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First record of *Gekko smithii* Gray, 1842 (Reptilia: Gekkonidae) from Sulawesi, Indonesia

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Abstract. *Gekko smithii* Gray, 1842 is herein reported for the first time from the Indonesian island of Sulawesi. Four specimens were recently collected on Sulawesi and the Togian Islands in the Gulf of Tomini, Central Sulawesi. This represents the first record of this large gecko species from east of Wallace's Line and for the Sulawesi region. Morphological data for Sulawesian *G. smithii* are compared with literature sources. Finally, the taxonomic status and origin of the Sulawesi population of *G. smithii* are discussed in light of observed biogeographic patterns and the possibility of human transportation.

Key words. Reptilia, Squamata, Gekkonidae, *Gekko smithii*, Indonesia, Sulawesi, Togian Islands, distribution.

Smith's green-eyed gecko, *Gekko smithii*, is one of the largest species of Southeast Asian geckos, reaching a maximal total length of 376 mm (Manthey & Grossmann 1997, Grossmann 2004). *Gekko smithii* is currently known to occur in south Thailand, the Malaysian Peninsula, and the islands of Borneo, Sumatra, Nias, and Java (Manthey & Grossmann 1997, Das 2004) (Fig. 1). In addition, *G. smithii* was recently recorded from Pulau (= island) Tioman (Lim & Lim 1999, Hien et al. 2001) and several additional islands of the adjacent Seribuat Archipelago in the South China Sea (Grismer et al. 2006). Populations on the Andaman Islands in the Bay of Bengal have been demonstrated to represent a closely related but morphologically distinct taxon, *G. verreauxi* Tytler, 1864 (Ota et al. 1991, Vesely 1999). Likewise, Ota & Nabhitabhata (1991) described *G. taylori,* a synonym of *G. siamensis* Grossmann & Ulber, 1990 from central Thailand based upon karyological and morphological differences compared to other populations of *G. smithii*.

Currently, fifteen gekkonid species are known to inhabit Sulawesi and adjacent islands. Among these are two species in the genus *Gekko*, *G. gecko* and *G. monarchus* (Iskandar & Tjan 1996, Brown et al. 2000, Gillespie et al. 2005, Zug 2006, Hayden et al. 2008, Linkem et al. 2008, Koch et al. 2009). During field work on Sulawesi and adjacent islands in September 2001 and July 2006 four specimens of a third *Gekko* species were collected. Morphological examinations and comparison with literature sources (Ota et al. 1991, Ota & Nabhitabhata 1991) and published photographs (e.g., Chan-Ard et al. 1999, Manthey & Grossmann 1997) revealed an identification of these specimens as *G. smithii* (Tab. 1). Thus, we here report on the first record of *G. smithii* both for Sulawesi and for the region east of Wallace's Line, the biogeographical boundary of Sundaland.

Herpetofaunal surveys in September 2001 were conducted at the Hengahenga waterfall (00°57'49"S, 122°46'33"E) near Luwuk on the eastern peninsula of Sulawesi, on Pulau Batudaka (00°26'24.1"S, 121°51'54.0"E) in the Togian Islands, and in North Sulawesi near the village of Torout (00°33'72"N, 123°54'23"E) on the eastern margin of Bogani Nani Wartabone National Park, North Sulawesi. In 2006, the vicinity of the village of Langger (00°25'23.38"S, 121°55'07.27"E), Pulau Togian, in Central Sulawesi was surveyed between 11 and 15 July. Opportunistic searching was undertaken during the day and night with the assistance of local guides. Of the four specimens collected on Sulawe-

