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A NEW SPECIES OF BENT-TOED GECKO *CYRTODACTYLUS* GRAY, 1827, (SQUAMATA: GEKKONIDAE) FROM THE ISLAND OF SULAWESI, INDONESIA

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Abstract: A new species of *Cyrtodactylus* is described from Sulawesi and the adjacent island of Kabaena, Indonesia. This new species is the largest *Cyrtodactylus* known from Sulawesi and differs from all other congeners by the absence of precloacal and femoral pores, enlarged femoral scales or pubic groove; medium to large size (up to 113.6 mm snout–vent length) and dark purple dorsum with irregular dark bands and yellow spots. Only two other species of *Cyrtodactylus* are currently described from Sulawesi and surrounding islands. Current taxonomy of the genus does not accurately reflect the diversity of *Cyrtodactylus* in Sulawesi. This species is one of several taxa new to science currently being described from the region.

Key words: Bent-toed gecko; *Cyrtodactylus*; Femoral pores; Gekkonidae; Indonesia; Kabaena; Morphology; Precloacal pores; Sulawesi; Wallacea

Cyrtodactylus Gray, 1827 is the most species-rich genus of gekkonids, with 97 recognized species. *Cyrtodactylus* range throughout the Indo-Australian Archipelago and west to the Indian subcontinent. The number of species is increasing despite the relegation of previously included Palearctic species to *Cyrtopodion*, *Mediodactylus* and *Tenuidactylus* (Golubev and Szczerbak, 1985; Macey et al., 2000; Szczerbak and Golubev, 1984, 1986), and establishment of *Nactus* (Kluge, 1983) and *Geckoella* (Gray, 1827) by Kluge (1991, 1993, 2001). Many species have recently been described from Myanmar (Bauer et al., 2002; Bauer et al., 2003), Thailand (Bauer, 2002, 2003; Pauwels et al., 2004), Vietnam (Ziegler et al., 2002), Laos (David et al., 2004), Sri Lanka (Batuwita and Bahir, 2005), West Malaysia (Grismer, 2005; Grismer and Leong, 2005; Youmans and Grismer, 2006), Borneo (Hikida, 1990), and the Papuan Region (Günther and Rösler, 2003; Kraus and Allison, 2006; Rösler, 2001). Boulenger (1897) and de Rooij (1915) recognized three species on Sulawesi: *Cyrtodactylus marmoratus* (Gray, 1831), which was thought to occur not only on Sulawesi but also throughout Sundaland, the Maluku Archipelago, and New Guinea; *C. fumosus* (Müller, 1895) from Northern Sulawesi, Halmahera, Morotai and Java; and *C. jellesmae* (Boulenger, 1897), a Sulawesi endemic. The total number of species known from Sulawesi decreased to two when Brongersma (1934) concluded that the populations from Sulawesi identified as *C. marmoratus* are referable to *C. fumosus*. He found significant morphological overlap in the characters used to distinguish the two species (the presence of poreless scales separating the precloacal and femoral pore series) and morphological differences distinguishing Sulawesi *C. marmoratus* from conspecifics known from the type locality in Java. Here, we report on a new species of large *Cyrtodactylus* from Sulawesi and the adjacent island of Kabaena. This new species has a unique set of character states differentiating it from all known congeneric

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species. The description of this new species brings the total number of described species on Sulawesi and adjacent islands back to three.

Materials and Methods

The following measurements were made to the nearest 0.1 mm using digital calipers following Bauer (2002): snout–vent length measured from the tip of the snout to vent (SVL), trunk length (the distance between limb insertions), crus length (from base of heel to knee), tail length, (from vent to tip of tail), tail width at base of tail, head length (from the retroarticular process of jaw to tip of snout), head width (measured at widest part of head), head height (from occiput to underside of jaw), ear length (along longest dimension of ear), forearm length (from base of palm to elbow), orbital diameter (from greatest diameter of orbit), naris to eye distance (from anteriormost part of eye to nares), snout to eye distance (from anteriormost part of eye to tip of snout), eye to ear distance (from anterior edge of ear opening to posterior edge of eye), internarial distance (distance between nares), and interorbital distance (distance between left and right superciliary scale rows). Meristic characters examined follow Grismer (2005): scale counts for postmentals (and degree of medial contact), supralabials (to midpoint of orbit), infralabials (including largest discernable scale up to rictus), scales bordering nostrils, longitudinal rows of tubercles on dorsum beginning at right lateral fold and ending at left, paravertebral tubercles between midpoint of forelimb insertion and midpoint of hind limb insertion, ventral scales between dorsolateral folds, and number of subdigital lamellae on 4th toe. Subdigital lamellae were counted to the phalange-metatarsal articulation. Scale counts were made using a 10× binocular microscope.

Field methodology consisted of intensive day and night visual encounter surveys in which reptiles and amphibians were collected by hand or with the aid of a blowpipe. Sampling strategies included long-term, extensive-sampling taking place in a single locality over the course of several weeks and spot sampling while completing transects in a vehicle. For each specimen the following ecological data was recorded: habitat type (garden, secondary forest, primary forest), vertical height and distance from stream at which the animal was first observed and stream width, as well as the substrate the animal was first observed on (tree trunk, leaf litter, branch, rock, etc.). Animals were euthanized via a cardiac injection of sodium pentobarbital (reptiles) or immersion in a chloretone solution (amphibians). Following euthanization, liver tissue was removed for subsequent molecular work and specimens were injected with a 4% formaldehyde solution and allowed to soak in this solution for several weeks before being transferred to 70% ethanol for permanent storage. Sex was determined by the presence of hemipenes everted while injecting the specimen with formaldehyde. Mass was determined using a digital balance and SVL and tail length to the nearest mm with a ruler.

