

## Systematic Composition of the *Eutropis multifasciata* (Kuhl 1820) Species Complex (Squamata: Scincidae) and Designation of a Neotype

A.A. THASUN AMARASINGHE<sup>1,9</sup>, PANUPONG THAMMACHOTI<sup>2</sup>, PATRICK D. CAMPBELL<sup>3</sup>, JAKOB HALLERMANN<sup>4</sup>, SUJAN M. HENKANATHTHEGEDARA<sup>5</sup>, D.M.S. SURANJAN KARUNARATHNA<sup>6</sup>, AWAL RIYANTO<sup>7</sup>, ERIC N. SMITH<sup>2</sup>, AND IVAN INEICH<sup>8</sup>

<sup>1</sup> Research Center for Climate Change, University of Indonesia, Gd. PAU Lt. 8.5, Kampus UI, Depok 16424, Indonesia

<sup>2</sup> Amphibian and Reptile Diversity Research Center, Department of Biology, The University of Texas at Arlington, Arlington, TX 76019, USA

<sup>3</sup> Department of Life Sciences, Darwin Centre, Natural History Museum, Cromwell Road, South Kensington, London SW7 5BD, UK

<sup>4</sup> Centrum für Naturkunde (CenNak), Zoologisches Museum, Universität Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany

<sup>5</sup> Biological and Environmental Sciences, Longwood University, Farmville, VA 23909, USA

<sup>6</sup> Nature Explorations and Education Team, No: B-1 / G-6, De Soysapura Flats, Moratuwa 10400, Sri Lanka

<sup>7</sup> Museum Zoologicum Bogoriense, Indonesian Institute of Science, Widyasatwaloka Building, Jl. Raya Jakarta Bogor, Cibinong 16911, Indonesia

<sup>8</sup> Muséum National d'Histoire Naturelle, Sorbonne Universités, Institut de Systématique, Évolution et Biodiversité, UMR 7205, 57 rue Cuvier, F-75005 Paris, France

**ABSTRACT:** The tricarinate skink *Scincus multifasciatus* was described by Kuhl in 1820, without the subsequent designation of a type specimen or specific type locality. In 1930, Mertens assigned the type locality as Java, Indonesia, but still with no type specimen. Therefore, in order to stabilize the name with a recognized type specimen, we designate a neotype for *Eutropis multifasciata* from western Java, and we accept Merten's type locality assignment. We examined all the available synonym type voucher specimens of *E. multifasciata* and associated subspecies deposited in museum collections throughout Europe, Indonesia, and India. Examination of the types of *E. m. balinensis* and *E. m. tjendikianensis* show nearly identical to the forma typica. Hence, we synonymize both subspecies to *E. multifasciata*. We compared the holotypes of *E. macrophthalma* (type locality: Java) and *E. grandis* (type locality: Sulawesi). Interestingly, the two species are morphologically and genetically nearly identical, and there are no diagnostic characters for their separation. Thus, we synonymize *E. grandis* with *E. macrophthalma*. The two type specimens of *E. macrophthalma* reached Europe from Java, through commercial animal trade, hence their type locality "Java" is suspicious. *Eutropis macrophthalma* has never been recorded from Java and the two type specimens probably originated in Sulawesi, from which museum vouchered specimens with precise locality are known. We consider *E. macrophthalma* to be a Sulawesi endemic, and conclude that the recorded type locality, Java, is erroneous.

**Key words:** *Eutropis grandis*; *Eutropis macrophthalma*; Java; Sulawesi

OUR TAXONOMIC understanding of the lizards known as the sun or tricarinate skinks (*Eutropis multifasciata* species complex) has been historically complicated, since the description of its first member. Heinrich Kuhl (1797–1821) was a German zoologist appointed to the Natuurkundige Commissie voor Nederlandsche Indië founded by a Dutch Royal Decree in 1820 (Roberts 1993; Adler et al. 2007; Klaver 2007). He arrived at Batavia (now Jakarta, Java) in December 1820, and embarked on his program of collecting and cataloging the fauna and flora of Batavia, Buitenzorg (now Bogor, Java), and their neighboring areas (Veth 1879). Unfortunately, after 8 mo in Indonesia, Kuhl died, and his collections, drawings, and manuscripts were subsequently sent to the Rijksmuseum van Natuurlijke Historie in Leiden and the Muséum National d'Histoire Naturelle in Paris (Sirks 1915).

*Scincus multifasciatus* (Kuhl 1820) was originally described without designating a type specimen or type locality. This species, now known as *Eutropis multifasciata*, has long been considered a widely spread species complex (Barley et al. 2015b), with several synonyms designated from different geographic regions. Since the original description by Kuhl (1820), authors have extended the known distribution of *Eutropis multifasciata* to northeastern India, southern China, the Malay Peninsula, the Greater Sunda Islands, Wallacea, and the Philippine Islands (Fitzinger 1826; Gravenhorst 1851; De Rooij 1915; Dammerman 1929; Smith

1935; Taylor 1963; Hendrickson 1966; Grandison 1972; Brown and Alcalá 1980; Manthey and Grossmann 1997; Cox et al. 1998; Gaulke 1999; Malkmus et al. 2002; Ziegler 2002; Mausfeld and Schmitz 2003; Wood et al. 2004; Bobrov and Semenov 2008; Sang et al. 2009; Grismer 2011; Hecht et al. 2013; Kaiser et al. 2013). In addition, several closely related taxa have been described and included in this complex. The *Eutropis multifasciata* complex currently consists of four recognized species: *E. multifasciata* (Kuhl 1820), *E. rudis* (Boulenger 1887a), *E. macrophthalma* (Mausfeld and Böhme 2002), and *E. grandis* Howard, Gillespie, Riyanto, and Iskandar 2007. This species complex can be characterized by having adults with relatively large body size (snout–vent length [SVL] of 65–125 mm), scaly lower eyelids, tricarinate dorsal scales, and no distinct tympanic lobules.

Duméril and Bibron (1839) described *Euprepes sebae* based on several specimens (multi-species type series), but without a precise type locality (Brygoo 1986). The type series is currently deposited in the Muséum National d'Histoire Naturelle, Paris, France (MNHN-RA). Gray (1853) described *Plestiodon sikkimensis* from North India. Later, Boulenger (1887a) synonymized *P. sikkimensis* and part of the *Euprepes sebae* series with *Mabuya multifasciata*, and Smith (1935) later still designated a lectotype for *Euprepes sebae* and synonymized it with *M. multifasciata*. Bleeker (1860) described another skink, *Tropidolepisma macrurus* from Agam, Sumatra, Indonesia, which was also later synonymized with *M. multifasciata* by Boulenger (1887b). Annandale (1905) described *M. monticola* from India (note:

<sup>9</sup> CORRESPONDENCE: e-mail, thasun@rccc.ui.ac.id

*Euprepes monticola* Günther 1864 has no relation to this taxon, which is currently a synonym of *Euprepis dissimilis* Hallowell 1857 [fide Boulenger 1887a], possibly from the eastern Himalayas or the hills of Assam in northeastern India (fide Das et al. 1998), which was also later synonymized with *M. multifasciata* by Smith (1935). More recently, Mertens (1927) described the subspecies *M. m. balinensis* from Bali, restricted the type locality of *M. m. multifasciata* to Java, Indonesia (Mertens 1930), and described the subspecies, *M. m. tjendikianensis*, from the Karimunjawa Archipelago of Indonesia (north of Central Java; Mertens 1956).

Boulenger (1887a) described *Mabuia rudis* based on a type series from Sumatra and Borneo; later, Bartlett (1895) described *Mabuia lewisi* from North Borneo. Smith (1935) recognized Boulenger's *M. rudis* as a subspecies of *Mabuia multifasciata*, but currently *E. rudis* is considered as a distinct species. Mausfeld and Böhme (2002) described *Mabuia macrophthalma* based on two specimens originating from animal trade in Java. More recently, Howard et al. (2007) described a similar species, *E. grandis*, from Sulawesi, although it was not compared to *M. macrophthalma*. The objective of our study is to use a combination of meristic, morphological, and molecular data to stabilize the taxonomy of this species complex, and designate a neotype for *Scincus multifasciatus* (Kuhl 1820).

#### MATERIALS AND METHODS

We compared *Eutropis multifasciata* to all related and relevant historical specimens (including types), compared original descriptions, and compared all synonymized species types of all the congeners of this particular species complex. The neotype designated for *E. multifasciata* was collected by hand, euthanized by cardiac injection (using sodium pentobarbital), and subsequently fixed in 10% buffered formalin prior to storage in 70% ethanol. Museum acronyms are those of Sabaj Pérez (2014). We examined specimens in the collections of the Natural History Museum, London, UK (BMNH); Muséum National d'Histoire Naturelle, Paris, France (MNHN-RA); Museum Zoologicum Bogoriense, Bogor, Indonesia (MZB); Naturalis Biodiversity Center, National Natuurhistorische Museum, Leiden, the Netherlands (RMNH/RENA); Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany (SMF); the Museum of Zoology, Research Center for Climate Change, University of Indonesia (UIMZ); the University of Texas at Arlington, USA (UTA); Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK); Museum für Naturkunde, Berlin, Germany (ZMB); Zoologisches Museum Hamburg, Germany (ZMH); and the Zoological Survey of India, Kolkata, India (ZSI). We obtained morphometric and meristic data for species comparisons from over 100 examined specimens (see Appendix). Sex was not determined from specimens unless the hemipenes were everted. All the distribution records are based on our personal observations and data associated with museum specimens examined.

Measurements were taken with Mitutoyo digital and Helios manual calipers ( $\pm 0.1$  mm) under a dissecting microscope (Wild M3Z, M8, and Zeiss DRC), and on the left side of the body for symmetrical characters. We measured SVL (from tip of snout to anterior margin of vent), femur length (FEL, from the anterior margin of the

hind limb at its insertion point on the body to the knee, while flexed), tibia length (TBL, from the posterior surface of the knee, while flexed, to the base of the heel), head length (HL, from posterior edge of mandible to tip of snout); head width (HW, width of head at the angle of the jaws), orbit diameter (ED, the horizontal diameter of the orbit); tympanum–eye length (TYE, from posterior border of orbit to anterior border of tympanum), snout length (ES, from anterior border of orbit to tip of snout), eye–nostril length (EN, from anterior border of orbit to the middle of narial opening), and toe and finger length (TL and FL respectively, from tip of claw to the nearest fork).

We counted supralabial and infralabial scales from the rictus to the rostral and mental scales (excluded), respectively. Our counts of ventrals include all scales from the postmental to the last ventral scale bordering the vent (not including the anal scale). We counted paravertebral scales between the postparietal (included) to the posterior margin of the thigh, in a straight line immediately left of the vertebral column. Subdigital lamellae on toe IV were counted from the first proximal enlarged scissor wider than the width of the largest palm scale to the distal-most lamella at the base of the claw. We counted the number of longitudinal scale rows (ventral and dorsal) at midbody.