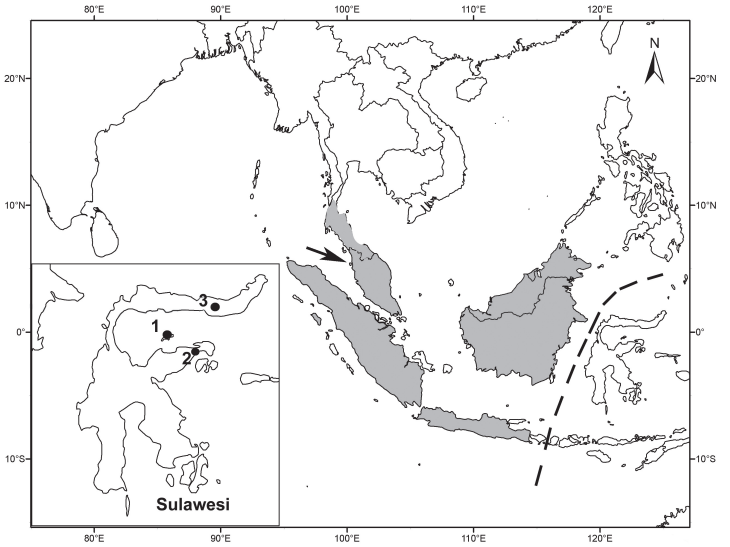

Fig. 1. Map of Southeast Asia showing the known distribution of *Gekko smithii* (shaded areas). Pulau Pinang, the type locality off the west coast of West Malaysia, is denoted by an arrow. Wallace's Line demarcating the continental shelf of Southeast Asia is shown by a dashed line. Inserted map of Sulawesi indicates the localities where *G. smithii* was recently discovered: 1 = Pulau Togian and P. Batudaka, Togian Islands, Central Sulawesi; 2 = Luwuk, East Sulawesi; 3 Torout, North Sulawesi.

si and in the adjacent Togian Islands, three are deposited in the herpetological collection of the Museum Zoologicum Bogoriense, Indonesia (MZB Lac. 3930, field number JAM 3373, Torout, North Sulawesi; MZB Lac. 3931, field number JAM 3957, Luwuk, East Sulawesi; MZB Lac. 6026 [see Fig. 2], field number AK0290, Pulau Togian, Togian Islands). The fourth voucher specimen, from Pulau Batudaka, Togian Islands, is deposited in the Louisiana State University Museum of Natural Science, USA (LSU 83984, field number JAM 3933). Morphological and meristic data collected from these specimens for comparison with previous literature sources are summarized in Table 1.

The voucher specimens have a snout-vent length of 139-170 mm and a tail length of 148-162 mm (tail broken in MZB Lac. 3931), resulting in a total length of 299-332 mm; the body is large and stoutly built; the tail is slightly shorter than SVL, a lateral fold is present; digits are webbed at base; fingers and toes are largely dilated and clawed except for the first phalanges; the small ear opening is vertical slit like to oval; 94-103 scales around midbody (vs. 89-141, mean 104.4 according to Ota & Nabhitabhata 1991); the dorsum is covered with small granulous scales and numerous interspersed tubercles arranged in 10-11 irregular longitudinal rows (vs. 8-13, mean 10.61 according to Ota & Nabhitabhata 1991); tubercles are also present on nuchal region and lateral side of the head; the ventrals are homogenous and larger than the dorsal scales; the rostral is quadrangular, twice as wide as high, and separated from the nostril by a large intervening scale; a middorsal notch is present; 12-16 supralabials (12-17, mean 14.61 according to Ota & Nabhitabhata 1991); 10-13 infralabials (10-14, mean 11.53 according to Ota & Nabhitabhata 1991); one pair of postmentals followed by a row of enlarged submaxillaries; 14-18 undivided subdigital scansors under first toes (vs. 16-20, mean 17.26 according to Ota & Nabhitabhata 1991); 18-21 scansors (17-18 undivided lamellae) under fourth toes (vs. 19-24,

Fig. 2. Adult specimen of *Gekko smithii* (MZB Lac. 6026, field number AK0290) from Pulau (= island) Togian, Togian Archipelago, Central Sulawesi.

mean 21.05 according to Ota & Nabhitabhata 1991; but 23-26 subdigitals, of which 21-23 are undivided, according to Manthey & Grossmann 1997); tail segmented by rings of slightly spinose tubercles, dorsally each segment with 5-9 rows of small scales (vs. 8-9 according to Manthey & Grossmann 1997 and vs. 8-11 above, 3 beneath, according to de Rooij 1915); median row of 80-99 paired subcaudal scales distinctly enlarged; row of 13-18 pores in precloacal region (vs. 7-17 according to Manthey & Grossmann 1997; 10-19 according to Ota & Nabhitabhata 1991); base of tail with one or two slightly enlarged spurs on each side (vs. 2-4 in males and two small in females according to Manthey & Grossmann 1997). The specimens' dorsal ground colour is light brown with 7-8 dark bordered light transverse bands from neck to base of tail. In one specimen (MZB Lac. 6026), the dorsal colour pattern consists of small round beige spots arranged in four transverse rows along the back. The limbs are irregularly light spotted. Tail with faded beige cross bands. The neck shows a V-shaped dark band beginning at the posterior margins of the eyes. The pupil is slit-like with four points of enlargement, the iris is green to olive. The whitish