Species Account

Cyrtodactylus **wallacei** *sp. nov.*
(Figs. 1, 2)

Holotype.—BSI (J. McGuire Biological Surveys and Inventories field series) 2574, an adult male collected in the village of Kelapa Dua, Kecamatan Andreani, Kabupaten Polewali, Propinsi Sulawesi Selatan, Sulawesi Is., Indonesia (S 03.6325°, E 119.7335°); collected by R. M. Brown, C. J. Hayden and M. I. Setiadi.

Paratype.—BSI 2575, adult male; data same as holotype (found on same tree). MZB (Museum Zoologicum Bogoriense) 3845 (G. Gillespie field series number KAB 01.021) and 4264, adult females collected at approximately 100 m elevation in Gua Watu Bari, Pulau Kabaena, Propinsi Sulawesi Tenggara (S 05.2272°, E 121.9557°) by G. Gillespie on 5 September, 2001.

Diagnosis.—The largest *Cyrtodactylus* known from Sulawesi with SVL reaching 113.6 mm; body robust, limbs medium in length; digits long; single pair of postmentals contacting posteriorly, isolating mental from chin shields; dorsum with 17–29 transverse rows of slightly keeled trihedral tubercles; 45–49 smooth, round, imbricate ventral scales between distinct ventrolateral folds; no pre-

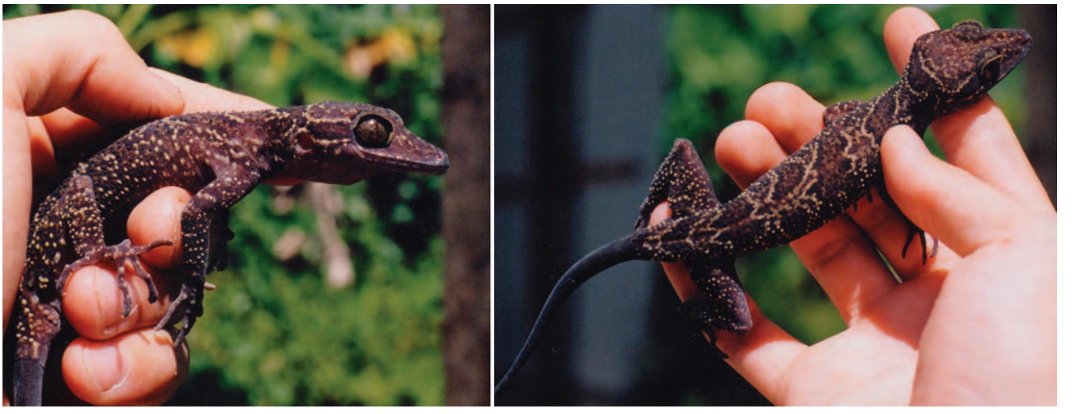

FIG. 1.—Holotype BSI 2574 of *Cyrtodactylus wallacei.*

cloacal groove, no precloacal or femoral pores, no enlarged femoral scales; slightly enlarged precloacal scale patch present; 7–9 widened lamellae proximal to basal inflection of 4th toe, 10–16 narrow lamellae distal to inflection; 18 rows of small postanals followed by slightly enlarged, rectangular subcaudals; scales of regrown tail similar in shape but diminutive in size, lacking tubercles, and completely saturated in dark purple. Five irregularly shaped dark-purple dorsal blotches between nape and base of tail, which vary in shade and are outlined by a fine yellow border; venter pale to dark.

Description of holotype.—Adult male, SVL 113.5 mm. Head moderately long (head length/SVL ratio 0.28), wide (head width/head length ratio 0.70), not heavily depressed (head height/head length ratio 0.42), distinct from neck. Pronounced supraorbital ridge continuous with similarly pronounced canthus rostralis. Distinct fronto-parietal depressions posterior to each supraorbital prominence. Lores weakly convex anteriorly, mildly depressed posteriorly; separated from anterior palpebrals and orbits by deep lacrimal grooves. Dorsal surface of snout anteriorly swollen. Lacrimal groove met orthogonally by midpalpebral depression continuing around orbit. Small, raised extension of skin comprised of superciliaries and distal-most rows of palpebrals extending circumference of orbit. Medial supraorbital scales similar to adjacent interorbitals, with small tubercles interspersed. Superciliaries large; overlapping, keeled, long (0.6–1.0 mm); forming crenulated, erect rim around eye; anterior superciliaries longest (to 1.0 mm), keeled diagonally on long axis of scale; superciliaries above iris shortest (to 0.6 mm), with keels parallel to scale border along midpoints. Eight rows of interorbitals across narrowest point of frontal bone. Snout short (snout to eye distance/head length ratio 0.39); longer than eye diameter (orbit diameter/snout to eye distance ratio 0.55). Scales of snout round, granular, uniform in size. Tubercles absent from rostrum; tiny tubercles present on medial palpebral and interorbital regions. Head tubercles pointed, symmetrical, larger posteriorly, attaining maximum size at occiput. Scales of rostrum granular, regular in size (as in snout region). No visible endolymphatic sacs. Eyes moderate (orbit diameter/head length ratio 0.2).