Univariate and multivariate analyses were conducted on seven morphometric ratios (HL/SVL, HW/SVL, ES/SVL, TYE/SVL, ED/SVL, TBL/SVL, and FEL/SVL), including *Eutropis multifasciata* from Java, *E. rudis* from Borneo and *E. macrophthalma* (= *E. grandis*, see below) from Sulawesi to assess morphometric variation and taxonomic differentiation. We performed separate univariate analyses of variance (ANOVAs) that treated morphometric ratio as the dependent variable and the species as the predictor variable. When appropriate, we used Tukey HSD post-hoc analyses. Multivariate analysis was conducted using nonmetric multidimensional scaling (NMDS) to reduce the morphometric ratio matrix from seven to two dimensions using the metaMDS function in the R package vegan (Oksanen et al. 2012). The ordination was based on a Bray-Curtis distance measure; the ordination plot was generated based on the Pearson correlation coefficient for each ratio against the NMDS axes. We considered stress less than 0.20 as an adequate solution (McCune and Grace 2002). All statistical analyses were conducted using the R statistical software program (v2.0–4; R Development Core Team 2010).

We preserved muscle tissue samples for DNA analysis in cell lysis buffer solution (0.50 M Tris/0.25% EDTA/2.5% SDS, pH 8.2), and these were deposited in triplicate at the Amphibian and Reptile Diversity Research Center UTA, and the Museum Zoologicum Bogoriense, Bogor (MZB) and the Universitas Brawijaya, Malang, both in Indonesia. DNA was extracted using Serapure magnetic beads (Rohland and Reich 2012). A mix of 10  $\mu$ L of lysis buffer with dissolved sample and 20  $\mu$ L of proteinase K was incubated at 55°C for 2 h. Then, the solution was mixed with 180  $\mu$ L of Serapure beads at a ratio of 1.8:1 (serapure bead:tissue sample in cell lysis buffer). The solution was washed twice with 80  $\mu$ L of 70% ethanol. The resulting DNA solution was dissolved in Tris pH 8.5, with 0.1% of Tween 20 (modified from Agencourt protocol, Beckman Coulter Co., Fort Collins, CO, USA).

TABLE 1.—List of *Eutropis* samples used for molecular analyses and associated GenBank sequence accession numbers for the MC1R and RP40 nuclear genes. MZB = Museum Zoologicum Bogoriense, Bogor, Indonesia; ZFMK = Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany.

| No. | Species                 | Voucher no. | Locality            | GenBank accession no. |          | Source              |
|-----|-------------------------|-------------|---------------------|-----------------------|----------|---------------------|
|     |                         |             |                     | MC1R                  | RP40     |                     |
| 1.  | <i>E. multifasciata</i> | MZB 11912   | Java, Indonesia     | KY942058              | KY942059 | This study          |
| 2.  | <i>E. multifasciata</i> | KU 322323   | Luzon, Philippine   | KJ574612              | KJ574950 | Barley et al. 2015a |
| 3.  | <i>E. multifasciata</i> | TNHC 59044  | Sulawesi, Indonesia | KJ574628              | KJ574966 | Barley et al. 2015a |
| 4.  | <i>E. multifasciata</i> | CAS 232271  | Sagaing, Myanmar    | KJ574611              | KJ574949 | Barley et al. 2015a |
| 5.  | <i>E. multifasciata</i> | CES 09/925  | Assam, India        | KJ574610              | KJ574948 | Barley et al. 2015a |
| 6.  | <i>E. macrophthalma</i> | ZFMK 71716  | “Java,” Indonesia   | KJ574634              | KJ574972 | Barley et al. 2015a |
| 7.  | <i>E. grandis</i>       | JAM 11362   | Sulawesi, Indonesia | KJ574568              | KJ574906 | Barley et al. 2015a |
| 8.  | <i>E. grandis</i>       | JAM 1148    | Sulawesi, Indonesia | KJ574569              | KJ574907 | Barley et al. 2015a |
| 9.  | <i>E. rudis</i>         | JAM 7517    | Sulawesi, Indonesia | KJ574619              | KJ574957 | Barley et al. 2015a |
| 10. | <i>E. rudis</i>         | TNHC 59050  | Sulawesi, Indonesia | KJ574630              | KJ574968 | Barley et al. 2015a |
| 11. | <i>E. rudis</i>         | FMNH 230155 | Borneo, Malaysia    | KJ574616              | KJ574954 | Barley et al. 2015a |
| 12. | <i>E. rudis</i>         | FMNH 269117 | Borneo, Malaysia    | KJ574617              | KJ574955 | Barley et al. 2015a |
| 13. | <i>E. rugifera</i>      | LSUHC 4067  | Borneo, Malaysia    | KJ574620              | KJ574958 | Barley et al. 2015a |

The two nuclear loci, MC1R (Pinho et al. 2010) and RP40 (Friesen et al. 1999), were amplified by polymerase chain reaction (PCR). For the MC1R locus, MC1RF (GGCNGCCATYGTCAAGAACCGGAACC) was used as the forward primer and MC1RR (CTCCGRAAGGCRT-TAATGATGGGTCCAC) as the reverse primer. For the RP40 locus, RP40.F (ATGTGGTGGATGYTGGCTCGT-GAAGTC) was used as the forward primer and RP40.R (GCTTCTCAGCWGCRGCCTGCTC) was used as the reverse primer. The thermal cycling profile (Nuclear Touchdown) consisted of an initial denaturation, 20 s at 94°C, followed by five cycles of 30 s of denaturation at 94°C, 30 s of annealing at 61°C, and 1 min 30 s of extension at 68°C. This was followed by five cycles of 30 s of denaturation at 94°C, 30 s of annealing at 59°C, and 1 min 30 s of extension at 68°C; then five cycles of 30 s at 94°C, 30 s at 57°C, 1 min 30 s of extension at 68°C, and 25 similar cycles with the annealing temperature reduced to 50°C. PCR products were Sanger sequenced using an ABI PRISM 3100xl Genetic Analyzer (Applied Biosystems) at the Genome Core Facility at the University of Texas at Arlington.

Raw sequence chromatograms were assembled and edited using the program Sequencher v5.03 (Gene Codes Corporation, Ann Arbor, MI). The resulting sequences were submitted to GenBank. To estimate evolutionary relationships, we compared the sequences from our western Java sample, the neotype, with that of *Eutropis multifasciata* and allied species available from GenBank (Table 1). We aligned all sequences using ClustalW in MEGA (v6.06; Tamura et al. 2013). We combined both MC1R and RP40 data sets using SequenceMatrix (Vaidya et al. 2011) and used Partition-Finder v1.1.1 (Lanfear et al. 2012) for obtaining evolutionary models for each partition subset. The best partition scheme had four partitions: F81 for MC1R third codon, HKY + I for MC1R first codon, JC for MC1R second codon, and HKY for RP40. We estimated evolutionary relationships through Maximum Likelihood (ML) using RAxML v8.1.114 on the Cipres Science Gateway v3.3 (Miller et al. 2010) and with 1000 bootstrap pseudoreplicates, and through a Bayesian Markov chain Monte Carlo approach using MrBayes v3.2.6 (Ronquist and Huelsenbeck 2003) with 5,000,000 generations. The program Tracer v1.5 (Rambaut et al. 2014) was used for checking stationarity with trace plots and effective

sample size values higher than 200. ML bootstrap values >70 and Bayesian posterior probabilities >0.95 were considered as strong support. The program Figtree (Rambaut 2007) was used for visualizing the RAxML and MrBayes topologies.

## RESULTS

Because *Eutropis multifasciata* was described without type specimens or locality designation, it is essential to designate a neotype for this species in order to achieve taxonomic stability (including problems related to *E. rudis*). Following Mertens (1930), “Java, Indonesia” should be the type locality for *E. m. multifasciata*. Herein, we designate the neotype, in accordance with Article 75 of the International Code of Zoological Nomenclature (ICZN 1999), from western Java. Because the original description of *E. multifasciata* is insufficient, we redescribe this species based on this neotype.

We identified those characters distinguishing *Eutropis macrophthalma*, *E. multifasciata*, and *E. rudis* (Tables 1–4; Appendix), and confirmed the status of all junior synonym type specimens of *Eutropis multifasciata* (Tables 5 and 6; Appendix). Furthermore, the currently valid trinomen, *E. m. tjendikianensis* Mertens 1956 seems identical to the forma typica. Hence, in accordance with the principle of priority (Article 23 of ICZN), we confirm its synonymy with *E. multifasciata*, which we consider as a monotypic species. The same can be said about *E. m. balinensis*, another synonym of *E. multifasciata* (following Mausfeld and Schmitz 2003).

The phylogenetic analyses of our two nuclear and protein-coding loci indicate that the *Eutropis multifasciata* complex in Southeast Asia forms a monophyletic clade, including *E. rudis* and *E. macrophthalma*. In addition, *E. multifasciata* is monophyletic. In the *E. multifasciata* clade, *E. multifasciata* from Java (MZB 11912 [field number ENS 15037], neotype) grouped with *E. multifasciata* from Assam, India (CES 09/925) and from Sagaing, Myanmar (CAS 232271). Also, *E. multifasciata* from Sulawesi, Indonesia (TNHC 59044) and Luzon, Philippines (KU 322323) are closely related to *E. multifasciata* from Java. In addition, *E. rudis* is monophyletic, and samples from Sulawesi (MVZ JAM 7517 and TNHC 59050) grouped with *E. rudis* from Sarawak, Borneo (FMNH 269117 and 230155).



TABLE 2.—Diagnostic morphometric and meristic character comparison of *Eutropis macrophthalma*, *E. multifasciata*, and *E. rudis*. ES = snout length; SVL = snout-vent length.

|   | <i>E. macrophthalma</i><br>(n = 15) | <i>E. multifasciata</i> (n = 72)                                       | <i>E. rudis</i> (n = 13) |
|---|-------------------------------------|--|--------------------------|
| Type locality   | Sulawesi                            | Java   | Sumatra and Borneo       |
| Distribution (based on examined materials)                    | Sulawesi                            | Northeastern India, Greater Sundaic Islands, Malay Peninsula, Wallacea | Greater Sundaic Islands  |
| Paravertebral scales  | 35–38                               | 43–48  | 42–46                    |
| Ventrals  | 49–52                               | 53–58  | 55–59                    |
| Subdigital lamellae on 4th toe                                | 21–24                               | 16–19  | 18–20                    |
| Midbody scale rows  | 24–26                               | 32–34  | 32–34                    |
| Supralabials (touch eye)                                      | 7 (6)                               | 6 (5)  | 6 (5)                    |
| Dorsal surface of thigh smooth (0), keeled (1)                | 1                                   | 0  | 1                        |
| Scales on temporal region smooth (0), keeled (1)              | 1                                   | 0  | 1                        |
| Lateral band invisible (0) slightly visible (1), distinct (2) | 1                                   | 1  | 2                        |
| Rostral scale indistinct (0), distinct (1) dorsally           | 1                                   | 1  | 0                        |
| Supraoculars touching frontal                                 | 2nd only                            | 2nd only   | 1st and 2nd              |
| ES/SVL, %   | 8.47–9.84%                          | 9.07–10.02%  | 7.7–9.0%                 |
| Average SVL (maximum SVL) in mm                               | 128.0 (136.4)                       | 95.8 (120.8)   | 92.0 (123.1)             |

We examined the holotype and the paratype of *Eutropis macrophthalma*, described from Java, Indonesia (obtained by a native Indonesian collector; Mausfeld and Böhme 2002). We examined a closely related taxon, *E. grandis* described from Sulawesi, Indonesia. The two species are morphologically identical and there are no diagnostic characters to separate them (Table 4). This result is supported by phylogenetic analyses using mitochondrial gene data (P. Thammachoti and E. Smith, personal observation; Barley et al. 2015a,b), including *E. macrophthalma* and *E. grandis*, that indicated no genetic difference between the two. In accordance with the principle of priority (Article 23 of ICZN), we synonymize *E. grandis* with *E. macrophthalma*. We assume that the *E. macrophthalma* type specimens were also collected in Sulawesi, but mistakenly labeled as originating ultimately in Java. It is significant to note that *E. macrophthalma* has not been recorded from Java, only in its original description in 2002. Our nuclear phylogenetic analysis supports this synonymy because the type *E. macrophthalma* (ZFMK 71716), supposedly from Java, falls within Sulawesi samples (MVZ JAM 11362, 11488). Therefore, taking the above into consideration, and in order to stabilize the taxon with a recognized locality, the type locality of *E. macrophthalma* should be corrected to Sulawesi, Indonesia.

