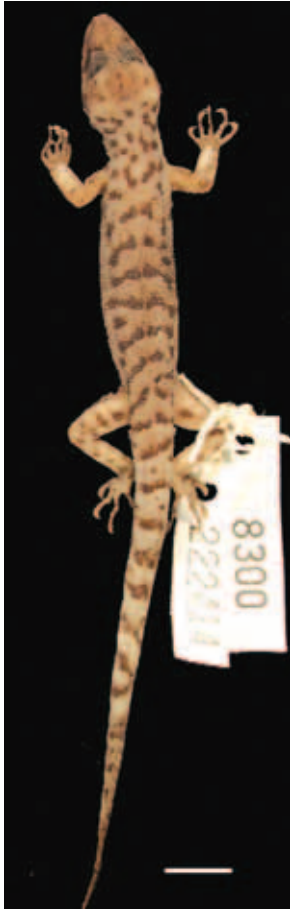


FIGURE 7. Holotype of *Cyrtodactylus gansi*, sp. nov. (CAS 222414) from Min Dat Township, Chin State, Myanmar. Note the relatively short digits, narrow dark crossbands, and lack of transverse rows of white punctations. Scale bar = 10 mm.

Dorsal scales of proximal forelimbs imbricate, without tubercles; scales of forearms heterogeneous with few scattered conical tubercles.

Fore- and hindlimbs relatively slender; forearm (ForeaL/SVL ratio 0.15) and tibia (CrusL/SVL ratio 0.17) moderate in length; digits relatively short, strongly inflected at each joint, all bearing robust, recurved claws; subdigital lamellae widened beneath basal phalanx to approximately half digital width; lamellae from first proximal scansor greater than twice

supranasals separated by a single, somewhat smaller, anterior internasal and two much smaller posterior internasals; rostral in contact with supralabial I, supranasals, and anterior internasal; nostrils oval, laterally oriented, each in broad contact with rostral and also surrounded by supranasal, first supralabial, and two postnasals; pigmented narial flap partially occludes posterior half of nostril; 2–5 rows of scales separate orbit from supralabials. Mental triangular, wider (2.3 mm) than deep (1.6 mm); one pair of greatly enlarged postmentals, each approximately 40% size of mental; left and right postmentals in broad medial contact with no intervening granules, each member of pair bordered laterally by first infralabial and an enlarged lateral chinshield, the pair bordered posteriorly by 7 slightly enlarged chin scales. Infralabials bordered by 2–3 rows of enlarged scales, largest anteriorly and laterally. Throat scales small, rounded, granular. Supralabials (to midorbital position) 8; enlarged supralabials to angle of jaws 11 (left)–12 (right); infralabials 11; interorbital scale rows across narrowest point of frontal bone 13.

Body moderately slender, elongate (TrunkL/SVL ratio 0.46) without discrete ventrolateral folds. Dorsal scales heterogeneous, mostly rounded to weakly conical granules with pitted or rugose surfaces, intermixed with regularly arranged small (3 times granule size), rounded, conical tubercles extending from occipital region on to back and base of tail; tubercles on nape smaller than those on body dorsum; tubercles in approximately 22 longitudinal rows at midbody; 53 tubercles in paravertebral row from occiput to mid sacrum. Ventral scales much larger than dorsal, cycloid, imbricate to subimbricate; enlarged between precloacal pores and vent; midbody scale rows across belly between lowest rows of dorsal tubercles 36; scales on throat minute, granular, grading into larger scales on chest. Precloacal pores large, in a single, strongly angled series of 17 lying in a shallow precloacal groove (Fig. 8); no femoral pores. Scales on palm and sole smooth, flattened; scales on dorsal aspects of hindlimbs granular, conical, similar to dorsal scales, with larger, conical tubercles interspersed.

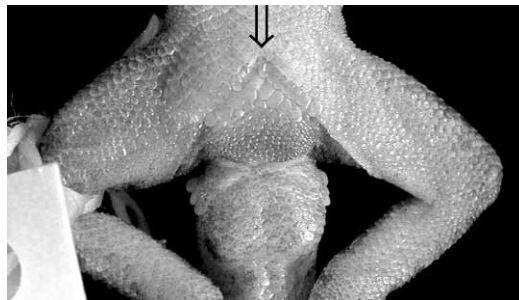


FIGURE 8. Cloacal region of holotype of *Cyrtodactylus gansi*, sp. nov. (CAS 222414). Note the strongly angled and shallowly recessed series of large precloacal pores and the enlarged row of scales posterior to the pore-bearing scales. Arrow indicates apex of pore-bearing scale series.

largest palm scale to basalmost digital inflection: 3–4–5–6–3 (manus) and 2–5–6–7–5 (pes); lamellae from basalmost digital inflection to toe tip, not including ventral claw sheath: 7–8–10–10–9 (manus) and 8–9–11–11–11 (pes); one to several rows of small, non-lamellar granules between basal and distal lamellar series; interdigital webbing present but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): IV (5.1) > III (4.8) > II (4.3) > V (4.0) > I (2.5); (pes): IV (6.2) > V (5.8) > III (5.6) > II (4.8) > I (2.8).

Partially regenerated tail longer than body (TailL/SVL ratio 1.24), slender, cylindrical in cross section. Scales arranged in regular segments; dorsal and ventral scales rounded at free margins. Eight circumferential rows per segment; pygal segments with one transverse row of 12 enlarged conical tubercles, each tubercle separated from next by 2–5 smaller scales; more distally tubercles decreasing to 6 then 2 per segment; tubercles absent on distal 3/4 of tail; posteriormost caudal scales narrow and elongate. Subcaudal scales much larger than dorsal, 3 rows per segment; no enlarged median plates. Cloacal spurs with 3 enlarged, smooth, flattened, pointed scales on each side of tail base.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 17.5 postpygal caudal vertebrae in the partly regenerated tail in holotype (31–34 in paratypes with complete tails, 1.5 in paratype with broken tail). One pair of slender, crescentic cloacal bones, with enlarged lateral flanges present in males at level of second pygal vertebrae (absent in female paratype). Cloacal bones relatively large in all males except subadult paratype (CAS 222411), which exhibits incomplete ossification of some long bones (juvenile paratype not examined osteologically). Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color light to medium brown with dark transverse markings, irregular from nape to shoulder, forming 7 more-or-less continuous crossbands from forelimb insertion to sacrum. Bands terminate abruptly on flanks; small, dark spots irregularly positioned at ventrolateral margins, between ends of crossbands. Top of head medium brown with a diffuse set of irregular dark brown spots. Canthal region somewhat darker than rest of snout. A brown streak running from behind orbit to above ear, in conjunction with dark spots on neck forming a broken nape band. Limbs and feet bearing dark spots. Dark markings on tail forming 10 bands, some partly fused with one another, on original portion of tail. Dark tail bands slightly narrower than lighter interstices. Tail patterning does not extend on to venter. Venter beige with scattered dark pigment on all surfaces, darkest under thighs and around cloaca. Palms and soles of feet darker than remainder of venter.

Color in life similar to that in preservative but rims of orbit and lateral tubercles yellow, with a yellowish tinge to the lighter areas of the limbs (Fig. 9).

VARIATION.—Comparative mensural data for the holotype and paratypes are presented in Table 3. Paratypes similar to holotype in most respects except as noted. Scale rows between lowest rows of tubercles at midbody 36–40. Rows of dorsal tubercles at midbody 20–25. Precloacal pores in males 16–29, in a continuous series. Pores present, but much smaller in the single adult females paratype (CAS 222413), a single poreless scale dividing the rightmost pore from a continuous series of 13;



FIGURE 9. Living paratype specimen of *Cyrtodactylus gansi*, sp. nov. (CAS 222411) illustrating the dorsal coloration of the species. Photo by Hla Tun.

TABLE 3. Mensural data for the types of *Cyrtodactylus gansi*, sp. nov.
Abbreviations as in Materials and Methods section; all measurements in mm.

| | CAS 222414 <i>Hholotype</i> | CAS 222411 <i>Pparatype</i> | CAS 222412 <i>Pparatype</i> | CAS 222413 <i>Pparatype</i> | CAS 226144 <i>Pparatype</i> | CAS 226145 <i>Pparatype</i> |
|------------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| <i>Sex</i> | male | male | male | female | male | juvenile |
| <i>SVL</i> | 60.8 | 46.5 | 57.3 | 62.4 | 62.3 | 29.3 |
| <i>ForeaL</i> | 8.9 | 7 | 8 | 8.6 | 8.5 | 4.5 |
| <i>CrusL</i> | 10.3 | 7.8 | 9.5 | 11 | 10.5 | 5.3 |
| <i>TailL (entire)</i> | 75.6 | 53.9 | 6.4 | 72 | 54.2 | 30.4 |
| <i>TailL (portion regenerated)</i> | 28.6 | — | broken | — | 47.8 | — |
| <i>TailW</i> | 5.9 | 3.9 | 5.8 | 4.2 | 4.9 | 2.2 |
| <i>TrunkL</i> | 28.1 | 20.6 | 25.7 | 30.3 | 25.2 | 11.5 |
| <i>HeadL</i> | 17.1 | 12.2 | 15.5 | 16.6 | 17.3 | 8.7 |
| <i>HeadW</i> | 10 | 7.8 | 9.4 | 9.9 | 10.2 | 5.6 |
| <i>HeadH</i> | 6.8 | 5 | 5.8 | 6 | 6.6 | 3.8 |
| <i>OrbD</i> | 4 | 2.7 | 3.9 | 4 | 4.3 | 2.1 |
| <i>EyeEar</i> | 4.2 | 3.9 | 4.5 | 4.6 | 5 | 2.6 |
| <i>SnEye</i> | 6.1 | 4.9 | 5.8 | 6.6 | 6.4 | 3.4 |
| <i>NarEye</i> | 4.5 | 3.1 | 3.8 | 4 | 4.6 | 2.3 |
| <i>Interorb</i> | 5.6 | 3.4 | 5 | 5.7 | 5.5 | 3.3 |
| <i>EarL</i> | 1.2 | 1.1 | 1.3 | 1.4 | 1.4 | 0.6 |
| <i>Internar</i> | 2.2 | 1.6 | 1.7 | 2.1 | 2 | 1.1 |

no preloacal groove in female specimen, no pores or groove in juvenile (CAS 226145). Supralabials to midpoint of orbit 7 on right side of CAS 222412 and 226144; infralabials 9 (CAS 226144, right) or 10 (CAS 222412 and CAS 226144, left). Supranasal scales in contact anteriorly in CAS 222413, one posterior internasal only in CAS 226144, two posterior internasals arranged longitudinally in CAS 222411.