In life, pupil vertical with moderately crenulated margins when dilated; when constricted, pupil consists of dark narrow slit with four regularly spaced black holes oriented vertically. Auricular openings rounded posteriorly, tapering to slight point anteriorly in preserved state. Shape of auricular opening slightly oval. Auricular openings large (ear length/head length ratio 0.1); eye to ear distance greater than diameter of eye (eye to ear distance/orbit diameter ratio 1.3). Rostral approximately 0.3 times deeper (1.3 mm) than wide (5.0 mm) at narrowest point, one-half as deep (2.5 mm) as wide (5.0 mm) at longest point; incompletely divided dorsally by pair of rostral grooves, each extending from sides of internasal scale; two supranasals, anteriormost pair separated by pair of median postinterna-

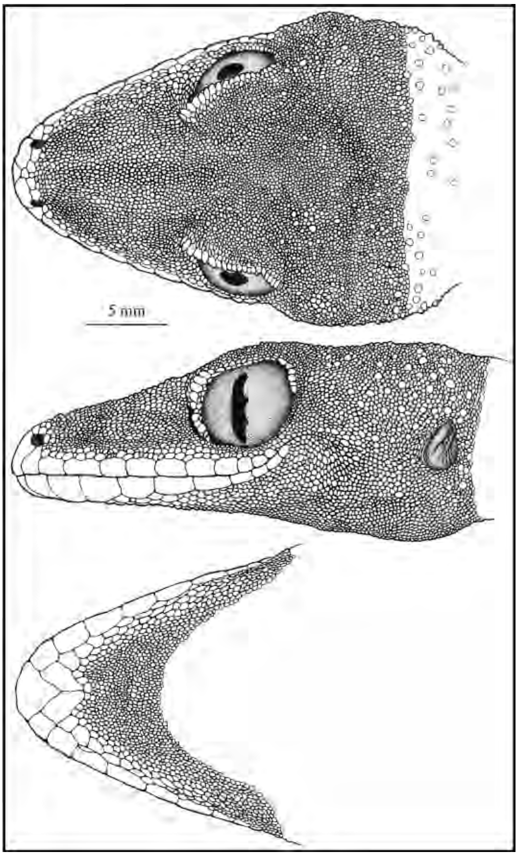

FIG. 2.—Dorsal, lateral and ventral aspects of head of holotype BSI 2574 of *Cyrtodactylus wallacei*.

sals and single internasal scale; rostral in contact with first supralabial, anteriormost supranasal, median postinternasal and internasal. Nostrils oval, oriented laterally, in contact with two supranasals, two postnasals, first supralabial; pigmentless opaque narial flap present, occluding posterior 70–80% of nostril; 5–7 scale rows separating orbit from supralabials. Mental triangular in shape, wider (4.3 mm) than deep (3.1 mm); single pair of postmentals contacting posteriorly. Postmentals bordered laterally by first infralabial; posteriorly by one enlarged chin shield (adjacent to second infralabial), three intermediate sized and one small irregularly shaped granular gular scales. Infralabials bordered ventrally by rows of enlarged scales decreasing in width and increasing in length posteriorly. Throat scales uniform in size, granular. Eight supralabials to midpoint of orbit (11 to angle of jaw). Seven infralabials to midpoint of orbit (11 to angle of jaw).

Body slender (trunk length/SVL ratio 0.5); distinct denticulate ventrolateral folds with tubercles of reduced size. Dorsals between forelimb insertion and caudals characterized by granular scales interspersed with irregularly spaced, weakly keeled tricarinate tubercles. Anterior side of tubercles convex, rising steeply, defined by pair of weakly pronounced lateral keels; posterior sides concave, gradually sloping; posterior keel usually pronounced. From forelimb insertion to frontal region, tubercles progressively decrease in size, becoming round, non-keeled on head. Twenty-nine paravertebral tubercles between forelimb and hindlimb insertions. Ventral scales swollen, posteriorly oriented, subimbricate, regular in size except for marginally enlarged pectorals, precloacals; ventrals larger in diameter than both granular and some dorsal tubercles; gulars small, granular, irregular in size; 48 scales between dorsolateral folds across midsection of body. No precoacal pores or precloacal groove. No femoral pores or enlarged femoral scales.

Limbs medium in length, moderately robust; forearms shorter than hindlimbs; forearm short (forearm length/SVL ratio 0.2); tibia short (crus length/SVL ratio 0.2); suprabrachials and prebrachials larger than scales of adjacent dorsum, granular, tuberculate, becoming subimbricate in postbrachial region proximal to elbow; infrabrachials small, granular, slightly larger than gulars; postantebrachials granular at elbow, increasing in size, becoming imbricate distally; heavy tuberculation present on all tibial surfaces, except infratibial regions; supraantebrachials small, granular proximally, becoming large, imbricate distally, continuous, unchanged in size with supracarpals and supradigital lamellae; infra-antebrachial squamation similar to supraantebrachials, though tubercles not present; suprafemorals and prefemorals similar to suprabrachials, scales small, granular, with tubercles; infrafemorals small, imbricate, decreasing in both size and degree of imbrication along ventral length of femur towards knee; no enlarged infrafemoral or postfemoral scale series, squamation similar to adjacent interfemorals, ventrals; supratibials and pretibials small, granular, as in ventral femoral regions; unlike supracarpal squamation, supratarsals consistently small, granular, met abruptly by enlarged supradigital lamellae; infratarsals similar in size proximally, but becoming enlarged, subimbricate distally, culminating in large, imbricate scale patch preceding infratarsal region; infratarsals variable in size: enlarged scale rows leading to 1st and 5th toes, continuous in size with respective lamellae in contrast with intervening patch of reduced infratarsals which are met abruptly by enlarged lamellae of toes 2–4. Digits long, strongly inflected at basal interphalangeal joints. Claws large (maximum length of 1.3 mm), surrounded by elongate, distal-most subdigital lamella, one predigital, one postdigital, one elongated supradigital lamella, 2–2.5 times longer than other supradigital lamellae. Subdigital lamellae elongate, narrow distal to first interphalangeal joint. Subdigital lamellae proximal to first interphalangeal joint wider than long, swollen, padlike, especially at interphalangeal joint. Counts of subdigital lamellae on manus 12 – 17 – 19 – 18, on pes 20 – 23 – 21 – 17 – 13; webbing absent. Relative lengths of digits on manus IV > III > II > I > V, on pes IV > V > III > II > I.