TABLE 3.—Statistical results from one-way analyses of variance for the morphometric ratios of *Eutropis multifasciata*, *E. rudis*, and *E. macrophthalma*. For the post-hoc comparisons (Tukey honestly significant difference [HSD]), values are indicated only when  $P < 0.05$ . See text for explanations of the acronyms used in each ratio. HL = head length; SVL = snout-vent length; HW = head width; TYE = tympanum-eye length; ES = snout length; ED = orbit diameter; TBL = tibia length; FEL = femur length.

| Morphometric ratio | F value | P value | P values for Tukey HSD pairwise comparisons |                                       |   |
|--------------------|---------|---------|---|---------------------------------------|---|
|                    |         |         | <i>multifasciata</i> vs. <i>rudis</i>       | <i>macrophthalma</i> vs. <i>rudis</i> | <i>macrophthalma</i> vs. <i>multifasciata</i> |
| HL/SVL             | 5.87    | <0.01   |   |                                       | <0.01   |
| HW/SVL             | 1.96    | >0.05   |   |                                       |   |
| ES/SVL             | 9.02    | <0.001  | <0.05                                       |                                       | <0.001  |
| TYE/SVL            | 10.50   | <0.001  |   | <0.01                                 | <0.001  |
| ED/SVL             | 1.78    | >0.05   |   |                                       |   |
| TBL/SVL            | 51.84   | <0.001  |   | <0.001                                | <0.001  |
| FEL/SVL            | 35.51   | <0.001  | <0.01                                       | <0.05                                 | <0.001  |

Statistically informative tests could not be performed on individuals based on sex, because of the difficulty in distinguishing sex externally. Separate one-way ANOVAs on seven morphometric ratios detected differences between *Eutropis multifasciata* (Java), *E. rudis* (Borneo), and *E. macrophthalma* (Sulawesi; Table 3). All morphometric ratio mean comparisons showed differences between the three species, except for HW/SVL ( $F = 1.96$ ,  $P > 0.05$ ) and ED/SVL ( $F = 1.78$ ,  $P > 0.05$ ). Post-hoc analyses showed differences in five morphometric ratios between *E. macrophthalma* and *E. multifasciata*, three between *E. macrophthalma* and *E. rudis*, and two between *E. multifasciata* and *E. rudis*, indicating taxonomic distinctiveness between the three taxa. The NMDS analysis achieved an adequate two-dimensional solution for these *Eutropis* species (Fig. 1; stress = 0.065). It generated three distinct clusters corresponding to the three species, highlighting the morphological distance existing between these species (Fig. 2).

## SYSTEMATICS

*Eutropis multifasciata* (Kuhl 1820)  
(Figs. 3–5; Tables 3–5)

- Scincus multifasciatus* Kuhl (1820: 126)  
*Gongylus (Euprepes) sebae* Duméril and Bibron (1839: 692)  
 in part  
*Plestiodon sikkimensis* Gray (1853: 388)  
*Tropidolepisma macrurus* Bleeker (1860: 328)  
*Mabuia monticola* Annandale (1905: 139–151)  
*Mabuya multifasciata balinensis* Mertens (1927: 181)  
*Mabuya multifasciata tjendikianensis* Mertens (1956: 255)  
 new synonym.

**Neotype (designated herein).**—Adult male, MZB 11912 (field number ENS 15037), SVL 104.0 mm, from Jalan Tanah, trail from Cilitung to the Pulosari Waterfall, Pandeglang, Banten (previously West Java), Indonesia, 525 m (6.32756°S, 105.95988°E; datum WGS84), collected on 20 December 2013 by Irvan Sidik, Ahmad Muammar Kadafi, and Eric N. Smith.

**Diagnosis.**—A combination of the following characters distinguishes *Eutropis multifasciata* from all other congeners: SVL 87.1–109.6 mm; three keels on dorsal scales; lower

TABLE 4.—Morphometric (in mm) and meristic character comparison of the holotype of *Mabuya macrophthalma* Mausfeld and Böhme 2002; the holotype of its new synonym, *Eutropis grandis* Howard, Gillespie, Riyanto and Iskandar 2007; and other specimens listed in the Appendix (without holotypes). ZFMK = Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany; MZB = Museum Zoologicum Bogoriense, Bogor, Indonesia; — = not measured.

| Species              | <i>Eutropis macrophthalma</i>                 |                                       |  |
|----------------------|---|---------------------------------------|--|
|                      | <i>M. macrophthalma</i> holotype (ZFMK 71717) | <i>E. grandis</i> holotype (MZB 4862) | <i>E. macrophthalma</i> other specimens (n = 14) |
| Type locality        | Java (in error)                               | Sulawesi                              |  |
| Sex                  | Female  | Male                                  | Both sexes                                       |
| Snout–vent length    | 98.0  | 130.3                                 | 78.7–142.6                                       |
| Head length          | 25.5  | 33.4                                  | 25.5–35.1  |
| Head width           | 13.5  | 18.3                                  | 11.6–24.0  |
| Snout length         | 8.3   | 12.0                                  | 8.3–12.6   |
| Orbit diameter       | 6.1   | 9.0                                   | 6.1–9.0  |
| Eye–tympanum length  | 5.4   | 7.2                                   | 5.4–13.7   |
| Axilla–groin length  | 39.6  | —                                     | —  |
| Femur length         | 15.3  | 22.9                                  | 15.3–24.0  |
| Tibia length         | 19.0  | 23.7                                  | 19.0–28.9  |
| Midbody scale rows   | 26  | 24                                    | 24–26  |
| Paravertebral scales | 36  | 36                                    | 35–38  |
| Ventrals             | 49  | 52                                    | 49–52  |
| Lamellae on 4th toe  | 22  | 23                                    | 21–24  |

eyelid disc scaled; paravertebral scales 43–48; ventrals 53–58; subdigital lamellae on Toe IV 16–19; midbody scale rows 32–34; dorsal surface of thigh smooth; scales on temporal region smooth; lateral surface of body with dark band.

**Description of neotype.**—Male, SVL 104.0 mm. Head moderately large (HL 26.8% of SVL, HL 51.5% of axilla–groin distance), narrow (HW 58.0% of HL, HW 15.5% of SVL), indistinct from neck; snout short (ES 34.1% of HL, ES 57.5% of HW), slightly concave in lateral profile; rostral shield large, hemispherical, distinctly visible from above, posterior margin of midpoint curved; frontonasal wide, anterior border slightly contacting rostral, lateral border touching first loreal; prefrontals in broad contact, separating frontal and frontonasal, longest distance along longitudinal axis of frontonasal equal to prefrontal length, lower border

touching both loreal scales, posterior border touching first supraocular and frontal; frontal large, elongate, subtriangular, bluntly pointed posteriorly, equal in length to frontoparietals and interparietal combined; frontoparietals two, in contact, distinct, larger than interparietal; parietals large and completely separated by interparietal, touching pretemporal scales laterally; single pair of nuchals, smooth, overlapping middorsally behind interparietal; interparietal with gray-colored visible parietal eye (pineal eye); nostril large, at middle of nasal; single supranasal on each side, slightly contacted; loreals two, anterior loreal touching nasal, supranasal, frontonasal, prefrontal, posterior loreal, and second supralabial; posterior loreal longer than anterior loreal, in antero-posterior axis, touching prefrontal and first supracilliary; presuboculars two; eye large (ED 30.3% of HL), ED smaller than TYE, pupil rounded; interorbital distance broad; postoculars three, small; supraoculars four, wide, second is longest in antero-posterior axis, widest in sagittal axis, fully contacts frontal; first supraocular contacts prefrontal, second contacts frontal, third contacts frontoparietals, and fourth contacts both frontoparietal and parietal; supracilliaries five; eyelid moveable, with a window composed of five scales; supralabials seven, fifth largest and at midorbital position (fifth touching eye); pretemporals four; primary temporals three, secondary temporals three; infralabials six; ear opening deep, small, near spherical and approximately one-quarter of eye diameter. Mental large; a single large postmental followed by two chin shield pairs, first pair meeting at midline and contacting first and second infralabial scales, second pair contacting second and third infralabials.

With the exception of head shields, nuchals, and some limb scales, all body scales are tricarinate, with one prominent median and two secondary keels per scale; all scales imbricate and lacking apical pits; scales on the dorsal surface of thigh smooth; body slender, elongate (axilla–groin distance 52.0% of SVL); midbody scale rows 34; paravertebral scales 43; preanal scales 6, enlarged.