Tab. 1. Meristic and morphological data of four specimens of *Gekko smithii* from Sulawesi compared with literature sources ($\bar{x}$ = mean value). Values from de Rooij (1915: 57) refer to *G. stentor* (Cantor, 1847), a junior synonym of *G. smithii*.

Characters	de Rooij (1915)	Ota & Nabhitabhata (1991)	Manthey & Grossmann (1997)	Sulawesi specimens (n = 4)
SVL (mm)	190	males 127.3-185.8 ($\bar{x}$ = 157.78) females 122.5-168.0 ($\bar{x}$ = 143.24)	males up to 191	139-170
TaL (mm)	180	–	–	148-162
ToL (mm)	370	–	males up to 376	299-332
Scales around midbody	–	89-141 ($\bar{x}$ = 104.4)	–	94-103
Dorsal tubercle rows	10 or 12	8-13 ($\bar{x}$ = 10.61)	10-12	10-11
Supralabials	12-14	12-17 ($\bar{x}$ = 14.61)	12-16	12-16
Infralabials	10-12	10-14 ($\bar{x}$ = 11.53)	11-13	10-13
Subdigitals under 1. toe	–	16-20 ($\bar{x}$ = 17.26)	–	14-18
Subdigitals under 4. toe	–	19-24 ($\bar{x}$ = 21.05)	23-26 (21-23 undivided)	18-21 (17-18 undivided)
Scales per tail segment	8-11 above, 3 beneath	–	8-9	5-9
Subcaudals	–	–	–	80-99
Precloacal pores	11-16 (in males)	10-19 (in males)	7-17	13-18
Postanal tubercles	–	–	2-4 in males, 2 small in females	2/2

ventral side is mottled with bright yellow-brown markings under the head. The belly is whitish in the middle and yellow-brown at the sides. Tail and limbs are yellowish.

In contrast with common house geckos such as *Hemidactylus frenatus* or *Gehyra mutilata*, it is unlikely that *G. smithii* was introduced to Sulawesi by humans. The preferred habitat of this species is primary forest (Manthey & Grossmann 1997, Grossmann 2006). However, it is reasonable to suggest that gecko eggs, which adhere to arboreal substrates, may be transported over long distances by floating on vegetation. The invasion of Sulawesi, either via human mediated means or naturally, most likely did not take place recently (e.g., <150 years ago) because *G. smithii* occurs in geographically widespread regions of Sulawesi, as well as on off-shore islands (Fig. 1). The possibility of repeated transportation by man from the Sunda region to Sulawesi and further on to the Togian Islands appears most unlikely for a species of undisturbed habitats. Thus, we hypothesize that *G. smithii* reached Sulawesi by natural colonization from the Sunda Shelf, and later reached the Togian Islands by natural colonization from Sulawesi. The minor differences in scalation characters described above (see also Tab. 1) possibly reflect incipient divergence due to geographic separation or even a cryptic Sulawesi taxon depending on the time since colonization. Forthcoming molecular genetic analyses (Bickford et al. unpubl. data) should illuminate whether the newly discovered Sulawesi and Togian populations represent one or more species distinct from Sunda shelf *G. smithii*.

Note added in proof

While this article was in press, we realised that we had overlooked a historical record of *Gekko smithii* (under the synonym *G. stentor*) from Sulawesi by Müller (1895). The large specimen is reported to have a total length of 340 mm and originates from Kema on the northern peninsula (Müller 1895). This first record of *G. smithii* from Sulawesi had been omitted by subsequent authors of the herpetofauna of Sulawesi (e.g., Boulenger 1897, Iskandar & Tjan 1996). Consequently, our own records represent the rediscovery of this large gecko species from Sulawesi after more than a century.

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