Color pattern less fragmented on nape and shoulders in some specimens (CAS 222412, 226144), yielding 10 transverse bands to sacrum. Dorsal markings less bold and continuous in juvenile (CAS 226145). Thirteen (CAS 222411) or 15 (CAS 222413) dark tail bands in specimens with original tails.

DIAGNOSIS.— *Cyrtodactylus gansi* may be distinguished from all congeners on the basis of its possession of short digits, a single, strongly angled and somewhat recessed series of preloacal pores (16–29) in males (pores smaller and not in groove in females), absence of femoral pores, 20–25 longitudinal rows of dorsal tubercles; 36–40 ventral scales between lowest rows of dorsal tubercles (no discrete ventrolateral folds), subcaudal scalation without enlarged midventral plates, and dorsal pattern of approximately 10 narrow, dark transverse bands from occiput to sacrum, sometimes fragmented anteriorly.

Among other species from Myanmar it is most similar to *C. khasiensis* and *C. ayeayarwadyensis* (see account of latter species above), from which it may be distinguished by its shallow preloacal groove (in males) and its dorsal color pattern.

DISTRIBUTION.— *Cyrtodactylus gansi* is currently known only from high elevation (750–1300

m) at the type locality of Che Stream, Min Dat Township, Min Dat District in Chin State, in the southern Chin Hills (Fig. 3). The recently described *C. slowinskii*, previously known only from Alaungdaw Kathapa National Park, in the Sagaing Division, is the only congener thus far found at this locality (CAS 222415).

***Cyrtodactylus wakeorum* Bauer, sp. nov.**

Figs. 10–11

HOLOTYPE.— California Academy of Sciences (CAS) 221935 (Field number JBS 8948), adult female; Rakhine Yoma Elephant Range, Gwa, Gwa Township, Rakhine State, Myanmar (17°35′02.4″N, 94°40′44.2″E); collected by Htun Win, Thin Thin, Kyi Soe Lwin and Awan Khwi Shein, 2 June 2001.

PARATYPE.— CAS 226148 (Field number JBS 8408), juvenile; Ye Bya Stream, Rakhine Yoma Elephant Range, Gwa Township, Rakhine State, Myanmar (17°41′17.5″N, 94°38′50.8″E, 180 m.); collected by J. B. Slowinski, G.O.U. Wogan, Htun Win, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 25 April 2001.

ETYMOLOGY.— The specific epithet honors Marvalee H. Wake (born 1939) and David B. Wake (born 1936) of the University of California, Berkeley for their contributions to herpetology, vertebrate morphology and evolutionary biology and for their valuable mentoring of many graduate students, myself included. It gives me particular pleasure to name and describe this species on the occasion of the nominal retirement of my former dissertation advisor and mentor, Marvalee Wake. The specific epithet is masculine (mixed gender) and is formed in the genitive plural.

DEFINITION.— A small sized *Cyrtodactylus*, snout-vent length to 64 mm; body moderately slender, limbs and digits relatively short; one pair of enlarged postmental scales in broad contact behind mental; dorsum with relatively smooth texture, with 24 longitudinal rows of small, oval to rounded, keeled tubercles; 31 ventral scales across midbody; no precloacal groove, 12 precloacal pores in a single series in female holotype, no femoral pores. Ten subdigital lamellae beneath 4th toe of pes distal to basal digital inflection, six broad lamellae basal to inflection. Subcaudal scales not forming broad transverse plates. Dorsal pattern of 6 thin dark bands (one nuchal and five between shoulders and sacrum), each bordered posteriorly by a thin white line. Head without dorsal pattern. Tail with alternating light and dark banding.

DESCRIPTION (based on holotype, CAS 221935).— Adult female containing two eggs. Snout-vent length 63.8 mm. Head relatively short (HeadL/SVL ratio 0.25), moderately narrow (HeadW/HeadL ratio 0.59), not depressed (HeadH/HL ratio 0.43), distinct from neck.



FIGURE 10. Holotype of *Cyrtodactylus wakeorum*, sp. nov. (CAS 221935) from Rakhine Yoma Elephant Range, Rakhine State, Myanmar. Note the relatively short digits, light-edged dark crossbands, and patternless head dorsum of this gravid female. Scale bar = 10 mm.

Lores and interorbital region weakly inflated, canthus rostralis not particularly prominent. Snout relatively short (SnEye/HeadL ratio 0.39); longer than eye diameter (OrbD/SnEye ratio 0.60); scales on snout and forehead rounded, granular, flattened to slightly conical, becoming heterogeneous posterior to mid-frontal region; scales on snout larger than those on occipital region. Eye relatively large (OrbD/HeadL ratio 0.25); pupil vertical with crenelated margins; supraciliaries short, without projecting spines. Ear opening oval, small (EarL/HeadL ratio 0.08); eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.38). Rostral 64% as deep (1.6 mm) as wide (2.5 mm), incompletely divided dorsally by well developed rostral groove; two enlarged supranasals separated by a much smaller anterior internasal and two even smaller posterior internasals; rostral in contact with supralabial I, supranasals, and anterior internasal; nostrils circular, each surrounded by supranasal, rostral, first supralabial, one postnasal, and crescentic nasal, rostral contact of narial border extensive; narial flap partially occludes posterior half of nostril; 1–3 rows of scales separate orbit from supralabials. Mental subtriangular, wider (2.1 mm) than deep (1.6 mm); one pair of enlarged postmentals, each 50% size of mental, in broad contact with one another medially, bordered anterolaterally by first infralabial (and second infralabial on left side only), posterolaterally by enlarged lateral chinshield, and posteriorly by 3 chin granules. Infralabials bordered medially by 1–2 rows of enlarged scales. Supralabials (to midorbital position) 8 (left) –9 (right); enlarged supralabials to angle of jaws 11; infralabials 10; interorbital scale rows across narrowest point of frontal 12.

Body relatively slender, relatively short (TrunkL/SVL ratio 0.40) with ventrolateral folds indistinct. Dorsal scales small, granular, conical, with regularly arranged small tubercles extending from frontal region on to tail base; each tubercle oval to rounded, bearing a single prominent keel; tubercles becoming smaller and less prominently keeled on flanks; largest keeled tubercles in approximately 24 regular rows at midbody. Ventral scales larger than dorsal, smooth, subimbricate laterally, imbricate across midventer; somewhat larger than elsewhere along ventral midline of abdomen, and especially in precloacal region; midbody scale rows across belly to edge of flanks (as demarcated by dorsal color pattern) 31; gular region with homogeneous scalation. Precloacal pores in a single continuous series of 12; bordered posteriorly by a row of greatly enlarged poreless scales. No femoral pores or precloacal groove. Scales on palm and sole smooth, rounded; scales on dorsal aspects of forelimbs smooth, subimbricating, heterogeneous but without tubercles. Hindlimbs with small scattered tubercles.

Fore and hindlimbs relatively stout; forearm short (ForeaL/SVL ratio 0.13); tibia short (CrusL/SVL ratio 0.16); digits moderately short, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae rounded, smooth, without scansorial surfaces; lamellae distal to much enlarged scale at basal digital inflection and not including ventral claw sheath: 4–4–5–5–5 (manus), 3–4–5–6–5 (pes), proximal 1–3 fragmented on most digits; enlarged basal lamellae (\geq twice size of palmar scales) to and including enlarged scale at basal inflection: 6–7–9–9–8 (manus), 7–7–10–10–11 (pes); interdigital webbing absent. Relative length of digits (manus; measurements in mm in parentheses): III (4.3) > IV (4.0) > II (3.4) \approx V (3.3) > I (2.2); (pes): IV (5.9) > III (5.2) \approx V (5.1) > II (3.9) > I (2.9).