TABLE 5.—Morphometric (in mm) and meristic character comparison of the neotype of *Scincus multifasciatus* Kuhl 1820 and the types of its synonyms: *Plestiodon sikkimensis* Gray 1853; *Tropidolepisma macrurus* Bleeker 1860; *Mabuia monticola* Annandale 1905; *Mabuya multifasciata balinensis* Mertens 1927; and *M. m. tjendikianensis* Mertens 1956. MZB = Museum Zoologicum Bogoriense, Bogor, Indonesia; BMNH = Natural History Museum, London; ZSI = Zoological Survey of India, Kolkata, India; SMF = Senckenberg Forschungsinstitut und Naturmuseum, Frankfurt, Germany; — = not measured.

| Species              | <i>Eutropis multifasciata</i>                |   |   |  |  |   |  |
|----------------------|--|---|---|--|--|---|--|
|                      | <i>S. multifasciatus</i> neotype (MZB 11912) | <i>P. sikkimensis</i> holotype (BMNH 1946.8.19.3) | <i>T. macrurus</i> holotype (BMNH 1946.8.19.54) | <i>M. monticola</i> syntypes (n = 3) (ZSI 2361–63) | <i>M. m. balinensis</i> holotype (SMF 22087) | <i>M. m. tjendikianensis</i> holotype (SMF 55147) | <i>E. multifasciata</i> other specimens (n = 65) |
| Type locality        | Java   | Sikkim, India                                     | Agam, Sumatra                                   | Northeast India                                    | Bali   | Karimunjawa                                       |  |
| Sex                  | Male   | Unknown   | Unknown   | Unknown  | Male   | Female  | Both sexes                                       |
| Snout–vent length    | 104.0  | 38.0  | Damaged (dry)                                   | 101.0–109.2  | 109.6  | 87.1  | 58.9–109.6                                       |
| Head length          | 26.7   | 12.9  | 12.0  | 24.1–25.7  | 27.1   | 22.4  | 19.9–27.1  |
| Head width           | 16.6   | 6.5   | 6.0   | 12.8–13.8  | 14.6   | 13.2  | 10.0–14.6  |
| Snout length         | 9.3  | 3.1   | 3.9   | 8.1–8.2  | 10.0   | 7.8   | 4.8–10.0   |
| Orbit diameter       | 8.1  | 1.8   | 3.7   | 6.9–7.3  | 7.0  | 5.2   | 2.8–7.0  |
| Eye–tympanum length  | 6.2  | 3.1   | 2.5   | 6.5–7.3  | 7.7  | 5.9   | 4.8–7.7  |
| Axilla–groin length  | —  | 18.2  | Damaged   | 50.5–52.3  | 53.0   | 46.5  | 28.2–53.0  |
| Femur length         | 17.0   | 5.9   | 5.7   | 13.2–15.1  | 16.7   | 14.5  | 9.1–16.7   |
| Tibia length         | 17.4   | 6.2   | 5.6   | 15.3–15.4  | 14.8   | 11.9  | 9.6–14.8   |
| Midbody scale rows   | 34   | 32  | Damaged   | 33   | 32   | 32  | 32–34  |
| Paravertebral scales | 43   | 44  | Damaged   | 43–44  | 48   | 43  | 43–48  |
| Ventrals             | 55   | 53  | Damaged   | 55–58  | 53   | 58  | 53–58  |
| Lamellae on 4th toe  | 17   | 19  | 16  | 16–17  | 18   | 19  | 16–19  |

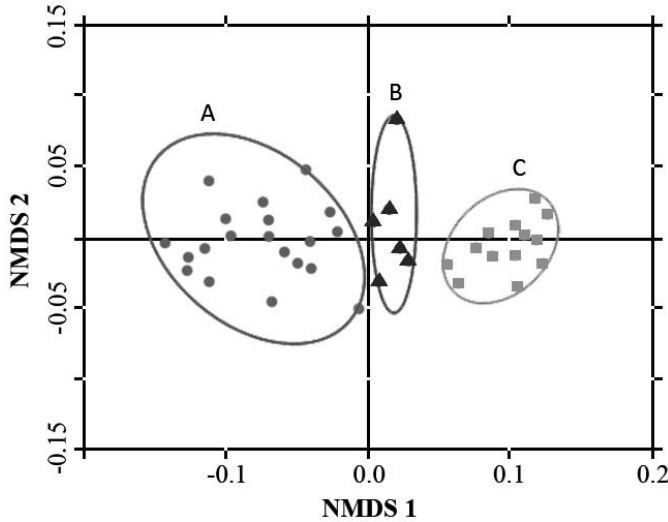


FIG. 1.—Nonmetric multidimensional scaling plot of morphometric variation in (A) *Eutropis multifasciata* from Java (circles), (B) *E. rudis* from Borneo (triangles), and (C) *E. macrophthalma* from Sulawesi (squares; stress = 0.065). Each point represents an individual specimen, and the relative distance between two points is equivalent to amount of similarity.

Forelimbs short (brachium length 10.5% of SVL, antebrachium length 9.3% of SVL); hind limbs relatively long (FEL 11.8% of SVL, TBL 14.4% of SVL); femur short and 82.4% of TBL; dorsal surfaces of fore and hind limbs smooth; subdigital lamellae: on fingers, I–5, II–9, III–11, IV–

10, and V–7, on toes, I–6, II–10, III–13, IV–17, and V–10; relative length of fingers: IV > III > II > V > I; relative length of toes: IV > III > V > II > I. Tail complete, distal two-thirds regenerated; median row of subcaudals of original tail equal in size to rest of subcaudals, those on regenerated section enlarged and wider than long.

**Coloration in preservative.**—Dorsum of head, body, limbs, and tail dark copper brown; brown irregular band from behind eye, through tympanum, and to shoulder, disappearing afterwards; black and white spotted scales scattered on the flanks; venter uniformly white.

**Variation.**—Based on adults examined (Appendix): SVL 58.9–109.6 mm, paravertebrals 43–48, ventrals 53–58, subdigital lamellae under fourth toe 16–19, midbody scale rows 32–34. Dorsum of head, body, limbs, and tail light or dark copper brown, gray, or dark olive brown. Venter uniformly white or cream color.

**Comparisons.**—*Eutropis multifasciata* can be distinguished from other congeners by having several distinctive characters (Table 3). Unlike *E. multifasciata*, with three keels on its dorsal scales, *Eutropis dissimilis* (Hallowell 1857) has two keels on its dorsal scales; *E. quadricarinata* Boulenger 1887a has four keels on the dorsal scales; *E. andamanensis* (Smith 1935), *E. carinata* (Schneider 1801), *E. gansi* (Das 1991), *E. madaraszi* (Méhely 1897), *E. multicarinata* (Gray 1845), *E. rugifera* (Stoliczka 1870), and *E. trivittata* (Hardwicke and Gray 1827) have five dorsal scale keels; *E. macularia* (Blyth 1853) and *E. tammanna* Das, de Silva and Austin 2008, have six dorsal scale keels; *E.*

TABLE 6.—Species composition of the syntypes of *Euprepes sebae*: based on the type series as recorded at MNHN-RA and as identified by Brygoo (1986). MNHN-RA = Muséum National d’Histoire Naturelle, Paris, France; SVL = snout vent length; — = not measured; ? = unknown.

| Catalogue no. (MNHN-RA) | Old catalogue no. (Registry) | Listed by Brygoo (1986) | Examined by Smith (1935) | Variété | Locality            | SVL (mm) | Species complex             | Remarks   |
|-------------------------|------------------------------|-------------------------|--------------------------|---------|---------------------|----------|-----------------------------|---|
| Accepted syntypes       |                              |                         |                          |         |                     |          |                             |   |
| 2950                    | 2820                         | +                       | +                        | A       | Coast of Malabar    | 108      | <i>E. carinata</i>          |   |
| 443                     | 2822                         | +                       | +                        | A       | Pondicherry         | 126      | <i>E. carinata</i>          |   |
| 7085                    | 2821                         | +                       | +                        | A       | Manilla             | 103      | <i>E. multicarinata</i>     | Identified as <i>E. multifasciata</i> by Smith (1935) |
| 7085A                   | 2821                         | +                       | +                        | A       | Manilla             | 76       | <i>E. cf. multifasciata</i> |   |
| Lost?                   | ?                            |                         |                          | A       | Java                | —        | ?                           |   |
| Lost?                   | ?                            |                         |                          | A       | Bengal              | —        | ?                           | Type restriction by Duméril et al. (1854)             |
| 1983                    | 2825                         | +                       | +                        | B       | ?                   | 147      | <i>E. carinata</i>          |   |
| 7087                    | 2824                         | +                       | +                        | B       | ?                   | 133      | <i>E. carinata</i>          |   |
| 7086                    | 2823                         | +                       | +                        | B       | Pondicherry         | 129      | <i>E. carinata</i>          | Specimen measured by Duméril and Bibron (1839)        |
| Lost?                   | ?                            |                         |                          | C       | ?                   | —        | ?                           |   |
| 7089                    | 2831                         | +                       | +                        | D       | Java                | 77       | <i>E. multifasciata</i>     |   |
| 7089A                   | 2831                         | +                       | +                        | D       | Java                | 70       | <i>E. multifasciata</i>     |   |
| 2952                    | 2827                         | +                       | +                        | D       | Hawaii              | 86       | <i>E. multifasciata</i>     |   |
| 2953                    | 2828                         | +                       | +                        | D       | Terre de Van Diemen | 91       | <i>E. multifasciata</i>     |   |
| 2951                    | 2826                         | +                       | +                        | D       | East Indies         | 87       | <i>E. multifasciata</i>     | Probably from Java                                    |
| 7091                    | 2835                         | +                       | +                        | E       | Timor               | 108      | <i>E. cf. multifasciata</i> |   |
| Lost?                   | ?                            |                         |                          | E       | ?                   | —        | ?                           |   |
| 2955                    | 2836                         | +                       | +                        | F       | Java                | 101      | <i>E. multifasciata</i>     |   |
| 2955A                   | 2836                         | +                       | +                        | F       | Java                | 100      | <i>E. multifasciata</i>     |   |
| 7092                    | 2839                         | +                       | +                        | F       | Java                | 9        | <i>E. multifasciata</i>     |   |
| 2956                    | 2837                         | +                       | +                        | F       | Jakarta             | 110      | <i>E. multifasciata</i>     | Lectotype designated by Smith (1935)                  |
| Lost?                   | ?                            |                         |                          | F       | Sulawesi            | —        | —                           |   |
| Rejected syntypes       |                              |                         |                          |         |                     |          |                             |   |
| 262                     | 2834                         |                         | +                        | ?       | ?                   | 54       | <i>E. macularia</i>         | Not indicated as syntype in museum catalogue          |
| 2957                    | 2838                         |                         | +                        | ?       | Java                | 49       | <i>E. rugifera</i>          | Not indicated as syntype in museum catalogue          |
| 7088                    | 2830                         |                         | +                        | ?       | Singapore           | 92       | <i>E. multifasciata</i>     | Not indicated as syntype in museum catalogue          |
| 2954                    | 2829                         | +                       | +                        | ?       | Timor               | 60       | <i>E. cf. multifasciata</i> | Not indicated as syntype in museum catalogue          |
| 7090                    | 2832                         |                         | +                        | ?       | Ambon, Maluku       | 89       | <i>E. multifasciata</i>     | Locality not included by Duméril and Bibron (1839)    |
| 1405                    | 2823                         |                         | +                        | ?       | Java                | 112      | <i>E. multifasciata</i>     | Entered the collection in June 1845                   |