Tail broken at base but regenerated, relatively long, (tail length/SVL ratio 0.7); original portion of tail subrectangular at base with regularly-spaced strongly trihedral, keeled tubercles more sparsely distributed than tubercles of dorsum; regenerated tail completely round; caudals of re-grown tail extremely reduced, tubercles absent; three prominent, enlarged post-cloacal spurs on each side of vent; subcaudals arranged in several rows of small, narrow rectangular scales followed by enlarged median subcaudal plates variable in size, largest 3.9 mm wide, 1.2 mm long; most approximately half this size; subcaudals of regenerated part of tail in proportion to original subcaudals, but reduced in size.

Dorsum dark purple with irregular dark bands and yellow spots; overall dorsal appearance dark, marked by irregular light brown to yellow lines surrounding irregular splotches and incomplete, slanting bands; bright yellow tubercles contrasted against dark purple regions of dorsum, pronounced on infrafemoral and postfemoral surfaces and markedly pronounced on infratibial and posttibial surfaces; 11 irregular fine yellow lines crossing dorsum in various angles and outlining 10 purple blotches; blotches darker purple when adjacent to yellow lines; head coloration lighter than dorsum and interrupted by small, yellow to light-brown blotches from occiput to nasal region; delicate yellow line running along superciliaries to occiput enclosing parietal region of head; labials and rostral scales purple, similar to regrown tail; nape dark, crossed with two sharp yellow lines; two distinct yellow stripes extending horizontally from upper and lower portion of orbit to tympanum; eyes golden-brown and with numerous black reticulations; lateral surfaces similar to dorsum but with yellow tubercles, strongly contrasted by dark purple base color; venter and undersides of limbs uniformly purple, ventral scales with numerous fine purple flecks covering otherwise pale scales; Regenerated part of tail deep purple, almost velvety black.

Variation.—Paratypes similar to holotype except as follows: paratype BSI 2575 with four pairs of enlarged chin shields bordering postmentals; one less scale in both supralabial and infralabial series; 19 paravertebral tubercles between limb insertions; tail also broken but regenerated; 46 ventral scales. Paratypes MZB 3845 and MZB 4264 with 10 supralabials (to midorbit), 9 infralabials and 29 and 31 paravertebral tubercles respectively; 9 and10 expanded lamellae and 16 and 14 unexpanded lamellae on 4th toe respectively; both paratypes with fewer enlarged distal palpebrals (only superciliaries enlarged) and scale row distal to it only slightly enlarged; ventrum almost white, but with tiny purple flecks in preservative; precloacal scale patch without enlarged scales in both; tail complete, with bands of light and dark purple, tuberculation less developed in caudal region; reticulate pattern absent from head in both paratypes; snout and digits damaged and missing numerous scales in paratype MZB 3845, presumably from transport of preserved specimen. The holotype BSI 2574 and paratype BSI 2575, which are both males from the village of Kelapa Dua, are more similar morphologically to each other than to the paratypes from Kabaena (MZB 3845 and MZB 4264), which are both females. It is unclear if this morphological variation is due to sexual dimorphism, population-level morphological variation in *C. wallacei*, or if the Kabaena paratypes are actually a distinct yet morphologically similar species of large *Cyrtodactylus* found in Sulawesi. The resolution of these issues requires further sampling and more specimens.

Measurements.—Measurements (in mm) of the holotype (BSI 2574) are followed by three paratypes in parentheses (BSI 2575, MZB 3845 and MZB 4264 respectively): SVL 113.5 (113.6, 93.6, 92.0), trunk length 51.6 (51.9, 40.0, 39.0), crus length 20.3 (21.9, 18.4, 15.5), tail length 78.7 (117.5, 117.0, 122.0), tail width 12.6 (12.4, 8.3, 8.6), head length 31.8 (32.5, 27.5, 27.7), head width 22.2 (22.3, 18.1, 17.7), head height 13.3 (13.3, 10.1, 10.2), ear length 3.7 (3.4, 1.9, 2.0), forearm length 16.7 (17.5, 15.2, 15.5), diameter of orbit 6.9 (7.3, 6.4, 5.8), nares to eye distance 10.3 (10.3, 9.9, 9.6), snout to eye distance 12.4 (12.2, 11.3, 11.2), eye to ear distance 8.6 (8.5, 6.9, 6.9), internarial distance 4.0 (4.0, 2.5, 2.5), and interorbital distance 11.2 (10.9, 5.9, 5.5).

Distribution and ecology.—The holotype (BSI 2574) and one paratype (BSI 2575) were found less than 1 m apart approximately 5 m above the ground in a large *Ficus* tree growing 6–8 m from the bank of a 1.5 m wide stream in disturbed secondary forest planted heavily with coffee. The holotype (BSI 2574) and one paratype (BSI 2575) were located by eye shine. Neither attempted to flee, despite large amounts of noise made while the collectors were climbing up the tree. Both specimens exhibited catatonic behavior while being photographed. Several individuals of *Cyrtodactylus jellesmae* were collected on the ground or bases of small trees in the immediate vicinity. The collection locality of BSI 2574 and BSI 2575 was visited several times. Climatic conditions consisted of variable heavy to light rain producing a cool and humid atmosphere.