Tail partly regenerated, slightly longer than body (TailL/SVL ratio 1.08), slender, tapering; divided into indistinct segments, each 8–9 dorsal scale rows in length; two rows of enlarged, flattened, keeled tubercles positioned paravertebrally on tail base only, remaining dorsal caudal scales small, smooth, rectangular; subcaudal scales larger (3 per tail segment), smooth, imbricate not forming a single series of transverse plates. Two enlarged, smooth, conical postcloacal spurs on each side of tailbase.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for

manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 17.5 post pygal caudal vertebrae in original tail in holotype (25 post pygal vertebrae in original tail of juvenile paratype). Adult female holotype containing two large eggs. No cloacal bones present in female, not discernable in juvenile. Juvenile paratype with most bones incompletely ossified. Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color mid brown. Boldly marked with a series of chocolate brown bands, each outlined posteriorly by a thin cream to whitish border one scale width in thickness. Occipital band turns at a right angle above and behind ear and extends anteriorly to orbit and under eye to loreal region, portion on temporal region almost completely surrounded by thin white border. Dorsum of head unpatterned. Nuchal markings paired, borders just touching one another along midline. Five additional bands between shoulders and sacrum, each successively more chevron-shaped, becoming more asymmetrical posteriorly. Dark markings faded on flanks. Limbs more-or-less uniform mid-brown with scattered small whitish markings. Hindlimb insertions with a large chocolate brown blotch at anterior border. Venter beige tinged by the light brown speckling of individual scales, except along midline. Tail with alternating chocolate brown and mid brown to cream banding. Paler bands wider than darker basally. Tail venter with scattered dark pigmentation, especially distally. Dorsal caudal color pattern extends onto ventrum, especially posteriorly.

Base color in life pinkish brown, venter whitish. Light borders around dark dorsal markings, and supraciliary scales yellowish to yellowish-orange. Iris golden brown (Fig. 11).

VARIATION.—Comparative mensural data for the holotype and paratype are presented in Table 4. The juvenile paratype (CAS 226148) is similar to the holotype in most respects except: left postmental scale fragmented into two scales; nostril bordered posteriorly by three postnasals; enlarged supralabial scales to middle of eye 9 (left) and 10 (right), to corner of mouth 11 (left) and 12 (right), infralabials 9 (left) and 10 (right); precloacal pores not developed, tail tip broken, occipital band not connected to temporal markings, nape markings fused to form a single band, more posterior bands paired, dark blotches at posterior border of hindlimb insertions. Both the holotype and paratype exhibit some skin abrasions, suggesting that the skin in life may be relatively delicate.

DIAGNOSIS.—*Cyrtodactylus wakeorum* may be distinguished from all congeners on the basis of its possession of relatively short limbs and digits, one pair of enlarged postmental scales in broad contact behind mental; dorsum with relatively smooth texture, with 24 longitudinal rows of tubercles, 31 ventral scales across midbody, ventrolateral folds absent, no precloacal groove, 12 precloacal pores in a single series in female holotype, no femoral pores, subcaudal scales not forming broad transverse plates, dorsal pattern of 6 thin dark bands (one nuchal and five between shoulders and sacrum), each bordered posteriorly by a thin white line, and head without dorsal pattern.

Cyrtodactylus wakeorum is superficially most similar to *C. consobrinoides* and, to a lesser extent, *C. annandalei*. It may be distinguished from the former by its possession of lack of subcaudal transverse plates, and its patternless head dorsum. It differs from the latter in its greater number of dorsal tubercle rows (24 vs 16–18), smaller number of ventral scale rows (31 vs 43), and light borders around only the posterior margins of the dark dorsal markings. Unfortunately the absence of adult male specimens precludes the use of certain precloacal and femoral pore charac-



FIGURE 11. Living holotype of *Cyrtodactylus wakeorum*, sp. nov. (CAS 221935) illustrating the yellowish edging of the dorsal bands and the supraciliary scales. Photo by Hla Tun.

ters which might further distinguish *C. wakeorum* from its congeners. Comparisons with other species are provided following the description of all new taxa.

DISTRIBUTION.— *Cyrtodactylus wakeorum* is known only from Rakhine Yoma Elephant Range, southern Rakhine State (Fig. 3). It is there sympatric with *C. ayeyarwadyensis*.

***Cyrtodactylus russelli* Bauer, sp. nov.**

Figs. 12–14

HOLOTYPE.— California Academy of Sciences (CAS) 226137 (Field number JBS 15525), adult male; upper Nat E-Su Stream, Htamanthi Wildlife Sanctuary, Hkamti Township, Sagaing Division, Myanmar (25°28'27.7"N, 95°37'20.5"E, 227 m.); collected by Htun Win, Thin Thin and Awan Khwi Shein, 8 November 2002.

PARATYPE.— CAS 226140 (Field number JBS 18088), adult female; Hepu Stream, Indawgyi Wildlife Sanctuary, Mohuyin Township, Kachin State, Myanmar (25°05'38.2"N, 96°22'49.0"E); collected by J.A. Wilkinson, G.O.U. Wogan, J.V. Vindum, Thin Thin, Kyi Soe Lwin, Awan Khwi Shein and Hla Tun, 16 May 2003.

ETYMOLOGY.— The specific epithet honors my friend and colleague Anthony P. Russell (born 1947) of the University of Calgary for his many contributions to the study of gekkonid lizards and for his influence on my professional career. The epithet is masculine and is formed in the genitive singular.

DEFINITION.— A large sized *Cyrtodactylus*, snout-vent length to 116 mm; body moderately slender, elongate with well developed ventrolateral folds, limbs stout, digits long; one pair of enlarged postmental scales in broad contact behind mental; dorsum with 22 longitudinal rows of small, conical to keeled tubercles; 35–41 ventral scales across midbody to ventrolateral folds; no precloacal groove, 15 precloacal pores in a single series in male holotype, 16–19 femoral pores on each thigh separated from precloacal pores by a diastema (precloacal and femoral pores absent in female paratype). Thirteen subdigital lamellae beneath 4th toe of pes distal to basal digital inflection, nine broad lamellae basal to inflection. Subcaudal scales forming broad transverse plates, but distinctly narrower than tail. Dorsal pattern poorly defined, including dark elongate blotches or bands and scattered lighter blotches on flanks. Tail with alternating light and dark banding.

DESCRIPTION (based on holotype, CAS 2261337, except as noted).— Adult male with abdominal incision from tissue removal. Snout-vent length 105.7 mm. Head relatively long (HeadL/SVL ratio 0.28), wide (HeadW/HeadL ratio 0.64), not depressed (HeadH/HL ratio 0.41), distinct from neck. Lores and interorbital



FIGURE 12. Holotype of *Cyrtodactylus russelli*, sp. nov. (CAS 226137) from Htamanthi Wildlife Sanctuary, Sagaing Division, Myanmar. Note the long digits, robust body, and obscure dorsal pattern. Scale bar = 10 mm.

region strongly inflated, canthus rostralis well developed. Snout moderately short (SnEye/HeadL ratio 0.39); longer than eye diameter (OrbD/SnEye ratio 0.60); scales on snout and forehead rounded, granular to weakly conical, intermixed with scattered small tubercles posterior to fronto-parietal suture; scales on snout much larger than those on occipital region. Eye relatively small (OrbD/HeadL ratio 0.23); pupil vertical with crenelated margins; supraciliaries short, each posterior or supraciliary bearing a short spines Ear opening rounded, partly occluded by horizontal fold of skin, small (EarL/HeadL ratio 0.04); eye to ear distance greater than diameter of eyes (EyeEar/OrbD ratio 1.17). Rostral 64% as deep (2.6 mm) as wide (4.1 mm), divided dorsally by a weakly developed inverted "V"-shaped rostral groove extending about 20% of scale height; two enlarged supranasals separated by two somewhat smaller and irregular internasals; rostral in contact with supralabial I, supranasals, and two internasals; nostrils oval, laterally oriented, each surrounded by one supranasal, rostral, first supralabial, one postnasal, and a larger crescentic nasal, rostral contact of narial border extensive; narial flap partially occludes posterior 2/3 of nostril; 3–5 rows of scales separate orbit from supralabials. Mental subtriangular, much wider (3.7 mm) than deep (3.1 mm); one pair of enlarged postmentals, each approximately 40% size of mental, in broad contact with one another medially, bordered anterolaterally by first infralabial, posterolaterally by enlarged lateral chinshield, and posteriorly by 4 small chin granules. Infralabials bordered medially by 2–3 rows of enlarged scales. Supralabials (to midorbital position) 9; enlarged supralabials to angle of jaws 11 (left) to 12 (right); infralabials 10 (left) to 11 (right); interorbital scale rows across narrowest point of frontal 28.

Body relatively robust, elongate (TrunkL/SVL ratio 0.47) with weakly denticulate, well developed ventrolateral folds. Dorsal scales heterogeneous, rounded, granular to weakly conical, intermixed with regularly arranged small (6–8 times granule size), keeled, rounded tubercles extending from parietal region on to back and tail base; tubercles on nape more strongly conical and without keels; tubercles in approximately 22 longitudinal rows at midbody; 42 tubercles in paravertebral row from occiput to mid sacrum. Ventral scales much larger than dorsal, cycloid, smooth, subimbricate to imbricate; not enlarged under thighs or between precloacal pores and vent; midbody scale rows across belly between ventrolateral folds 35; scales on throat minute, granular, grading into larger scales on chest. Precloacal pores in a single continuous series of 15, in a weakly developed groove; 19 femoral pores on left thigh, 16 on right thigh, each series separated from precloacal pore series by 3 poreless scales; Scales on palm and sole smooth, flattened; scales on dorsal aspects of limbs granular to conical, similar to dorsal scales, with larger, conical tubercles interspersed.