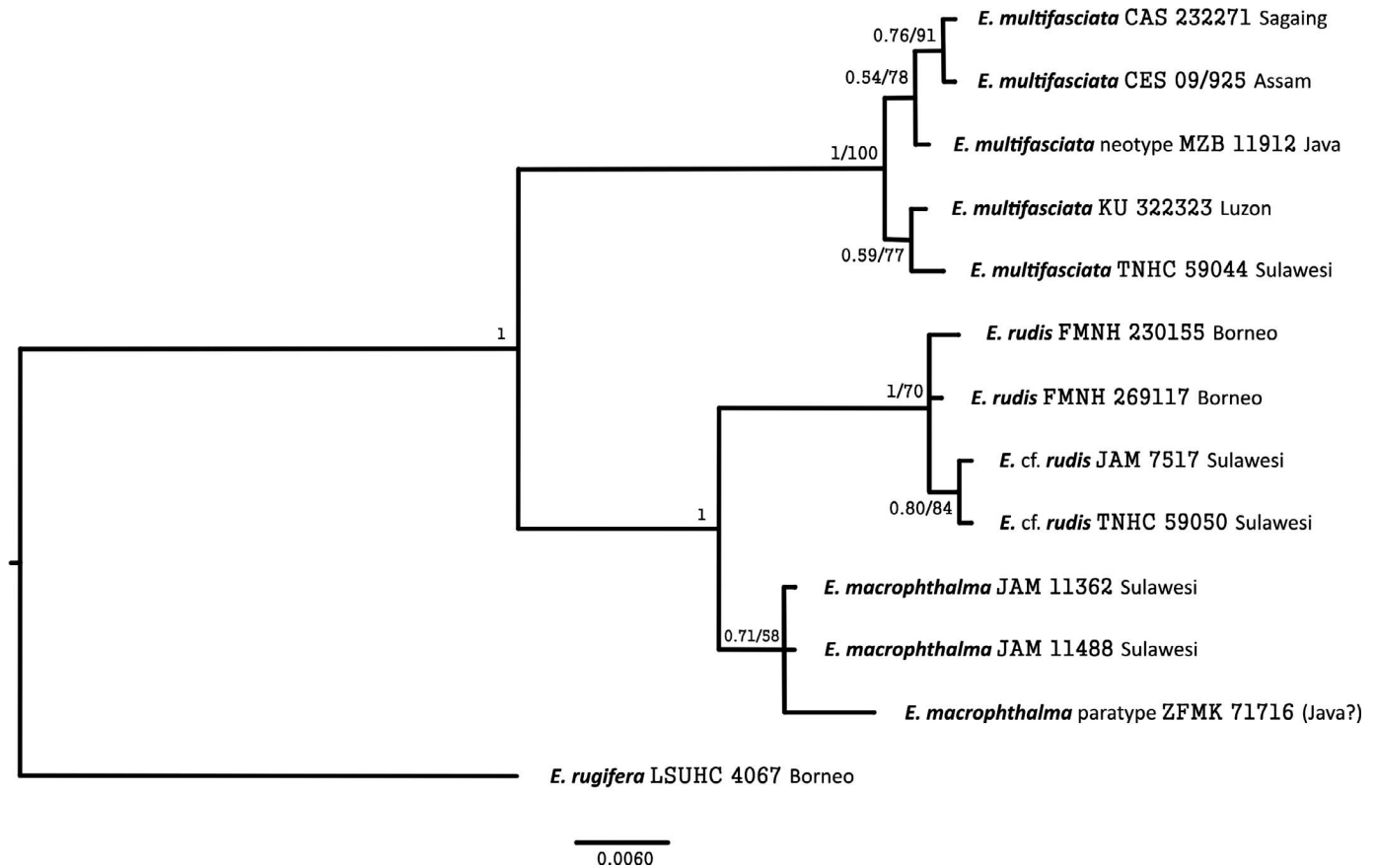


FIG. 2.—Phylogenetic tree of the concatenated nuclear genes MC1R and RP40, represented by the maximum likelihood (ML) topology and showing Bayesian posterior probabilities and ML bootstrap supports on branches. *Eutropis rugifera* was used as outgroup. Scale indicates rate of base substitutions per site.

*austini* Batuwita, 2016 has five to eight dorsal scale keels; and *E. englei* (Taylor 1925) has seven to nine dorsal scale keels. *Eutropis beddomei* (Jerdon 1870) has 12–16 lamellae on the fourth toe, *E. floweri* (Taylor 1950) has 15–16 lamellae, and *E. tyleri* (Theobald 1868) has 28 lamellae (vs. 20–21 in *E. multifasciata*). *Eutropis bibronii* (Gray 1839), *E. innotata* (Blanford 1870), *E. nagarjunensis* (Sharma 1969), *E. longicaudata* (Hallowell 1857), and *E. quadratilobus* (Bauer and Günther 1992) have a transparent lower eyelid disc (vs. scaly in *E. multifasciata*). *Eutropis clivicola* (Inger, Shaffer, Koshy and Bakde 1984) has 46 ventrals (vs. 65–70 in *E. multifasciata*). *Eutropis allapallensis* (Schmidt 1926) has frontoparietals fused (vs. separate in *E. multifasciata*). *Eutropis ashwamedhi* (Sharma 1969), *E. cumingi* (Brown and Alcalá 1980), *E. greeri* Batuwita 2016, *E. indeprensa* (Brown and Alcalá 1980), and *E. bontocensis* (Taylor 1923) have prefrontals separated (vs. in contact in *E. multifasciata*). *Eutropis chapaense* (Bourret 1937) has no supranasal (vs. present in *E. multifasciata*).

#### DISCUSSION

The original description of *Eutropis multifasciata* most likely was based on skinks collected from Java, most probably around Jakarta or Bogor. However, there is no evidence to indicate that a type specimen of *E. multifasciata* was ever deposited in a museum. Furthermore, we were unsuccessful in trying to locate any type specimens of *E. multifasciata*

from either RMNH/RENA or MNHN-RA. Indonesia had been under the administration of the Dutch government (the Dutch East Indies) since the 17th century, and most of the specimens arriving in the Netherlands natural history museums prior to 1850 originated from Java, Indonesia, in particular from the province of West Java (since 2000, divided into West Java and Banten) and adjacent Batavia (now Jakarta; Amarasinghe et al. 2015). Based on this history, we accept Merten's correction of the type locality being Java (Article 75 of the ICZN).

Duméril and Bibron (1839:692) described “*Gongylus (Euprepes) sebae*,” a species they included in their group of species having a scaly (as opposed to a transparent) lower eyelid. Among the specimens at their disposal at the time (see Table 6 for the type series), they recognized six color “variétés”: A, B, C, D, E, and F; but they only described color characters for each of them. Other details were omitted, such as scalation patterns, collector's names, location details, and the number of specimens examined. Their description lists several different localities that include several recognized countries: Bengal and the Coromandel Coast (India, including “Pondichéry”), Java (Indonesia), “Manilla” (Philippines), Célèbes (=Sulawesi, Indonesia), Timor, and Sandwich Islands (=Hawaii). Duméril and Bibron (1839) also provided mensural data for one specimen only (mm): total length 337, HL 26, neck length 20, trunk length 75, anterior member length 36, posterior member



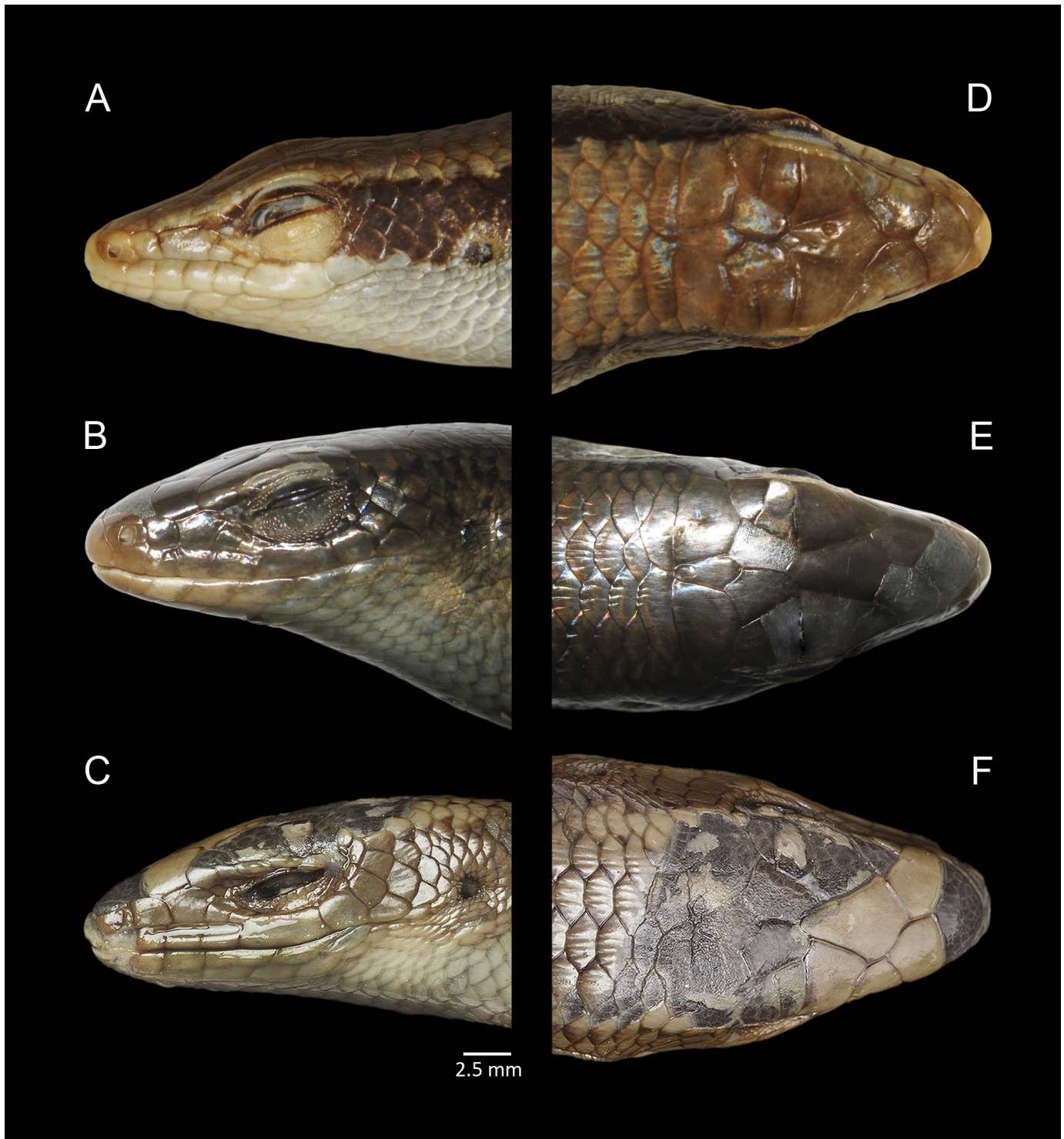


FIG. 3.—Holotype of *Mabuya macrophthalma* Mausfeld and Böhme 2002 (female, ZFMK 71717) from “Java” [Sulawesi], Indonesia: (A) head in lateral view, (D) head in dorsal view; neotype of *Scincus multifasciatus* Kuhl 1820 (male, MZB 11912) from Java, Indonesia: (B) head in lateral view, (E) head in dorsal view; syntype of *Mabuia rudis* Boulenger 1887a (male, BMNH 1946.8.15.26) from Sumatra, Indonesia: (C) head in lateral view, (F) head in dorsal view. A color version of this figure is available online.

length 50, tail length 216. Therefore, we calculated the SVL (HL + neck length + trunk length) as 121 mm. The other meristic characters given in the description show broad ranges in certain counts, suggesting that values for these traits were obtained from >1 specimen (e.g., 16–25 lamellae

under Toe IV, 25–33 longitudinal scale rows at midbody, and 3–7 keels on dorsal scales).