Paratypes MZB 3845 and MZB 4264 were collected on the wall of a large cave complex with many chambers (within 30 m of cave entrance) on Kabaena Island, Sulawesi Tenggara Province (for a detailed treatment of region, see Gillespie et al., 2005). While *C. wallacei* is known from only two localities, we suspect that the species will eventually be found throughout the island of Sulawesi, as well as on other islands separated from Kabaena by shallow marine channels (i.e., the islands of Buton and Muna). Geologically, Sulawesi is composed of at least three major paleo-islands: west Sulawesi, the east and southeast peninsulas, and the Northern peninsula (see Fig. 3). *C. wallacei* may be absent from the Northern Peninsula, having a distribution restricted to west Sulawesi and the southern peninsulas. Similar distribution patterns are seen in the Lyogosomine skink *Lamprolepis* and the Colubrid snake *Boiga dendrophila*, indicating this pattern is the result of a common biogeographical force.

Comparisons.—*Cyrtodactylus wallacei* is distinguishable from all but ten congeneric species by either the absence of a pubic groove, the absence of precloacal and femoral pores or both. Specifically, the presence of precloacal pores aligned in a pubic groove distinguishes *C. wallacei* from *C. annulatus*, *C. aurensis*, *C. cavernicolus*, *C. fumosus*, *C. gansi*, *C. halmahericus*, *C. marmoratus*, *C. philippinicus*, and *C. pulchellus*. The presence of a pubic groove lacking preanal pores distinguishes *C. wallacei* from *C. pubisculus* and *C. semenanjungensis*. The presence of both preanal pores and femoral pores in an enlarged scale series distinguishes *C. wallacei* from *C. aaroni*, *C. abrae*, *C. aequalis*, *C. agusanensis*, *C. annandalei*, *C. baluensis*, *C. brevipalmatus*, *C. chanhomeae*, *C. consubrinus*, *C. d'armandvillei*, *C. deveti*, *C. feae*, *C. gubernatoris*, *C. interdigitalis*, *C. intermedius*, *C. irianjayaensis*, *C. jarujini*, *C. loriae*, *C. louisiadensis*, *C. malcomsmithi*, *C. mimikianus*, *C. novaeguineae*, *C. papilionoides*, *C. redimiculus*, *C. russelli*, *C. sadleri*, *C. seribautensis*, *C. slowinskii*, *C. tigroides*, *C. tiomanensis*, *C. tuberculatus*, *C. variegatus*, and *C. wetariensis*. The presence of preanal pores and enlarged femoral scales distinguishes *C. wallacei* from *C. adleri*, *C. angularis*, *C. condorensis*, *C. consobrinoides*, *C. cracens*, *C. edwardtaylori*, *C. fraenatus*, *C. matsuii*, *C. oldhami*, *C. papuensis*, *C. quadrivirgatus*, *C.*