Fore and hindlimbs relatively short, stout; forearm short (ForeaL/SVL ratio 0.15); tibia short (CrusL/SVL ratio 0.17); digits long, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae rounded, smooth, without scansorial surfaces, widened beneath basal phalanx to almost width of toes; lamellae from first proximal scansor greater than twice largest plam scale to basal digital inflection: 5–7–7–7–8 (manus), 6–8–8–9–8 (pes); lamellae from basal inflection to toe tip, not including ventral claw sheath: 10–10–13–10–11 (manus), 9–11–13–13–13 (pes); one to several rows of distal lamellae fragmented; interdigital webbing present, especially between digits II and III and III and IV, but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): IV (10.4) > V (10.0) > III (9.3) > II (8.2) > I (6.0); (pes): V (11.6) \approx IV (11.5) > III (10.9) > II (9.0) > I (6.0).

Tail in holotype broken at base. Original tail in paratype longer than body (TailL/SVL ratio 1.19), slender, tapering, slightly depressed in corss section. Scales arranged in regular whorls; ventral scales rectangular, dorsal scales rounded at free margins or hexagonal. 9 circumferential rows of dorsal scales per tail segment; basalmost postpygal segment with one transverse row of 10 enlarged keeled tubercles, each tubercle separated from the next by 1–4 smaller scales; more dis-

tally tubercles decreasing by pairs to just two per transverse row; posteriormost caudal scales narrow and relatively elongate. Subcaudal scales much larger, 2 per tail segment, each transversely enlarged but distinctly narrower than tail; tail segmentation weakly demarcated ventrally. Cloacal spurs with 3–4 slightly enlarged, smooth, rounded scales on each side of tailbase.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 1.5 post pygal caudal vertebrae in regenerated tail in holotype (39 post pygal vertebrae in original tail of paratype). One pair of crescentic cloacal bones present, expanded posterolaterally (absent in female paratype). Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Dorsum mid- to dark brown with poorly differentiated darker markings forming elongate paravertebral blotches and more-or-less continuous longitudinal bands of variable thickness on the dorsolateral margins of trunk (Fig. 12); lighter longitudinally oriented blotches on flanks. A series of three grayish spots with irregular margins across shoulders. Forelimb insertions and axillae pale grayish. Forelimbs mottled brown, hindlimbs mottled brown but with some irregular grayish barring proximally; head darker than trunk, without obvious markings; loreals and area beneath orbit somewhat darker than rest of head; labial pale with scattered dark pigment on all scales. Venter grayish cream with dark pigment on limb margins and on throat and margins of jaws; scattered pigment across all ventral scales. Tail dorsum with alternating wider darker bands and narrower light brown bands; 9 dark bands on original tail; caudal color pattern extends onto venter, more distinct posteriorly (based on paratype).

Pattern much bolder in life, consisting of a series of wavy-edged, transverse dark markings with thin, pale borders. Anteriormost marking continuous across occiput, nape and shoulder markings fragmented, four continuous markings across body and sacrum (Fig. 13). Large brown patch continuous from snout to anterior of forelimb insertion (Fig. 14). Iris bronze.

VARIATION.— Comparative mensural data for the holotype and paratype are presented in Table 4. Adult female paratype (CAS 226140) differs from holotype in: internasals 2 but arranged along body axis, not transversely; rostral crease straight, not “V”-shaped; 9 (right) to 10 (left) supralabials to middle of eye, 11 (right) to 12 (left) to corner of mouth, 9 (right) to 10 (left) infralabials; 41 ventral scales between ventrolateral folds; 44 tubercles in paravertebral row from occiput

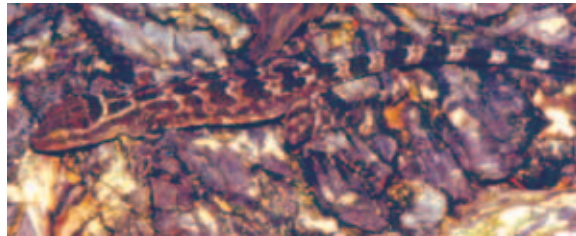


FIGURE 13. Living paratype of *Cyrtodactylus russelli*, sp. nov. (CAS 226140) illustrating the dorsal pattern of wavy dark cross-bars. Photo by Hla Tun.



FIGURE 14. Lateral view of living paratype of *Cyrtodactylus russelli*, sp. nov. (CAS 226140) illustrating the large brown patch on the side of head and neck, whitish outline of dorsal markings, beige venter, and golden iris. Photo by Hla Tun.

TABLE 4. Mensural data for the types of four new species of *Cyrtodactylus*. Abbreviations as in Materials and Methods section; all measurements in mm.

| | <i>C. wakeorum</i> | | <i>C. russelli</i> | | <i>C. chrysopylos</i> | <i>C. aequalis</i> |
|------------------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | CAS 221935 Holotype | CAS 226148 Paratype | CAS 226137 Holotype | CAS 226140 Paratype | CAS 226141 Holotype | CAS 222185 Holotype |
| <i>Sex</i> | female | ? (juvenile) | male | female | female | female |
| <i>SVL</i> | 63.8 | 33 | 105.7 | 116 | 79.1 | 90.1 |
| <i>ForeaL</i> | 8.5 | 4.9 | 16 | 17.9 | 13.2 | 14 |
| <i>CrusL</i> | 10 | 5.6 | 18.3 | 20.5 | 16.1 | 16.2 |
| <i>TailL (entire)</i> | 69 | 31.8 | 11 | 138.6 | 6.2 | 92.1 |
| <i>TailL (portion regenerated)</i> | 24 | bBroken | broken | — | broken | 49.5 |
| <i>TailW</i> | 5.1 | 2.4 | 10.6 | 10.6 | 7 | 7 |
| <i>TrunkL</i> | 28.4 | 14.1 | 49.4 | 52.3 | 36 | 38.8 |
| <i>HeadL</i> | 15.9 | 10.2 | 29.2 | 31.4 | 22.4 | 24.3 |
| <i>HeadW</i> | 9.4 | 5.5 | 18.6 | 22.2 | 14 | 15.9 |
| <i>HeadH</i> | 6.9 | 3.7 | 11.8 | 12.9 | 9.3 | 10.1 |
| <i>OrbD</i> | 4 | 2.7 | 6.8 | 7.4 | 6.3 | 6.6 |
| <i>EyeEar</i> | 5.4 | 2.7 | 8 | 9.3 | 5.5 | 6.5 |
| <i>SnEye</i> | 6.4 | 4.1 | 11.2 | 12.2 | 9.4 | 9.8 |
| <i>NarEye</i> | 4.8 | 2.8 | 8.2 | 8.9 | 6.6 | 7.3 |
| <i>Interorb</i> | 5.9 | 3.5 | 10.6 | 11.7 | 8.3 | 8.3 |
| <i>EarL</i> | 1.2 | 0.8 | 1 | 1.6 | 2.1 | 2 |
| <i>Internar</i> | 1.6 | 1.1 | 3.8 | 3.6 | 2.6 | 3.2 |

to mid-sacrum; no precloacal or femoral pores; tail original; dorsal markings more pronounced than in holotype, consisting of dark brown and grayish mottling; dark paravertebral markings on nape prominent; dark occipital band present; a narrow whitish line across occiput, fading on temporal region.

DIAGNOSIS.— *Cyrtodactylus russelli* may be distinguished from all congeners on the basis of its very large size (to 116 mm SVL), ventrolateral folds well developed, digits long, dorsum with 22 longitudinal rows of tubercles, 35–41 ventral scales across midbody to ventrolateral folds, no precloacal groove, 15 precloacal pores in a single series in male holotype, 16–19 femoral pores on each thigh separated from precloacal pores by a diastema (precloacal and femoral pores absent in female paratype), subcaudal scales forming broad transverse plates, but distinctly narrower than tail width, and dorsal pattern poorly defined, including dark elongate blotches or bands and scattered lighter blotches on flanks.

Among its congeners in Myanmar, the new species is approached in size only by *C. slowinskii* (maximum SVL 108 mm), to which it appears closely related. It differs from this species in its less well demarcated dorsal pattern, white (vs yellowish) light markings, predominantly transverse wavy dorsal markings (vs paired blotches), and larger number of precloacal pores (15 vs 9–11) and femoral pores (16–19 per thigh vs 11–12). Comparisons with other species are provided following the new species descriptions.

DISTRIBUTION.— *Cyrtodactylus russelli* is known from two localities (Htamanthi Wildlife

Sanctuary, Sagaing Division and Indawgyi Wildlife Sanctuary, Kachin State), approximately 85 km apart in northern Myanmar. The region lies between the border ranges with Assam, India and the Mangin and Kumon Ranges in the east. It occurs with *C. khasiensis* at Htamanthi (CAS 226138). Given the limited sampling in this region of Myanmar, it is impossible to estimate the extent of the species' range as a whole. Although no similar geckos have been recorded from Assam, sampling in this region of India remains inadequate and it may yet be recorded outside of Myanmar.