Later, Duméril et al. (1854) restricted the locality for *Euprepes sebae* to Bengal (it could be considered the type locality). However, we failed in our attempts to locate a



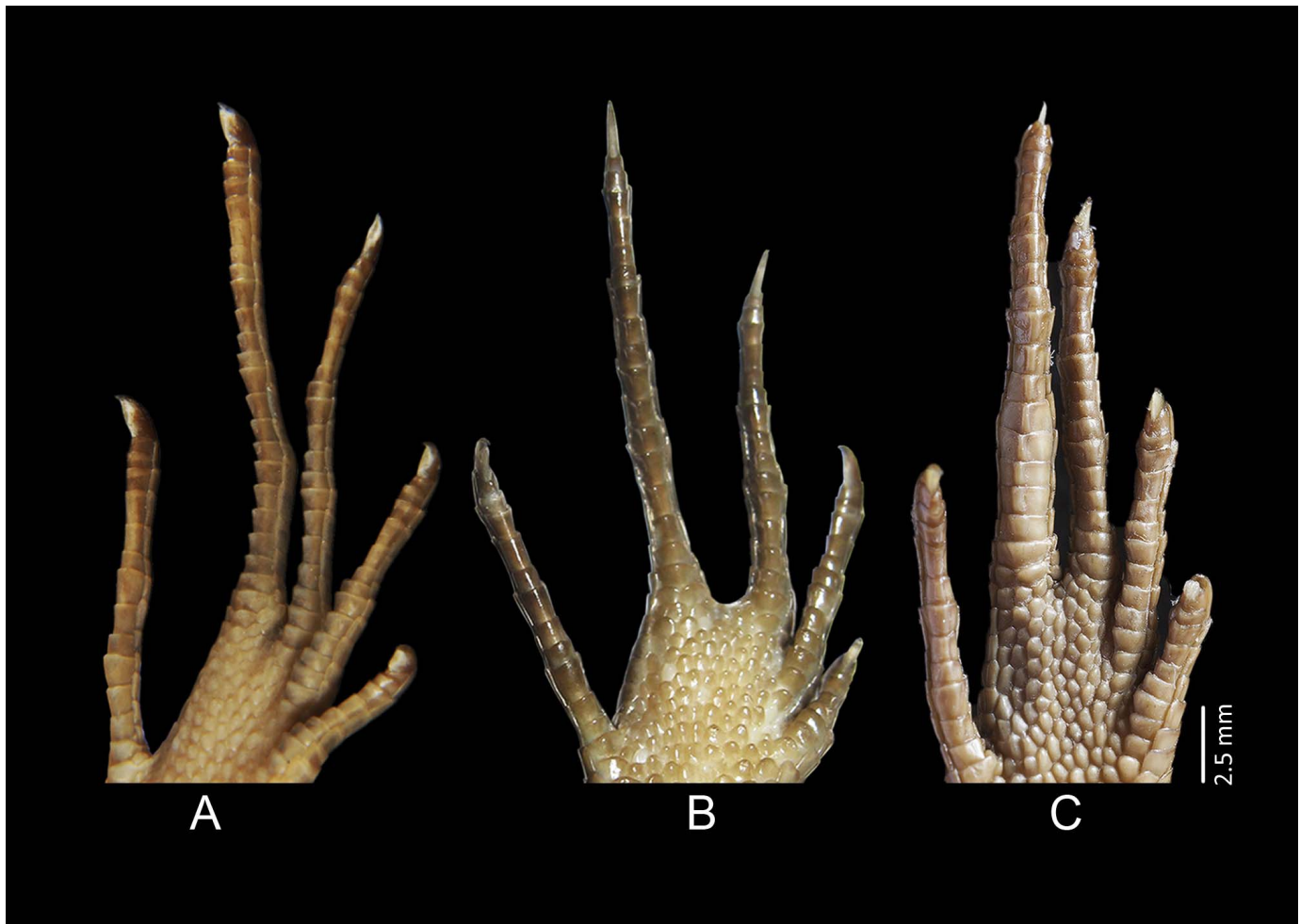


FIG. 4.—Subdigital lamellae of (A) holotype of *Mabuya macrophthalmia* (ZFMK 71717), the (B) neotype of *Scincus multifasciatus* (MZB 11912), and (C) a syntype of *Mabuya rudis* (BMNH 1946.8.15.26). A color version of this figure is available online.

specimen collected from Bengal. When Smith (1935) examined the original type series of *E. sebae* (23 specimens) at MNHN-RA he noticed that the type series was composed of four species: 16 specimens of *Scincus multifasciatus* Kuhl 1820; five specimens of *S. carinatus* Schneider 1801; one specimen of *Tiliqua rugifera* Stoliczka 1870; and one specimen of *Euprepes macularius* Blyth 1853 (Table 6). Smith (1935) further designated specimen MNHN-RA 2956 from Batavia (Jakarta, Java, Indonesia) as the lectotype of *E. sebae*.

Based on data available at MNHN-RA (Duméril and Duméril 1851), Brygoo (1986: 78) indicated the precise composition of the syntype specimens in each of the recognized varieties (Table 6). We noticed some discrepancies, however: there are a number of contradictions recorded on the cards and catalogues. We examined all the relevant catalogues and registers at MNHN-RA, also the original specimens within the syntype series, as defined by Brygoo (1986). There were no specimens listed from Bengal or Célèbes (Sulawesi), two localities which were reported in the original description; two additional specimens (MNHN-RA 2950, 2953) from the coasts of Malabar and Van Diemen in Australia, respectively, were listed as a part of original type series but these locations were not included in the original

description of Duméril and Bibron (1839). Furthermore, specimen MNHN-RA 7090, collected from Amboina (Amboin) in the Moluccas (Maluku), is labeled in the MNHN catalogue as being part of original syntypes, but the latter locality was not included in the original description either.

Brygoo (1986) also mentioned the following two specimens, which were absent from the 1851 catalogue (as being part of the original syntype series): the “variété A” specimen from Java and the “variété E” specimen with an unknown locality (both originating from the Leyden Museum). We found a specimen that could have been the syntype (MNHN-RA 0262) in question; however, it turned out to be a different species (*Eutropis macularia*), and it did not correspond to the pattern of the “variété A” specimen. We concluded that this is not the specimen from Java mentioned in the original description. The same catalogue also states that the “variété C” specimens were missing and that they must be considered lost, because there was no evidence linking any of the remaining specimens as possible “variété C” specimens. As such, the “variété C” taxon remains a mystery. Four specimens (MNHN-RA 0397–400) were erroneously reported as syntypes of *Euprepes sebae* by Guibé (1954). The labels correspond to amphibians and reptiles from other countries and refer to other species.

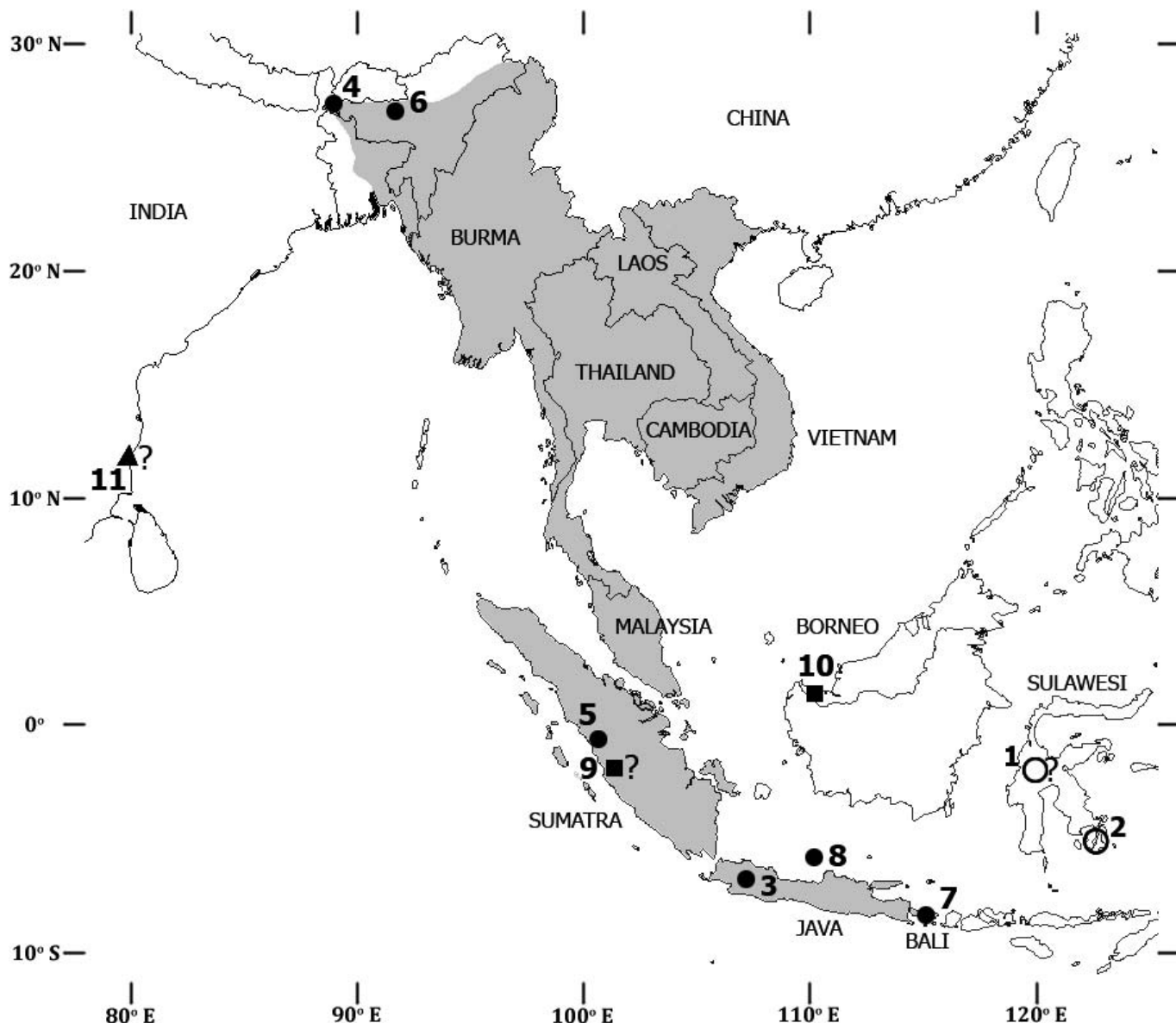


FIG. 5.—Current distribution of *Eutropis multifasciata* based on examined specimens and literature cited (gray shading) showing type localities of *E. multifasciata* (closed circles), *E. macrophthalma* (open circles), *E. rudis* (closed squares); and their synonyms, *Mabuia macrophthalma* (1<sup>♀</sup> with unknown type locality), *Eutropis grandis* (2), *Scincus multifasciatus* (3), *Plestiodon sikkimensis* (4), *Tropidolepisma macrurus* (5), *Mabuia monticola* (6), *Mabuia multifasciata balinensis* (7), *Mabuia multifasciata tjendikianensis* (8), *Mabuia rudis* (9), *Mabuia lewisi* (10), and *Euprepes sebae* (11<sup>?</sup>, junior objective synonym of *Eutropis carinata* with unknown type locality) marked in closed triangle.

Even though the attribution of Brygoo (1986) is not always clear, we generally agree with the composition of the type series as recorded at MNHN-RA (Table 6).