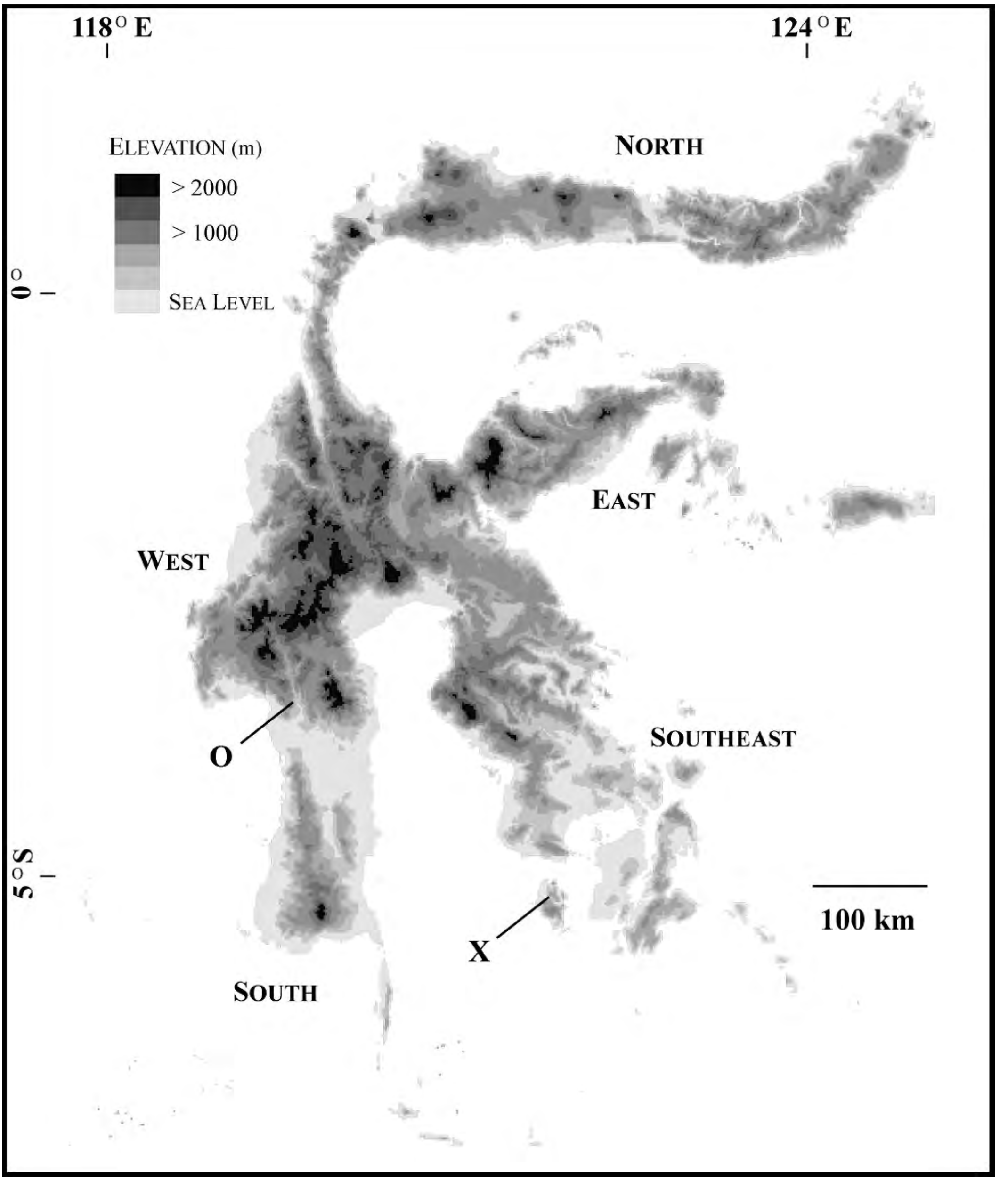

FIG. 3.—Map of Sulawesi showing collection localities of *Cyrtodactylus wallacei*. Type locality of the holotype BSI 2574 and paratype BSI 2575 from the village of Kelapa Dua indicated by **O**. Collection locality of paratypes MZB 3845 and MZB 4264 indicated by **X**.

ramboda, *C. soba*, *C. subsolanus*, and *C. sworderi*. The presence of a precloacal pore series alone distinguishes *C. wallacei* from *C. ayeyarwadyensis*, *C. battalensis*, *C. brevidactylus*, *C. chrysopylos*, *C. dattanensis*, *C. elok*, *C. ingeri*, *C. irregularis*, *C. khasiensis*, *C. lateralis*, *C. malayanus*, *C. markuscombaii*, *C. martinstollii*, *C. peguensis*, *C. phongnhakebangensis*, *C. rubidus*, *C. sumonthai*, *C. wakeorum*, and *C. yoshii*.

Species for which males are not represented in museum collections are distinguishable from *Cyrtodactylus wallacei* as follows: *Cyrtodactylus buchardi* (which was described from a single juvenile from Xepian National Biodiversity and Conservation Area, southern Laos) is distinguished by its distinct dark band running from eye to eye, fifteen dark chocolate brown blotches on the dorsum, fewer midbody scale rows and supralabials, and a triangular rostral scale (David et al., 2004). *Cyrtodactylus derongo* (for which all types are females [Brown and Parker, 1973]) is distinguished by its enlarged femoral scale row forming a distinct border, which is continuous with an enlarged precloacal series, enlarged precloacal scales posterior to the enlarged femoral scale row, and white dorsal tubercles. *Cyrtodactylus mintoni* (known from a single female [Golubev and Szczerbak, 1981]) is distinguished by its small size and a dorsal amber yellow coloration broken with a series of dark, thin bands. *Cyrtodactylus murua* (known from two female specimens [Kraus and Allison, 2006]) is distinguished by its distinct dorsal banding pattern and white coloration along nape, sides of throat and along the labial region.

There are six species of *Cyrtodactylus* for which males are known to lack precloacal and femoral pores. These congeners may be distinguished from *C. wallacei* by the following characters: smaller size, unenlarged subcaudals and light brown dorsal coloration distinguish *C. jellesmae* (Boulenger, 1897); the absence of dorsal conical tubercles, a chocolate dorsal coloration and small size (maximum SVL 43 mm) distinguish *C. laevigatus* (Darevsky, 1964); the presence of an enlarged femoral scale row forming a distinct boundary and separating smaller posterior femorals distinguishes *C. paradoxus* (Darevsky and Szczerbak, 1997); presence of enlarged femoral scales, smaller snout–vent length and dark bands or blotches contrasting with a light gray background distinguish *C. semangjungensis* (Grismer and Leong, 2005); presence of a quadrangular rostral bordered by fewer scales and with a single median cleft, smaller size, and heavy yellow spotting on arms, dorsum and, most distinctively, along ventrolateral folds and labial regions distinguish *C. sermowaiensis* (De Rooij, 1915); presence of an extremely enlarged femoral and precloacal scale series, slightly smaller size and distinct yellow banding distinguish *C. thirakhupti* (Pauwels et al., 2004).

Remarks.—The herpetofauna of Sulawesi is depauperate and highly endemic compared to the adjacent regions of Sundaland and New Guinea (Whitten and Whitten, 1992; Iskandar and Tjan, 1996). While a detailed treatment of the island's herpetofauna is yet to be completed, similar levels of faunal impoverishment and endemism are documented for mammals (Musser, 1987) and invertebrates (Gressit, 1961; Vane-Wright, 1991; Whiten et al., 1987), indicating the pattern observed in reptiles and amphibians is likely real and not merely an artifact of the limited attention biologists have payed to Sulawesi's herpetofauna in comparison to other regions in Southeast Asia.

Complete isolation for at least 25 million yr and, possibly, for the island's entire history (Hall, 1996, 1998, 2001) is the obvious explanation for these biogeographical patterns. Paleogeographic studies indicate Sulwesi's current topology is the result of a complex suite of geological processes which occurred throughout the Tertiary, producing isolated land masses- on which evolution proceeded as on oceanic islands- now joined together as a single more or less continuous tract of land (Moss and Wilson, 1998).

At higher levels (family and genus) Sulawesi's fauna is comprised of both Sundaic and Australian elements (Whitten and Whitten, 1992); however, bird (Holmes and Phillips, 1996; Mayr, 1944; Michaux, 1996) and invertebrate (Gressit, 1961; Vane-Wright, 1991; Whiten et al., 1987) faunas are dominated by Sundaic elements. Similarly, Wallacean and Australian *Cyrtodactylus* are likely of western origin as the bulk of the species diversity in the genus is Sundaic, with more than 90% of described species occuring west of Wallace's line. While hypotheses regarding the interspecific relationships of *Cyrtodactylus* are currently lacking, discovery of *C. wallacei* is biogeographically significant as it is the first large *Cyrtodactylus* to be found on Sulawesi.