***Cyrtodactylus chrysopylos* Bauer, sp. nov.**

Figs. 15–17

HOLOTYPE.— California Academy of Sciences (CAS) 226141 (Field number JBS 13417), adult male; Panlaung-Pyadalin Cave Wildlife Sanctuary, Ywa Ngan Township, Shan State, Myanmar (21°07'58.4"N, 96°20'25.0"E, 319 m.); collected by G.O.U. Wogan, R.S. Lucas, J.V. Vindum, Htun Win, Thin Thin, Awan Khwi Shein and H. Tun, 14 July 2002.

ETYMOLOGY.— The specific epithet is derived from the Greek *chrysos* (golden) and *pylos* (gate) and refers to Golden Gate Park, San Francisco the location of the California Academy of Sciences, which spearheaded the herpetological surveys of Myanmar that revealed this and many other new taxa. The name commemorates the 150th anniversary of the Academy and its long history of herpetological research in Asia. I particularly express my gratitude to the curators and curatorial staff of the Department of Herpetology for their support of my research and field expeditions over the past 20 years. The epithet is a masculine noun in apposition.

DEFINITION.— A moderately sized *Cyrtodactylus*, snout-vent length of unique holotype 79 mm; body slender, elongate, limbs and digits long; one pair of enlarged postmental scales in broad contact behind mental; dorsum with 16 longitudinal rows of small, keeled tubercles; 37 ventral scales across midbody to distinct ventrolateral folds; no precloacal groove or femoral pores, 10 precloacal pores in a single series; a single, much larger, pored scale posterior to precloacal series and separated from it by a single, enlarged scale without pores. Thirteen subdigital lamellae beneath 4th toe of pes distal to basal digital inflection, six broad lamellae basal to inflection. Dorsal pattern of distinct alternating brown and white bands (one on occiput, one across shoulders, six between limb insertions, one on sacrum, two on pygal portion of tail).

DESCRIPTION (based on holotype, CAS 226141).— Adult female with midventral incision from tissue removal. Snout-vent length 79.1 mm. Head relatively long (HeadL/SVL ratio 0.28), moderately wide (HeadW/HeadL ratio 0.62), not depressed (HeadH/HL ratio 0.42), distinct from neck. Lores and interorbital region inflated, canthus rostralis not particularly prominent. Snout moderately long (SnEye/HeadL ratio 0.42); much longer than eye diameter (OrbD/SnEye ratio 0.67); scales on snout and forehead



FIGURE 15. Holotype of *Cyrtodactylus chrysopylos*, sp. nov. (CAS 226141) from Panlaung-Pyadalin Cave Wildlife Sanctuary, Shan State, Myanmar. Note the long digits, slender limbs, and alternating light and dark dorsal markings. Scale bar = 10 mm.

rounded, granular, flattened to slightly conical, becoming heterogeneous posterior to frontal region; scales on snout larger than those on occipital region. Eye large (OrbD/HeadL ratio 0.28); pupil vertical with crenelated margins; supraciliaries short, with small, blunt spines. Ear opening oval, large (EarL/HeadL ratio 0.09); eye to ear distance less than diameter of eyes (EyeEar/OrbD ratio 0.88). Rostral 56% as deep (1.9 mm) as wide (3.4 mm), dorsal half incompletely divided by rostral groove; two enlarged supranasals separated by a single, smaller internasals; rostral in contact with supralabial I, supranasals, and internasal; nostrils circular, each surrounded by supranasal, rostral, first supralabial, and two postnasals, rostral and supralabial contact of narial border extensive; narial flap partially occludes posterior third of nostril; 2–4 rows of scales separate orbit from supralabials. Mental subtriangular, much wider (3.6 mm) than deep (2.8 mm); one pair of enlarged postmentals, each 30% size of mental, in broad contact with one another medially, bordered anterolaterally by first infralabial, posterolaterally by enlarged lateral chinshield, and posteriorly by 3 chin granules. Infralabials bordered medially by 1–3 rows of enlarged scales, largest anterior and lateral. Supralabials (to midorbital position) 8 (left) –9 (right); enlarged supralabials to angle of jaws 11; infralabials 10; interorbital scale rows across narrowest point of frontal 19.

Body relatively slender, elongate (TrunkL/SVL ratio 0.45); ventrolateral folds small but distinct, without denticulate margins. Dorsal scales small, granular to weakly conical, with regularly arranged small tubercles extending from frontal and temporal regions on to tail base; each tubercle rounded, bearing a single prominent keel; tubercles becoming smaller and less prominently keeled on flanks; largest keeled tubercles in approximately 16 regular rows at midbody. Ventral scales much larger than dorsal, smooth, subimbricate on abdomen, imbricate across chest; somewhat larger than elsewhere along ventral midline of chest and abdomen, and especially in precloacal region; midbody scale rows across belly between ventrolateral folds 37; gular region with homogeneous scalation. Precloacal pores in a single continuous series of 10 enlarged scales, bordered posteriorly by an enlarged poreless median scale, this in turn bordered posteriorly by an even larger pored scale (Fig. 16). No femoral pores or precloacal groove. Scales on palm and sole smooth, rounded; scales on dorsal aspects of proximal forelimbs smooth to weakly conical, relatively homogeneous. Hindlimbs and distal forelimbs with scattered conical tubercles.

Fore- and hindlimbs long, stout; forearm long (ForeaL/SVL ratio 0.17); tibia long (CrusL/SVL ratio 0.20); digits relatively long, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae rounded, smooth, without scansorial surfaces, widened beneath basal phalanx to approximately $\frac{3}{4}$ width of toes; lamellae from first proximal scansor greater than twice largest plam scale to basal digital inflection: 3–6–5–6–5 (manus), 5–6–6–6–6 (pes); lamellae from basal inflection to toe tip, not including ventral claw sheath:



FIGURE 16. Cloacal region of *Cyrtodactylus chrysopylos*, sp. nov. (CAS 226141) showing the precloacal pore-bearing scales, including the very large scale posterior to the main series (arrow). Note also the absence of enlarged femoral scales.

10–10–11–12–12 (manus), 11–12–13–13–14 (pes); one to several rows of distal lamellae fragmented; very weakly developed interdigital webbing present, especially between digits II and III and III and IV, but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): IV (7.9) > III (7.2) > V (6.70) > II (6.2) > I (4.7); (pes): IV (9.3) > III (8.5) > V (8.2) > II (6.7) > I (4.4).

Tail broken at base; 3 enlarged, smooth, blunt, conical postcloacal spurs on each side of tail-base.

Mensural data are presented in Table 4.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 0.5 post pygal caudal vertebrae in regenerated tail in unique holotype. No cloacal bones present in female type. Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color a mottled mid brown. Strongly marked with alternating chocolate brown and white bands. Dark occipital band extending anteriorly to orbit and under eye to nostril, becoming less well defined anterior of orbit; bordered above by a broken white line extending to posterior supraciliaries, bordered posteriorly by a thick white line passing through ear and onto supralabials. Supraciliaries white, a diffuse white line from anterior of orbit to nostril. Additional pairs of light and dark alternating bands across shoulders, 6 such pairs between limb insertions and one across sacrum; 2 additional such pairs on pygal portion of tail. Pattern roughly bilaterally symmetrical, faded on lower flanks. Dorsum of head with 4 diffuse dark marks on parietal table, largest at posterior margin of orbit. Posterior supralabials white, anterior supralabials with scattered white spots. Forelimbs mottled, with white blotches on limbs and limb insertions; hindlimbs with ill-defined alternating dark brown and white markings. Hindlimb insertions with large chocolate brown blotches at posterior border of thighs. Venter beige tinged by the light brown speckling of individual scales, especially on the borders of the jaws.

Base color in life purplish brown. Larger light dorsal markings with a yellowish cast, smaller lateral spots whitish. Throat white with a pinkish suffusion. Venter beige to light brown (Fig. 17).

DIAGNOSIS.— *Cyrtodactylus chrysopylos* may be distinguished from its congeners by its relatively long digits, 16 longitudinal rows of dorsal tubercles; 37 ventral scales across midbody to distinct ventrolateral folds, 10 precloacal pores in a single series, a single, greatly enlarged pored scale posterior to apex of precloacal series (Fig. 16), and dorsal pattern of distinct alternating brown and white bands (one on occiput, one across shoulders, six between limb insertions, one on sacrum, two on pygal portion of tail).

As the species is known only from a single female, the reliability of precloacal and femoral pore characteristics may be called into question, as such features often differ between genders. However, female *Cyrtodactylus*, if different from males, typically have a reduced number of pores, or may lack femoral or both femoral and precloacal pores all together. In this instance the presence in a female of a distinctive large pored scale posterior to the precloacal series is very likely to be present in males as well. This feature is unique among *Cyrtodactylus* and is alone sufficient to diagnose *C. chrysopylos* from all of its con-



FIGURE 17. Living holotype of *Cyrtodactylus chrysopylos*, sp. nov. (CAS 226141) illustrating the yellowish and whitish dorsal and lateral markings and the long slender digits. Photo by Hla Tun.

genera. In addition, its distinctive dorsal pattern of nine bands between occiput and sacrum is unique.

DISTRIBUTION.— *Cyrtodactylus chrysopylos* is known only from Panlaung-Pyadalin Cave Wildlife Sanctuary in Shan State, Myanmar at an elevation of 319 m. This locality lies in the western portion of the extensive hill region occupying east central Myanmar. The new species is sympatric with *C. peguensis* at Panlaung-Pyadalin Wildlife Sanctuary (CAS 226142–226143).