After searching for the syntype series as reported by Brygoo (1986), and following the examination of the MNHN catalogues, we were able to locate a specimen that closely matched the measurements for one of the specimens (MNHN-RA 7086) mentioned in the original description (Table 6). The SVL of this specimen is 129 mm (vs. 121 in the original description) and its tail length is 215 mm (vs. 216). This specimen is from the Coromandel Coast in Pondicherry, on the southeastern coast of India (Tamil Nadu). There are no specimens collected from Bengal in the recognized type series (Duméril and Bibron 1839), despite Duméril et al. (1854) suggesting this as the only locality for

the species, among the available syntype series of *Euprepes sebae*. We believe that the specimen MNHN-RA 7086 should have been the selected as the lectotype by Smith (1935) as this was the only specimen from which the measurements were taken. Unfortunately, Smith (1935) selected MNHN-RA 2956 as a lectotype, thereby restricting the type locality of *E. sebae* to Java. Nevertheless, following the Article 74.1.1 of the ICZN we agree with Smith's (1935) lectotype designation, and place that name as a junior subjective synonym of *Eutropis multifasciata*.

Our phylogenetic analyses plus previous studies show that the genus *Eutropis* in Southeast Asia is monophyletic (Mausfeld et al. 2000; Mausfeld and Schmitz 2003; Datta-Roy et al. 2012). The genetic variation within *Eutropis multifasciata* presents an interesting biogeographical scenar-

io, where *E. multifasciata* is widely distributed and has traversed many regions without apparent speciation or genetic divergence that would usually accompany such a widely distributed lizard. Barley et al. (2015b) studied the genomic landscape of *E. multifasciata* in Southeast Asia and found genetic differentiation among mainland and island populations of Southeast Asia. Unfortunately, the number of samples accessed was limited, and they lacked genetic data from Java, the type locality of *E. multifasciata*. Thus, our study presents important genetic data for *E. multifasciata*, of Javanese origin, filling a data gap for *E. multifasciata* in Southeast Asia.

**Acknowledgments.**—We thank the Ministry of Research and Technology of the Republic of Indonesia, particularly S. Wahyono and L. Shalahuddin for granting research permits to AATA and to ENS (SIPs [149, 151, 153, 155]-A/SIP/FRP/SM/XII/2013), and R. Ubaidillah, A. Hamidy, Syaripudin, W. Trilaksono, and other staff members of MZB (Lembaga Ilmu Pengetahuan Indonesia) for facilitating the in-house study of specimens under their care. We are in debt to students from UTA and Universitas Brawijaya for their hard work in the field. We also thank K. Venkataraman (ZSI) for granting research permission, and K. Chandra, K.C. Gopi, and K.A. Subramanian for their help throughout the permitting process. K. Deuti, P.G.S. Shethy, S. Raha, P. Bag, and S. Debnath assisted with the examination of specimens in the ZSI collections. We thank M.O. Rödel, F. Tilakk (ZMB), G. Köhler and L. Acker (SMF) for loan of specimens under their care. Finally, we thank J. Supriatna and the staff of the Research Center for Climate Change, University of Indonesia, for their support.

#### LITERATURE CITED

- Adler, K., J.S. Applegarth, and R. Altig. 2007. Contributions to the History of Herpetology, vol. 2. Contributions to Herpetology, vol. 21. Society for the Study of Amphibians and Reptiles, USA.
- Amarasinghe, A.A.T., P.D. Campbell, J. Hallermann, I. Sidik, J. Supriatna, and I. Ineich. 2015. Two new species of the genus *Cylindrophis* Wagler, 1828 (Squamata: Cylindrophidae) from Southeast Asia. *Amphibian & Reptile Conservation* 9:34–51.
- Annandale, N. 1905. Contributions to Oriental herpetology. Suppl. III. Notes on the Oriental lizards in the Indian Museum, with a list of the species recorded from British India and Ceylon. *Journal of Asiatic Society Bengal* 2:139–151.
- Barley, A.J., A. Datta-Roy, K.P. Karanth, and R.M. Brown. 2015a. Sun skink diversification across the Indian–Southeast Asian biogeographical interface. *Journal of Biogeography* 42:292–304.
- Barley, A.J., P.J. Monahan, R.C. Thomson, L.L. Grismer, and R.M. Brown. 2015b. Sun skink landscape genomics: Assessing the roles of micro-evolutionary processes in shaping genetic and phenotypic diversity across a heterogeneous and fragmented landscape. *Molecular Ecology* 24:1696–1712.
- Bartlett, E. 1895. The crocodiles and lizards of Borneo in the Sarawak Museum, with descriptions of supposed new species, and the variation of colours in the several species during life. *Journal of the Straits Branch Royal Asiatic Society Singapore* 28:73–96.
- Batuwita, S. 2015. Description of two new species of *Eutropis* (Reptilia: Scincidae) from Sri Lanka with a redescription of *Eutropis madaraszi* (Méhely). *Journal of Herpetology* 50:486–496.
- Bauer, A.M., and R. Gunther. 1992. A preliminary report on the reptile fauna of the Kingdom of Bhutan with the description of a new species of scincid lizard (Reptilia: Scincidae). *Asiatic Herpetological Research* 4:23–36.
- Blanford, W.T. 1870. Notes on some Reptilia and Amphibia from Central India. *Journal of Asiatic Society Bengal* 39:335–376.
- Bleeker, P. 1860. Reptilien van Agam aangeboden door E.W.A. Ludeking. *Natuurkundig Tijdschrift voor Nederlandsch Indie, Batavia* 20:325–329.
- Blyth, E. 1853. Notices and descriptions of various reptiles, new or little-known. Part I. *Journal of Asiatic Society Bengal* 22:639–655.
- Bobrov, V.V., and D.V. Semenov. 2008. Lizards of Vietnam. KMK Scientific Press Ltd., Russia. [In Russian.]
- Boulenger, G.A. 1887a. Catalogue of the Lizards in the British Museum (Natural History) III. Lacertidae, Gerrhosauridae, Scincidae, Anelytropidae, Dibamidae, Chamaeleontidae. Trustees of the British Museum of Natural History, UK.
- Boulenger, G.A. 1887b. Note on some reptiles from Sumatra described by Bleeker in 1860. *Annals & Magazine of Natural History* 5:152.
- Bourret, R. 1937. Notes herpetologiques sur l'Indochine française. XII. Les lézards de la collection du Laboratoire des Sciences Naturelles de l'Université. Descriptions de cinq espèces nouvelles. XIII. Serpents. *Bulletin Général de l'Instruction Publique, Hanoi* 1937:1–39.
- Brown, W.C., and A.C. Alcala. 1980. Philippine lizards of the family Scincidae. Silliman University of Natural Science, the Philippines, Series 2:246.
- Brygoo, E.R. 1986. Les types de Scincidés (Reptiles, Sauriens) du Muséum National d'Histoire Naturelle. Catalogue critique. *Bulletin de Muséum National d'Histoire Naturelle, France*, vol. 4, Supplement 7:126.
- Cox, M.J., P.P. Van Dijk, N. Jarujin, and K. Thirakhuat. 1998. A Photographic Guide to Snakes and Other Reptiles of Peninsular Malaysia, Singapore and Thailand. Ralph Curtis Publishing, USA.
- Dammerman, K.W. 1929. On the zoogeography of Java. *Treubia* 11:1–88.
- Das, I. 1991. A new species of *Mabuya* from Tamil Nadu State, Southern India (Squamata: Scincidae). *Journal of Herpetology* 25:342–344.
- Das, I., B. Dattagupta, and N.C. Gayen. 1998. History and catalogue of reptile types in the collection of the Zoological Survey of India. *Journal of South Asian Natural History* 3:1–52.
- Das, I., A. de Silva, and C.C. Austin. 2008. A new species of *Eutropis* (Squamata: Scincidae) from Sri Lanka. *Zootaxa* 1700:35–52.
- Datta-Roy, A., M. Singh, C. Srinivasulu, and K.P. Karanth. 2012. Phylogeny of the Asian *Eutropis* (Squamata: Scincidae) reveals an 'into India' endemic Indian radiation. *Molecular Phylogenetics and Evolution* 63:817–824.
- de Rooij, N. 1915. The Reptiles of the Indo-Australian Archipelago. I. Lacertilia, Chelonia, Emydosauria. E.J. Brill, the Netherlands.
- Duméril, A.M.C., and G. Bibron. 1839. *Erpétologie Générale on Histoire Naturelle Complète des Reptiles*, vol. 5. Roret/Fain et Thunot, France.
- Duméril, A.M.C., and A.H.A. Duméril. 1851. *Catalogue Méthodique de la Collection des Reptiles du Muséum d'Histoire Naturelle de Paris*. Gide et Baudry/Roret, France.
- Duméril, A.M.C., G. Bibron, and A.H.A. Duméril. 1854. *Erpétologie Générale on Histoire Naturelle Complète des Reptiles*, vol. 7. Roret, France.
- Fitzinger, L. 1826. Neue Classification der Reptilien nach ihren natürlichen Verwandtschaften nebst einer Verwandtschafts-Tafel und einem Verzeichnisse der Reptilien-Sammlung des K.K. Zoologischen Museums zu Wien. J.G. Heubner, Austria.
- Friesen, V.L., B.C. Congdon, M.G. Kidd, and T.P. Birt. 1999. Polymerase chain reaction (PCR) primers for the amplification of five nuclear introns in vertebrates. *Molecular Ecology* 8:2147–2149.
- Gaulke, M. 1999. Die Herpetofauna von Calauit Island (Calamianes-Inseln, Provinz Palawan, Philippinen) (Amphibia et Reptilia). Faunistische Abhandlungen Staatliches Museum für Tierkunde in Dresden, 21:19.
- Grandison, A.G.C. 1972. The Gunong Benom Expedition 1967, 5. Reptiles and amphibians of Gunong Benom with a description of a new species of *Macrocalamus*. *Bulletin of the British Museum (Natural History) Zoology* 23:45–101.
- Gravenhorst, J.L.C. 1851. Über die im Zoologischen Museum der Universität Breslau befindlichen Wirtelschleichen (Pseudosaura), Krüppelfüssler (Brachypoda), und einige andere, Denselben verwandte Reptilien aus den Zünften der Schleichen und Dickzüngler [*Euprepes striolatus*]. *Nova Acta Academiae Caesareae Leopoldino-Carolinae Germanicae Naturae Curiosorum* 23:291–394.
- Gray, J.E. 1839. Catalogue of the slender-tongued saurians, with descriptions of many new genera and species. Part 2. *Annals Magazine Natural History* 1:287–293.
- Gray, J.E. 1845. Catalogue of the Specimens of Lizards in the Collection of the British Museum. Trustees of the British Museum, UK.
- Gray, J.E. 1853. Descriptions of some undescribed species of reptiles collected by Dr. Joseph Hooker in the Khassia Mountains, East Bengal, and Sikkim Himalaya. *Annals & Magazine of Natural History* 2:386–392.
- Grismer, L.L. 2011. Lizards of Peninsular Malaysia, Singapore and their Adjacent Archipelagos. Edition Chimaira, Germany.
- Guibé, J. 1954. *Catalogue des Types de Lézards*. Bayeux, Imprimerie Colas, France.
- Günther, A.C.L.G. 1864. The Reptiles of British India. Ray Society, UK.
- Hallowell, E. 1857. Notice of some new and rare species of Scincidae in the collection of the Academy of Natural Sciences of Philadelphia. *Transactions of the American Philosophical Society, Philadelphia* 11:71–82.
- Hardwicke, T., and J.E. Gray. 1827. A synopsis of the species of saurian