While *C. wallacei* is much larger than its Sulawesi congeners, the absence of both precloacal and femoral pores and enlarged femoral scales suggests it is possibly closely allied with the smaller Sulawesi endemic, *C. jellesmae*. The largest species of *Cyrtodactylus* occur in New Guinea, with *C. novae-guineae* and *C. irianjayensis* regularly reaching 160–172 mm in snout–vent length (Brongersma, 1934; Rösler, 2001; Zweifel, 1980). However, these large New Guinea species are clearly not closely allied with *C. wallacei* as they differ drastically in color pattern and squamation. However, *C. wallacei* may be related to other New Guinea *Cyrtodactylus* of more moderate size. New Guinea's *C. sermowaiensis* is 75 to 85 mm adult SVL and similar in lacking precloacal and femoral pores and enlarged femoral scales and with a dorsal color pattern not drastically different from that of *C. wallacei*. Considering species west of Wallace's Line, several Bornean members are morphologically similar to *C. wallacei*. As summarized by Hikida (1990), Bornean *Cyrtodactylus*, such as *C. baluensis*, *C. consubrinus*, *C. ingeri*, *C. malayanus*, *C. matsui* and *C. yoshii*, are similar to *C. wallacei* either in size or superficial resemblance and possess no or very few enlarged femoral scales or femoral pores, but differ in possessing precloacal pores. The Bornean endemic *C. cavernicolous* is smaller than *C. wallacei*, but has a similarly dark habitus and is cavernicolous, as also was true for the Kabaena paratypes (MZB 3845 and MZB 4264) of *C. wallacei*.

The absence of precloacal pores, femoral pores and an enlarged femoral scale series in *C. wallacei*, *C. jellesmae* and *C. sermowaiensis* suggests these species may be closely related. These are the only species of *Cyrtodactylus* known which share this suit of characters. Both *C. wallacei* and *C. jellesmae* are Sulawesi endemics while *C. sermowaiensis* is restricted to the North coast of New Guinea. Nothing is known about the evolutionary lability of pore-loss or other frequently-used diagnostic morphological characters in *Cyrtodactylus*, however change in body size is a frequent path of evolutionary change. Thus, we propose two competing evolutionary scenarios with regards to the interspecific affinity of *C. wallacei* that can be distinguished in a phylogenetic framework. The first hypothesis unites species lacking femoral and precloacal pores and enlarged femoral scales (*C. wallacei*, *C. jellesmae*, and *C. sermowaiensis*) as a monophyletic group marked by evolutionary changes in body size. Alternatively, the second hypothesis posits that *C. wallacei* is closely allied to members of a Sunda Shelf assemblage from Borneo. All species of this putatively monophyletic Sundaland group (e.g., *C. consubrinus*, *C. ingeri*, *C. malayanus*, and *C. matsuii*) possess precloacal pores, indicating loss of pores in *C. wallacei*. Answers to these questions await a phylogenetic analysis of the genus.

Key to Species of *Cyrtodactylus* of Sulawesi

This key is based on morphological characteristics of adult males, therefore females and juveniles may be difficult to identify. It should be acknowledged that current taxonomy does not accurately reflect the diversity of *Cyrtodactylus* in Sulawesi.

1a Preanal groove present in males **2**
1b Preanal groove absent in males **3**
2a 42–52 preanal and femoral pores, either in a continuous series or with poreless scales separating preanal and femoral pore series .... *C. fumosus*
2b Preanal and femoral pores in a continuous series of 21–26; restricted to Halmahera .... *C. halmahericus*
3a No preanal or femoral pores; snoutvent length greater than 92 mm; enlarged subcaudals .... *C. wallacei*
3b No preanal or femoral pores SVL less than 70 mm; no enlarged subcaudal scales *C. jellesmae*

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Appendix I

Specimens Examined

Museum abbreviations follow Leviton, et al., (1980) and are as follows: CAS, California Academy of Sciences; LSUMZ, Louisiana State University, Museum of Natural Science; MVZ, Museum of Vertebrate Zoology, University of California, Berkeley; MZB, Museum Zoologicum Bogoriense; NMPNG, National Museum of Papua New Guinea; UP, University of Papua New Guinea. Several specimens examined are yet to be formally accessioned. These specimens are designated by collector's field series number with the museum into which specimens are to be deposited listed in parentheses: BSI, Biological Surveys and Inventories Sulawesi Grant of Jimmy A. McGuire (this material will be deposited in the MVZ and MZB); CCA, Christopher C. Austin field series (this material will be deposited in the LSUMZ); JAM, Jimmy A. McGuire field series (this material will be deposited in the MVZ and MZB); RMB, Rafe M. Brown field series (this material will be deposited in the MVZ and MZB). Where noted, field collection numbers for specimens are in parentheses.

Cyrtodactylus agusanensis.—LSUMZ 41601, 41602 *males*, LSUMZ 41603 *female*, LSUMZ 41604, 41605 *males*, Philippines, Mindanao, Province of Davao del Norte, 70 km South of Bislig.

Cyrtodactylus annulatus.—LSUMZ 41606 *female*, 41608, 41609 *males*, Philippines, Mindanao, Province of Davao del Norte, 70 km South of Bislig.

Cyrtodactylus baluensis.—CAS 25626 *male*, East Malaysia, Sabah, Kina Balu Peak.

Cyrtodactylus cavernicolus.—CAS 23726 *male*, East Malaysia, Sarawak, Niah Cave.

Cyrtodactylus consobrinus.—AS 105993 *male*, East Malaysia, Sarawak, Bintulu District, Sungei Seran; LSUMZ 55833 *male*, Brunei, Temburang District, Sungai Belalang; MVZ 11782 *male*, East Malaysia, Sarawak, Kapit District, Sungai Mengiong.