***Cyrtodactylus aequalis* Bauer, sp. nov.**

Figs. 18–20

HOLOTYPE.— California Academy of Sciences (CAS) 222185 (Field number JBS 10347), adult male; Kyaik-Hti-Yo Wildlife Sanctuary, Kyaik Hto Township, Mon State, Myanmar (17°26'38.1"N, 97°05'56.8"E); collected by Htun Win, Thin Thin and Awan Kwi Shein, 21 November 2001.

ETYMOLOGY.— The epithet is derived from the Latin *aequalis* meaning “same,” in reference to the fact that the number of dorsal tubercle rows equals the number of ventral scale rows across midbody between the ventrolateral folds. This condition is unique among species of *Cyrtodactylus*. The epithet is an adjective in the nominative singular.

DEFINITION.— A moderately sized *Cyrtodactylus*, snout-vent length of unique holotype 90 mm; body slender, limbs robust, digits long; one pair of enlarged postmental scales in broad contact with one another behind mental; dorsum with 24 longitudinal rows of relatively large, strongly keeled tubercles; 24 enlarged ventral scales between distinct ventrolateral folds; no precloacal groove, 9 minute precloacal pores in female type, 3–4 minute femoral pores separated from precloacal pores by a diastema. Fourteen subdigital lamellae beneath 4th toe of pes distal to basal digital inflection, eight broad lamellae proximal to inflection. Subcaudal scales forming transverse plates approximately 2/3 width of tail. Dorsal pattern of paired dark markings bordered by thin white lines (one on occiput, one across shoulders, five between limb insertions). Top of head with white vermiform marks on parietal table and frontonasal region. Tail with alternating light and dark bands.

DESCRIPTION (based on holotype, CAS 222185).— Adult female. Snout-vent length 90.1 mm. Head relatively long (HeadL/SVL ratio 0.27), wide (HeadW/HeadL ratio 0.66), not depressed (HeadH/HL ratio 0.42), distinct from neck. Lores and interorbital region inflated, canthus rostralis not especially well developed. Snout moderately long (SnEye/HeadL ratio 0.41); much longer than eye diameter (OrbD/SnEye ratio 0.66); scales on snout and forehead rounded, granular to slightly conical, intermixed with scattered small tubercles posterior to border of orbit; scales on snout larger than those on occipital region. Eye relatively large (OrbD/HeadL ratio 0.27); pupil vertical with crenelat-



FIGURE 18. Holotype of *Cyrtodactylus aequalis*, sp. nov. (CAS 222185) from Kyaik-Hti-Yo Wildlife Sanctuary, Mon State, Myanmar. Note the long digits and bold dorsal and head markings. Scale bar = 10 mm.

ed margins; supraciliaries short, posterior scales bearing small spines. Ear opening oval, vertically oriented, relatively large (EarL/HeadL ratio 0.08); eye to ear distance similar to diameter of eyes (EyeEar/OrbD ratio 0.98). Rostral 56% as deep (1.9 mm) as wide (3.4 mm), no rostral groove; two enlarged supranasals in broad median contact, a roughly pentagonal internasal positioned between rostral and supranasals; rostral in contact with supralabial I, supranasals, and internasal; nostrils oval, laterally oriented, each in broad contact with rostral and first supralabial, also contacted by supranasal and two postnasals; pigmented narial flap partially occludes posterior half of nostril; 3–4 rows of scales separate orbit from supralabials. Mental subtriangular, slightly wider (2.9 mm) than deep (2.8 mm); one pair of enlarged postmentals, each 60–70% size of mental, in broad contact with one another medially, bordered anterolaterally by first infralabial, posterolaterally by enlarged lateral chinshield, the pair bordered posteriorly by 8 chin scales including several enlarged lateral chin scales. Infralabials bordered medially by 2–3 rows of enlarged scales. Supralabials (to midorbital position) 7; enlarged supralabials to angle of jaws 9 (left) to 10 (right); infralabials 10 (left) to 11 (right); interorbital scale rows across narrowest point of frontal 19.

Body relatively robust, relatively elongate (TrunkL/SVL ratio 0.43) with very weakly denticulate ventrolateral folds. Dorsal scales heterogeneous, mostly rounded to weakly conical granules with pitted or rugose surfaces, intermixed with regularly arranged, moderately large (8–10 times granule size), strongly keeled to mucronate, rounded tubercles extending from posterior border of orbits and temporal region on to tail base; tubercles on nape, head, and lower flanks more strongly conical and without keels; tubercles in approximately 24 longitudinal rows at midbody (Fig. 19); 39 tubercles in paravertebral row from occiput to mid-sacrum. Ventral scales much larger than dorsal, smooth, imbricate, enlarged along midventral line and in precloacal region; midbody scale rows across belly to ventrolateral folds 24 (Fig. 20); scales on throat minute, granular, rapidly grading into much larger scales on chest. Minute precloacal pores in a single continuous series of 9; 3 minute femoral pores on left thigh separated from precloacal pores by diastema of 7 poreless scales; right thigh with 4 femoral pores (with one poreless scale between the two most distal pores); femoral pores pierced in row of enlarged femoral scales; no precloacal groove. Scales on palm and sole smooth, flattened; scales on dorsal aspects of hindlimbs and forearms granular to weakly conical, similar to dorsal scales, with larger keeled tubercles interspersed; dorsal scales of proximal forelimbs without tubercles.

Fore- and hindlimbs relatively stout; forearm moderate (ForeaL/SVL ratio 0.15); tibia relatively long (CrusL/SVL ratio 0.18); digits long, strongly inflected at basal interphalangeal joints, all bearing robust, slightly recurved claws; subdigital lamellae rounded, smooth, without scansorial surfaces, widened beneath basal phalanx to approximately $\frac{3}{4}$ width of toes; lamellae from first proximal scansor greater than twice largest palmar scale to basal digital inflection: 5–6–7–7–7 (manus), 6–8–8–8–8 (pes); lamellae from basal inflection to toe tip, not including ventral claw sheath: 10–11–13–13–12 (manus), 11–11–13–14–16 (pes); interdigital webbing present, especially between digits II and III and III and IV, but weakly developed. Relative length of digits (manus; measurements in mm in parentheses): III (8.8) > IV (8.4) > V (7.2) > II (7.0) > I (5.5); (pes): IV (11.0) > V (10.4) > III (9.9) > II (8.1) > I (5.8).

Tail partly regenerated, slightly longer than body (TailL/SVL ratio 1.02), slender, tapering, somewhat depressed in cross section. Scales arranged in regular whorls, 8 dorsal scale rows per tail segment; pygal segment with one transverse row of 10 enlarged keeled tubercles, each tubercle separated from next by 1–3 smaller scales; on posterior portion of tail enlarged tubercles reduced to 4 per transverse row, becoming flattened and eventually unkeeled; tubercles absent on regenerated portion of tail, regenerated dorsal caudal scales somewhat irregular in shape, narrow and elongate. Subcaudal scales larger, 2 rows per tail segment, segments not strongly demarcated ventral-

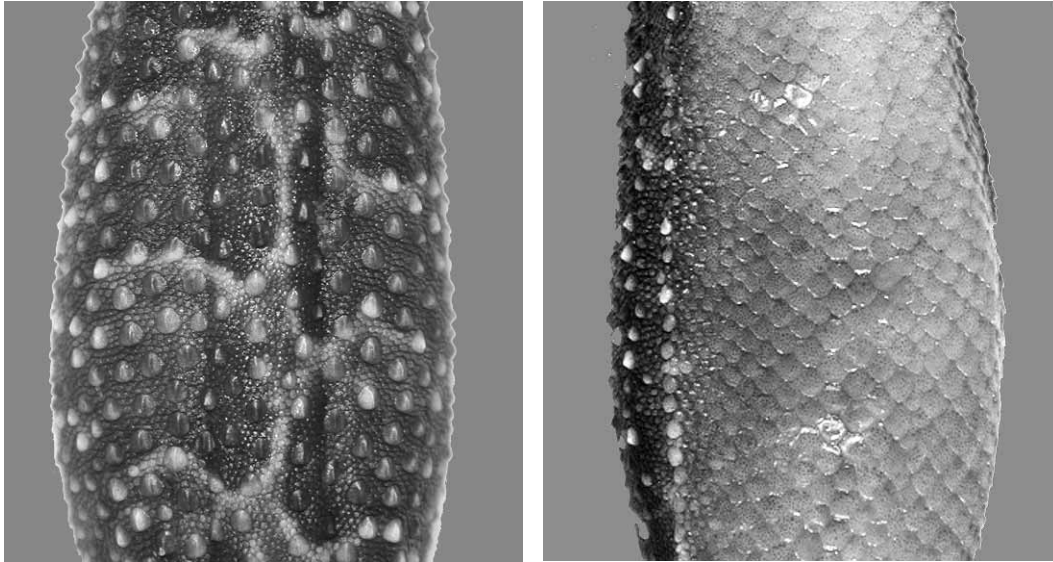


FIGURE 19 (left). Dorsum of holotype of *Cyrtodactylus aequalis*, sp. nov. (CAS 222185) illustrating the large, keeled tubercles of the dorsum (note: not all tubercle rows are visible in this view).

FIGURE 20 (right). Venter of holotype of *Cyrtodactylus aequalis*, sp. nov. (CAS 222185) illustrating the large, imbricate ventral scales and the well-demarcated ventrolateral margin.

ly; median subcaudal scales approximately $2/3$ width of tail, forming a row of enlarged plates. Cloacal spurs with 3–4 enlarged, smooth, rounded scales on each side of tail base.

Mensural data are presented in Table 4.

Osteology. Parietal bones paired. Stapes imperforate. Phalangeal formulae 2–3–4–5–3 for manus and 2–3–4–5–4 for pes. Presacral vertebrae 26, including 3 anterior cervical (without ribs), 1 lumbar, and 2 sacral vertebrae; 5 pygal and 12.5 post pygal caudal vertebrae in regenerated tail of unique holotype. No cloacal bones present in female type. Endolymphatic sacs not enlarged extracranially.

Coloration (in preservative). Base color a medium brown with a series of pairs of dark brown markings bordered by thin (one scale row wide) white lines. Occipital band continuous with temporal stripe that continues to orbit and passes beneath eye. Ventral white line beneath dark temporal stripe continues onto supralabials and infralabials; dorsal white line above temporal stripe continues onto supraciliaries. A series of 5 partly coalescent blotches across nape, a pair of well demarcated blotches over shoulders, 5 pairs of increasingly asymmetrical marks between limb insertions, each with some degree of coalescence with its mate.

Top of head medium brown with a diffuse set of white vermiform marks on parietal table and frontonasal region. Canthal region crossed by a diffuse whitish stripe. A small white mark at anteroventral margin of orbit. Labials white with scattered brown blotches. Limbs barred with white bands extending onto digits, diffuse proximally, more well defined on forearm and crus. More clearly marked on hindlimb than forelimb. Tail with alternating light and wider dark brown bands. Asymmetrical distally, with white bands having dark brown centers. Regenerated portion of tail mottled mid-brown. Venter beige with much scattered brown pigment, especially on posterior abdomen, limb margins, throat and anterior chest. Underside of tail mottled dark brown with small white blotches.

DIAGNOSIS.— *Cyrtodactylus aequalis* may be distinguished from all congeners on the basis of

its long digits, dorsum with 24 longitudinal rows of relatively large, strongly keeled tubercles (Fig. 19), 24 enlarged ventral scales between distinct ventrolateral folds (Fig. 20), no preloacal groove, 9 minute preloacal pores in female type, 3–4 minute femoral pores separated from preloacal pores by a diastema, subcaudal scales forming transverse plates approximately 2/3 width of tail, dorsal pattern of paired dark markings bordered by thin white lines (one on occiput, one across shoulders, five between limb insertions), and top of head with white vermiform markings.

Although the comparison of the preloacal and femoral pore characters of the female type of *C. aequalis* with those of males has some limitations, it may be assumed that males also possess femoral pores, though the number of such pores may be higher. Pore characters aside, the relatively large number of dorsal tubercle rows and small number of ventral scale rows results in equal counts for these two parameters. This situation is unique in the genus and serves to diagnose the species from all other congeners. Comparisons with other species are presented below.

DISTRIBUTION.—*Cyrtodactylus aequalis* is known only from Kyaik-Hti-Yo Wildlife Sanctuary in Mon State in southern Myanmar, just to the west of the Gulf of Martaban (Gulf of Mottama).

SPECIES COMPARISONS

The condition of preloacal and femoral scales and pores in males has traditionally been widely used to distinguish members of the genus *Cyrtodactylus* (e.g., Smith 1935; Darevsky and Szczerbak 1997; Bauer 2002). Unfortunately, three of the new species are represented only by adult females or juveniles. Nonetheless, two of these may be easily distinguished on the basis of unique features occurring in no other *Cyrtodactylus*: *C. chrysopylos* possesses a single, much larger, pored scale posterior to preloacal series and separated from it by a single, enlarged scale without pores (Fig. 13) and *C. aequalis* has greatly enlarged ventral scales (Fig. 17), resulting in an equal number of ventral midbody scale rows and longitudinal dorsal tubercle rows.

All of the remaining new species from Myanmar lack a deep preloacal groove (a shallow groove is present in male *C. gansi*) and can thus be distinguished from *C. annulatus* (Taylor, 1915), *C. cavernicolus* Inger and King, 1961, *C. fumosus* (Müller, 1895), *C. marmoratus* (Gray, 1831), *C. papuensis* (Brongersma, 1934), *C. philippinicus* (Steindachner, 1867), *C. pubisulcus* Inger, 1958, *C. pulchellus* Gray, 1827, *C. rubidus* (Blyth, 1860), and *C. sadleiri* Wells and Wellington, 1984; they may be separated from *C. biordinis* Brown and McCoy, 1980 by the presence of a single vs. double row of femoral pores and from the following species by the presence of preloacal pores (at least in males): *C. jellesmae* (Boulenger, 1897), *C. laevigatus* Darevsky, 1964, *C. paradoxus* (Darevsky and Szczerbak, 1997), *C. sermowaiensis* (de Rooij, 1915), and most members of the subgenus *Geckoella* (*C. albofasciatus* [Boulenger, 1885], *C. collegalensis* [Beddome, 1870], *C. deccanensis* [Günther, 1864], *C. jeyporensis* [Beddome, 1877], *C. nebulosus* [Beddome, 1870], and *C. yakhuna* [Deraniyagala, 1945]). All of the new species also lack the acutely angled, short preloacal pore series (maximum 12 pores) characteristic of *C. ingeri* Hikida, 1990 and *C. yoshii* Hikida, 1990, the denticulate tail margin of *C. brevipalmatus* (Smith, 1923), and the very short digits of *C. brevidactylus* Bauer, 2002 and *C. (G.) triedrus* (Günther, 1864).

Cyrtodactylus annandalei and *C. russelli* differ from the following species by the presence of femoral pores (at least in males): *C. adleri* Das, 1997, *C. angularis* (Smith, 1921), *C. ayeyarwadyensis* Bauer, 2003, *C. condorensis* (Smith, 1920), *C. consobrinoides* (Annandale, 1905), *C. elok* Dring, 1979, *C. fraenatus* (Günther, 1864), *C. gansi* Bauer, 2003, *C. intermedius* (Smith, 1917), *C. irianjayaensis* Rösler, 2001, *C. irregularis* (Smith, 1921), *C. khasiensis* (Jerdon, 1870), *C. lateralis* (Werner, 1896), *C. malayanus* (de Rooij, 1915), *C. matsuii* Hikida, 1990, *C. oldhami* (Theobald, 1876), *C. peguensis* (Boulenger, 1893), *C. quadrivirgatus* Taylor, 1962, *C. sumon-*

thai Bauer, Pauwels and Chanhome, 2002, and *C. sworderi* (Smith, 1925); and from the following species by the presence of a diastema between precloacal and femoral pore-bearing scales in males: *C. abrae* Wells, 2002; *C. feae* (Boulenger, 1893), *C. jarujini* Ulber, 1993, *C. loriae* (Boulenger, 1898), *C. lousiadensis* (de Vis, 1892), *C. malcolmsmithi* (Constable, 1949), *C. novaeguineae* (Schlegel, 1844), *C. papilionoides* Ulber and Grossmann, 1991, *C. tiomanensis* Das and Lim, 2000, *C. tuberculatus* (Lucas and Frost, 1900), *C. variegatus* (Blyth, 1859), and a new species from Saraburi Province, Thailand (Bauer et al., in press).

Cyrtodactylus russelli differs from the following species in having ≤ 35 ventral scale rows (vs ≥ 40 , except *C. darmandvillei*, ≥ 36): *C. annandalei*, Bauer, 2003, *C. baluensis* (Mocquard, 1890), *C. consobrinus* (Peters, 1871), *C. darmandvillei* (Weber, 1890), *C. derongo* Brown and Parker, 1973, *C. interdigitalis* Ulber, 1993, and *C. mimikanus* (Boulenger, 1914), and from the following in having 15 precloacal pores (vs. ≤ 11): *C. aaroni* Günther and Rösler, 2003, *C. agusanensis* (Taylor, 1915), *C. gubernatoris* (Annandale, 1913), *C. redimiculus* King, 1962, *C. slowinskii* Bauer, 2002, *C. wetariensis* (Dunn, 1927) and a new species from Kanchanaburi Province, Thailand (Bauer et al., in press). *Cyrtodactylus annandalei* differs from these same species (except *C. gubernatoris*) by its much smaller adult size (55 mm for an adult female vs. 70 mm and above). It differs from *C. gubernatoris* by its greater number of ventral scales across midbody (43 vs. 33).

Cyrtodactylus ayeyarwadyensis, *C. gansi* and *C. wakeorum* may be distinguished from the following species by their lack of transversely enlarged subcaudal plates: *C. abrae* Wells, 2002, *C. baluensis*, *C. condorensis*, *C. fraenatus*, *C. interdigitalis*, *C. intermedius*, *C. lousiadensis*, *C. sumonthai*, *C. tuberculatus*, *C. variegatus*, and a new species from Saraburi Province, Thailand (Bauer et al., in press); from the following by their smaller adult size (< 79 mm SVL for *C. ayeyarwadyensis*, < 64 mm for *C. wakeorum*, and < 63 mm for *C. gansi* vs ≥ 90 mm SVL): *C. agusanensis*, *C. angularis*, *C. consobrinus*, *C. derongo*, *C. irianjayaensis*, *C. jarujini*, *C. loriae*, *C. matsuii*, *C. mimikanus*, *C. novaeguineae*, *C. papilionoides*, *C. russelli*, and *C. slowinskii*; from *C. adleri*, *C. elok*, *C. irregularis*, *C. oldhami*, *C. peguensis*, *C. quadrivirgatus*, and *C. sworderi* in having more than 8 precloacal pores; from *C. lateralis* and *C. malayanus* by their lower number of ventral scales (≤ 40 vs ≥ 50); and from *C. malcolmsmithi* by their greater number of dorsal tubercle rows (20 or more vs 16).