Cyrtodactylus d'armandvillei.—LSUMZ 81732 (JAM 3176) *male*, Indonesia, Propinsi Nusa Tenggara Barat, Pulau Lombok.

Cyrtodactylus derongo.—NMPNG R23452 *female*, Papua New Guinea, Western Province, Derongo.

Cyrtodactylus fumosus.—LSUMZ 81868 (RMB 2702) *male*, LSUMZ 81869 (RMB 2711) *female*, LSUMZ 81870 (JAM 2782) *female*, LSUMZ 81871 (JAM 3066) *male*, LSUMZ 81872 (JAM 3069) *male*, LSUMZ 81873 (JAM 3070) *female*, LSUMZ 81874 (JAM 3075) *subadult male*, LSUMZ 81875 (JAM 3076) *female*, LSUMZ 81876 *male*, all from Indonesia, Propinsi Java Barat, Sukabumi.

Cyrtodactylus cf. fumosus.—JAM 6444, 6451, 6620 *males*, 6450, 6452, 6621 *females*, Indonesia, Propinsi Sulawesi Barat, Takendeang; JAM 6572–6574 *males*, 6575–6577 *females*, Indonesia, Propinsi Sulawesi Barat, Jalan Tasiu-Tibo.

Cyrtodactylus irianjayensis.—CCA 3142 *female*, 3415 *juvenile*, Papua New Guinea, Sandaun Province, Utai; CCA 3674 *male*, Papua New Guinea, Sandaun Province, Bewani Station.

Cyrtodactylus jellesmae.—JAM 5628, 5631 *males*, Indonesia, Propinsi Sulawesi Selatan, Anabanua; JAM 5643 *female*, Indonesia, Propinsi Sulawesi Selatan, Harapan; JAM 5670, 5671, 5678 *males*, 5677 *female*, Indonesia, Propinsis Sulawesi Selatan, Takalasi; JAM 5680, 5683, 5684, 5686, 5688, 5704 *males*, 5681, 5682, 5685, 5687 *females*, Indonesia, Propinsi Sulawesi Selatan, Maroangin; JAM 5705, 5747, 5749, 5768, 5769, 5771 *males*, 5770, 5772, 5773 *females*, Indonesia, Propinsi Sulawesi Selatan, Enrekang; JAM 5783, 5784 *females*, Indonesia, Propinsi Sulawesi Selatan, Tapung; JAM 5850, 5851 *females*, 5852 *juvenille*, Indonesia, Propinsi Sulawesi Selatan, Pecinong; JAM 5892, 5895, 5897, 5899 *males*, 5893, 5896, 5898 *females*, 5900 *juvenile*, Indonesia, Propinsi Sulawesi Selatan, Mariorilau; JAM 6341–6343, 6346 *males*, 6339, 6340, 6344, 6345, 6347 *females*, 6338 *juvenile*, Indonesia, Propinsi Sulawesi Barat, Kabiraan; LSUMZ 8403 (JAM 3540) *male*, 8400 (JAM 3583) *female*, 8401 (JAM 3583) *juvenile*, Indonesia, Propinsi Sulawesi Tenggah, Donggala Kabupaten; LSUMZ 8402 (JAM 3880) *male*, Indonesia, Propinsi Sulawesi Tenggah, Poso Kabupaten; LSUMZ 8405 (JAM 3708) *male*, 8404 (JAM 3945), 8406 (JAM 3707) *females*, Indonesia, Propinsi Sulawesi Tenggah, Luwok Kabupaten.

Cyrtodactylus loriae.—CAS 117964 *male*, CAS 118018 *female*, NMPNG R23625, R8347, R8348, all from Papua New Guinea, Chimbu Province, Karimui; UP 5687, *male*, Papua New Guinea; UP 0976 *female*, Papua New Guinea, Western Highlands Province, Kaironk; NMPNG 24730 Papua New Guinea, Morobe Province, Wau.

Cyrtodactylus louisiadensis.—CCA 4096 *female*, 4426, 4427, 4582, *males*, 4428 *juvenile*, Papua New Guinea, Milne Bay Province, Halowina.

Cyrtodactylus cf. quadrivirgatus.—MVZ 239338 (JAM 4094) *male*, 239578 (JAM 4095) *female*, Indonesia, Sumatera, Propinsi Bengkulu, 46 km East of Bengkulu.

Cyrtodactylus sermowaiensis.—CCA 3108, 3143, 3407, 3411, 3448–3451, 3506, 3507, 3517 *males*, 2895, 2911, 3034, 3144, 3188, 3224, 3233, 3358, 3359, 3490, 3530 *females*, Papua New Guinea, Sandaun Province, Utai; CCA 3603 *male*, 3604 *juvenile*, Papua New Guinea, Sandaun Province, Bewani Station; NMPNG R22712, Papua New Guinea, Madang Province, Sapi Creek; NMPNG R24803–24806, Papua New Guinea, Madang Province, South Naru; NMPNG R22796, Papua New Guinea, East Sepik Province, Maprik; UP 3914–3916, Papua New Guinea, Sandaun Province, Idam River.

Cyrtodactylus sp. nov. 1.—JAM 5307–5309 *males*, 5269, 5270, 5272, 5275, 5284, 5310 *females*, 5271, 5273, 5311 *juvenile*, Indonesia, Propinsi Sulawesi Selatan, Pulau Tana Jampea.

Cyrtodactylus sp. nov. 2.—JAM 5113, 5170, 5200, 5205, 5207 *males*, 5114, 5167–5169, 5171, 5199, 5206 *females*, 5152 *juvenile*, Indonesia, Propinsi Sulawesi Selatan, Pulau Selayar, Jalan Telkom Tower.