Cyrtodactylus ayeyarwadyensis and *C. gansi* differ from the following species in having precloacal pores only (barely extending onto thighs in some *C. ayeyarwadyensis*): *C. aaroni*, *C. annandalei*, *C. darmandvillei*, *C. feae*, *C. gubernatoris*, *C. redimiculus*, *C. tiomanensis*, *C. wetariensis*, and a new species from Kanchanaburi Province, Thailand (Bauer et al., in press). Female *Cyrtodactylus wakeorum* may be similarly distinguished from these species, but the male condition is unknown. Regardless, *C. wakeorum* differs from all of these species in its particular dorsal pattern of dark, narrow crossbands edged posteriorly with yellow. *Cyrtodactylus ayeyarwadyensis* and *C. gansi* may be distinguished from *C. wakeorum* and *C. consobrinoides* by the absence of enlarged femoral scales. Differences among *C. khasiensis*, *C. ayeyarwadyensis*, and *C. gansi*, and between *C. wakeorum* and *C. consobrinoides*, respectively, are discussed in the diagnostic sections of the new species accounts above.

DISCUSSION

Herpetofaunal diversity of Myanmar has long been underestimated, chiefly owing to limited collecting activity (Inger, 1999; Slowinski and Wüster, 2000). In the genus *Cyrtodactylus* this has been exacerbated by the gross similarity in color pattern of nearly all species (mid-brown with darker blotches or bands, often with whitish borders) which has made identifications difficult for

non-specialists. Further, some of the species endemic to the region are known only from a few specimens, or have been plagued by confusion in the literature. A case in point is *Cyrtodactylus feae*. This species was described by Boulenger (1893) from Puepoli, in the Karen Hills of south-eastern Burma based on one male specimen collected by Leonardo Fea in 1886. Annandale (1905a) considered three female specimens from "Sinkip Island, East Sumatra" to be referable to the species, but subsequently (Annandale 1913) reidentified these specimens as juvenile *C. consobrinus* (see also de Rooij 1915). Smith (1935) reexamined the type and concluded that it was a female, not a male, and determined that Boulenger's (1893) count of 32 continuous precloacal-femoral pores was incorrect. Instead Smith regarded the enlarged precloacal and femoral scales to be merely pitted, not perforated by pores. Constable (1949) followed Smith's interpretation and referred a specimen from Calcutta, India to *C. feae*. However, both this specimen's provenance and its supposed resemblance to *C. intermedius* strongly suggest that this specimen is not conspecific with that described and figured by Boulenger (1893). No additional specimens that are unambiguously referable to *C. feae* have since been collected.

Similar confusion regarding precloacal and femoral pore condition is rampant in *Cyrtodactylus*. My examination of several hundred specimens suggests that some early authors, working with hand lenses or inferior low magnification microscopes with poor lighting, may have overlooked tiny pores and thus mischaracterized certain taxa. Other features that have been widely used in differentiating members of the genus, including postmental scale condition and the state of subcaudal scales, while easily observed, appear to have been described differently enough by different authors as to render literature accounts unreliable for comparative purposes. To assist in the identification of future collections from Myanmar, I provide the following key to the 16 species thus far recorded from the country.

Key to the Species of *Cyrtodactylus* Occurring in Myanmar

- 1a. Deep precloacal (pubic) sulcus present *C. rubidus*
- 1b. Precloacal sulcus absent 2
- 2a. Greatly enlarged pore-bearing scale posterior to main precloacal pore row . . . *C. chrysoptylos*
- 2b. No enlarged pore-bearing scale 3
- 3a. Ventral scales enlarged, equal in number to dorsal tubercle rows *C. aequalis*
- 3b. Scale rows across mid-belly substantially exceed dorsal tubercle rows 4
- 4a. Males² with precloacal pores only (or precloacal pores barely reaching thigh base) 5
- 4b. Males with diastema between precloacal and femoral pore series 14
- 5a. Femoral scales enlarged 6
- 5b. Femoral scales not enlarged 10
- 6a. Dark dorsum patterned with light markings 7
- 6b. Light dorsum patterned with dark markings 8
- 7a. Light markings arranged transversely, head with light reticulations *C. feae*
- 7b. Light markings arranged longitudinally, head without reticulations *C. oldhami*
- 8a. Dorsal pattern of thin dark bands with light edging 9
- 8b. Dorsal pattern of dark spots or regular blotches *C. peguensis*

² Female condition only known for *C. wakeorum*

- 9a. Dorsum of head unpatterned *C. wakeorum*
 9b. Dorsum of head with dark markings *C. consobrinoides*
- 10a. Median subcaudal scales enlarged to form transverse plates *C. variegatus*
 10b. No median subcaudal plates 11
- 11a. Digits very short, subcaudal scalation granular *C. brevidactylus*
 11b. Digits moderately long, subcaudal scales much larger than dorsal tail scales 12
- 12a. Precloacal pores in a strongly angled series, recessed in a shallow groove (males only);
 females with precloacal pores present *C. gansi*
 12b. Precloacal pores less acutely angled, not recessed; pores absent in females 13
- 13a. Dorsal pattern of paired dark rectangular markings with white punctuations or bands, light
 bands on tail much narrower than dark *C. ayeyarwadyensis*
 13b. Dorsal pattern not as above, light and dark tail bands subequal *C. khasiensis*
- 14a. Large (SVL to over 100 mm), digits elongate 15
 14b. Small (SVL < 56 mm), digits relatively short *C. annandalei*
- 15a. Precloacal pores 15, femoral pores 16–19 per thigh, dorsal pattern of transverse dark bands
 *C. russelli*
 15b. Precloacal pores 9–11, femoral pores 11–12 per thigh, dorsal pattern of regular, paired dark
 blotches *C. slowinskii*

To date a complete revision of *Cyrtodactylus* has not been attempted, nor have any phylogenetic analyses of the group been undertaken. Phenetic similarity, however, suggests some probable affinities among the species of Myanmar. It is clear that *C. russelli* is closely allied to *C. slowinskii*. These are the only two species in Myanmar to exceed 100 mm SVL and the two share similarities in precloacal and femoral pore configuration as well as color pattern. Together these species are probably part of a more widespread clade of large-bodied, long-fingered forms that includes *C. consobrinus* and other species extending from southeast Asia through the Indoaustralian Archipelago to the western Pacific. Although less similar in overall appearance, *C. aequalis* and *C. chrysopylos* also have elongate digits, relatively large body size and well-demarcated, denticulate ventrolateral body folds and are probably members of this same clade.

Cyrtodactylus wakeorum is phenetically very similar to *C. consobrinoides* and is probably closely related to this form. *Cyrtodactylus annandalei* is also somewhat similar in appearance to *C. consobrinoides*, and to *C. peguensis*, but its pore configuration is substantially different from either. All of these species are relatively small bodied and have moderately short digits and weakly-developed ventrolateral folds, without denticulate margins. *Cyrtodactylus ayeyarwadyensis* and *C. gansi* are very similar to *C. khasiensis* with respect to size, body proportion, scalation, and general color pattern. These species almost certainly are each others closest relatives and replace one another geographically from the northern Assam border ranges (*C. khasiensis*), to the Chin Hills (*C. gansi*), to the lowlands west and south of the Rakhine Yoma (*C. ayeyarwadyensis*).

The distribution of the seven new species of *Cyrtodactylus*, and of all geckos in Myanmar, is largely a function of collecting effort. That so many new taxa should be discovered in a short period reflects both the intensive collecting effort of the Myanmar Herpetological Survey and the fact that the Survey has collected chiefly in areas that have not previously been explored herpetologically. For example, the collections made and reported on by Theobald (1868) were chiefly from Pegu (Bago) and Tenasserim (Tanintharyi). Even Fea, who traveled extensively in both Upper and

Lower Burma, including Tenasserin, Carin (now Kayin) State, Mandalay, and Bhamo (Banmo) in the Cactin (Kakhien) Mountains near the Yunnan border (Boulenger 1887a, 1887b, 1888, 1893; Fea 1897; Hallermann et al. 2002), collected almost exclusively east of the Ayeyarwady River.

It is not surprising that the only one of the species for which several localities over a distance of more than 100 km exist is the lowland form *C. ayeyarwadyensis*. Although the additional localities for the other taxa may be expected, it seems likely that most *Cyrtodactylus* in Myanmar will be found to be restricted to individual montane areas or hill ranges. This is almost certainly the case for *C. brevidactylus*, which occurs on the isolated Mt. Popa in north-central Myanmar, but probably also applies to species inhabiting the north-to-south running ranges both east and west of the central dry zone, which is itself an apparent area of endemism (Bauer 2002). Despite the intensive work of the Myanmar Herpetological Survey, Annandale's (1905b) statement that "the country between northern Assam and southern Tenasserim is one . . . which even the systematist has not yet exhausted the vertebrate zoology" is as true today as it was nearly a century ago.

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