- reptiles, collected in India by Major-General Hardwicke. *Zoological Journal* 3:213–229.
- Hecht, V.L., T.P. Cuong, T.N. Tao, Q.N. Truong, B. Michael, and T. Ziegler. 2013. First report on the herpetofauna of Tay Yen Tu Nature Reserve, northeastern Vietnam. *Biodiversity Journal* 4:507–552.
- Hendrickson, J.R. 1966. Observations on the fauna of Pulau Tioman and Pulau Tulai. 5. The Reptiles. *Bulletin of the National Museums Singapore* 34:53–71.
- Howard, S.D., G.R. Gillespie, A. Riyanto, and D. Iskandar. 2007. A new species of large *Eutropis* (Scincidae) from Sulawesi, Indonesia. *Journal of Herpetology* 41:604–610.
- [ICZN] International Code of Zoological Nomenclature. 1999. *International Code of Zoological Nomenclature*, 4th edition. International Trust for Zoological Nomenclature, UK.
- Inger, R.F., H.B. Shaffer, M. Koshy, and R. Bakde. 1984. A report on a collection of amphibians and reptiles from the Ponnudi, Kerala, South India. *Journal of Bombay Natural History Society* 81:551–570.
- Jerdon, T.C. 1870. Notes on Indian herpetology. *Proceeding of Asiatic Society Bengal* 1870:66–85.
- Kaiser, H., C. Sanchez, S. Heacox, A. Kathriner, A.V. Ribeiro, Z.A. Soares, L.L. Araujo, and S.M. Mecke. 2013. First report on the herpetofauna of Atauro Island, Timor-Leste. *Check List* 9:752–762.
- Klaver, C. 2007. Inseparable Friends in Life and Death, the Life and Work of Heinrich Kuhl (1797–1821) and Johan Conrad van Hasselt (1797–1823), Students of Prof. Theodorus van Swinderen. Barkhuis Publishing, the Netherlands.
- Kuhl, H. 1820. *Beiträge zur Zoologie und Vergleichenden Anatomie*. Hermannsche Buchhandlung, Germany.
- Lanfear, R., B. Calcott, S.Y. Ho, and S. Guindon. 2012. Partition Finder: Combined selection of partitioning schemes and substitution models for phylogenetic analyses. *Molecular Biology and Evolution* 29:1695–1701.
- Malkmus, R., U. Manthey, G. Vogel, P. Hoffmann, and J. Kosuch. 2002. *Amphibians and Reptiles of Mount Kinabalu (North Borneo)*. A.R.G. Gantner Verlag, Liechtenstein.
- Manthey, U., and W. Grossmann. 1997. *Amphibien & Reptilien Südostasiens*. Natur und Tier Verlag, Germany.
- Mausfeld, P., and W. Böhme. 2002. A new *Mabuya* from Java, Indonesia. *Salamandra* 38:135–144.
- Mausfeld, P., and A. Schmitz. 2003. Molecular phylogeography, intraspecific variation and speciation of the Asian scincid lizard genus *Eutropis* Fitzinger, 1843 (Squamata: Reptilia: Scincidae): Taxonomic and biogeographic implications. *Organisms Diversity and Evolution* 3:161–171.
- Mausfeld, P., M.S.A. Vences, and M. Veith. 2000. First data on the molecular phylogeography of scincid lizards of the genus *Mabuya*. *Molecular Phylogenetics and Evolution* 17:11–14.
- McCune, B., and J.B. Grace. 2002. *Analysis of Ecological Communities*. MjM Software Design, USA.
- Méhely, L. 1897. *Zur Herpetologie von Ceylon*. *Termes Fuzetek*, Budapest 20:55–70.
- Mertens, R. 1927. *Herpetologische Mitteilungen XVII. Mabuya multifasciata* Kuhl auf Bali. *Senckenbergiana* 9:181–182.
- Mertens, R. 1930. Die Amphibien und Reptilien der Inseln Bali, Lombok, Sumbawa und Flores. *Senckenbergischen Naturforschenden Gesellschaft, Frankfurt am Main, Abhandlungen* 42:117–344.
- Mertens, R. 1956. Eidechsen (Reptilia) vom Karimundjawa-Archipel. *Treubia* 23:253–257.
- Miller, M.A., W. Pfeiffer, and T. Schwartz. 2010. Creating the CIPRES Science Gateway for inference of large phylogenetic trees. Pp. 1–8 in *Proceedings of the Gateway Computing Environments Workshop*, New Orleans. Institute of Electrical and Electronics Engineers, USA.
- Oksanen, J., F.G. Blanchet, R. Kindt, and H. Wagner. 2012. *Vegan: Community Ecology Package*, R package version 2.0-4. Available at <http://CRAN.R-project.org/>. Archived by WebCite at <http://www.webcitation.org/T8g8UVs14> on 4 July 2011.
- Pinho, C., S. Rocha, B.M. Carvalho, S. Lopes, S. Mourão, M. Vallinoto, T.O. Brunes, C.F.B. Haddad, F. Gonçalves, and N. Ferrand. 2010. New primers for the amplification and sequencing of nuclear loci in a taxonomically wide set of reptiles and amphibians. *Conservation Genetics Resources* 2:181–185.
- Rambaut, A. 2007. *FigTree: A graphical viewer of phylogenetic trees*. Available at <http://tree.bio.ed.ac.uk/software/figtree/>.
- Rambaut, A., M.A. Suchard, D. Xie, and A. J. Drummond. 2014. *Tracer*, version 1.6. Available at <http://beast.bio.ed.ac.uk/Tracer>.
- R Development Core Team. 2010. *R: A Language and Environment for Statistical Computing*, Version 2.0-4. Available at <http://www.R-project.org>.
- Roberts, T.R. 1993. The freshwater fishes of Java, as observed by Kuhl and van Hasselt in 1820–23, *Zoologische Verhandlungen* 285:1–94. Available at <http://www.repository.naturalis.nl/record/317766>. Archived by WebCite at <http://www.webcitation.org/73RAoj5B4> on 25 October 2018.
- Rohland, N., and D. Reich. 2012. Cost effective, high throughput DNA sequencing libraries for multiplexed target capture. *Genome Research* 22:939–946.
- Ronquist, F., and J.P. Huelsenbeck. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19:1572–1574.
- Sabaj Pérez, M.H. (ed.). 2014. *Standard Symbolic Codes for Institutional Resource Collections in Herpetology and Ichthyology: An Online Reference*, Version 5.0. Accessed on 22 September 2014. American Society of Ichthyologists and Herpetologists, USA. Available at <https://asih.org/standard-symbolic-codes>. Archived by WebCite at <http://www.webcitation.org/73RACYcMK> on 25 October 2018.
- Sang, N.V., T.C. Ho, and Q.T. Nguyen. 2009. Herpetofauna of Vietnam. Chimaira, Germany.
- Schmidt, K.P. 1926. Amphibians and reptiles of the James Simpson–Roosevelt Asiatic Expedition. *Field Museum of Natural History* 12:167–173.
- Schneider, J.G. 1801. *Historiae Amphibiorum Naturalis et Literariae. Fasciculus Secundus Continens Crocodilos, Scincos, Chamaesauras, Boas, Pseudoboas, Elapes, Angues, Amphisbaenas et Caecilias*. Frommanni, Germany.
- Sharma, R.C. 1969. Two new lizards of the genera *Mabuya* Fitzinger and *Riopa* Gray (Scincidae) from India. *Bulletin of Systematic Zoology (Calcutta)* 1:71–75.
- Sirks, M.J. 1915. *Indisch Natuuronderzoek. Een Beknopte Geschiedenis van de Beoefening der Natuurwetenschappen in de Nederlandsche Koloniën, Mededeeling (Koloniaal Instituut)*, the Netherlands.
- Smith, M.A. 1935. *The Fauna of British India, including Ceylon and Burma. Reptilia and Amphibia, vol. II: Sauria*. Taylor & Francis, UK.
- Stoliczka, F. 1870. Observations on some Indian and Malayan Amphibia and Reptilia. *Journal of Asiatic Society Bengal* 39:134–228.
- Tamura, K., G. Stecher, D. Peterson, A. Filipski, and S. Kumar. 2013. *MEGA6: Molecular Evolutionary Genetics Analysis Version 6.0*. *Molecular Biology and Evolution* 30:2725–2729.
- Taylor, E.H. 1923. Additions to the herpetological fauna of the Philippine Islands, III. *Philippine Journal of Science* 22:515–557.
- Taylor, E.H. 1925. Additions to the herpetological fauna of the Philippines IV. *Philippine Journal of Science* 26:97–111.
- Taylor, E.H. 1950. Ceylonese lizards of the family Scincidae. *University of Kansas Science Bulletin* 33:481–518.
- Taylor, E.H. 1963. The lizards of Thailand. *University of Kansas Science Bulletin* 44:687–1077.
- Theobald, W. 1868. Catalogue of reptiles in the Museum of the Asiatic Society Bengal. *Journal of Asiatic Society Bengal* 37:7–88.
- Vaidya, G., D.J. Lohman, and R. Meier. 2011. *SequenceMatrix: Concatenation software for the fast assembly of multi-gene datasets with character set and codon information*. *Cladistics* 27:171–180.
- Veth, H.J. 1879. *Overzicht van Hetgeen, in het Bijzonder door Nederland, Gedaan is Voor de Kennis der Fauna van Nederlandsen Indië*. Doesburgh, the Netherlands.
- Wood, P.L., H. Kaiser, S. Looper, T.M. Youmans, J.L. Grismer, and L.L. Grismer. 2004. A first report on the herpetofauna of Pulau Besar, Johor, West Malaysia. *Hamadryad* 28:106–109.
- Ziegler, T. 2002. Die Amphibien und Reptilien eines Tieflandfeuchtwald-Schutzgebietes in Vietnam. *Natur und Tier Verlag*, Germany.

Accepted on 19 July 2018  
Associate Editor: Bryan Stuart

## APPENDIX

### Specimens Examined

*Eutropis macrophthalmma*.—Java (in error), Indonesia: ZFMK 71717 (holotype), ZFMK 71716 (paratype); Sulawesi, Indonesia: MZB 4862 (holotype of *E. grandis*), MZB 3870–73, 4313–14, 4316–17, 4319, 4321–22 (paratypes of *E. grandis*), MZB 7785, 1781.  
*Eutropis multifasciata*.—Bali, Indonesia: SMF 22087 (type of *Mabuya multifasciata balinensis*), MZB 2042, 2100, 8739; Java, Indonesia: MZB

11912 (neotype), 289, 552, 651, 715, 746, 748, 765, 772, 854, 914, 1477, 1495, 1510, 2168, 2170, 2368, 8431, 9419, 11912–16, ZMH R10058; Karimundjawa, Indonesia: SMF 55147 (type of *Mabuia multifasciata tjendikianensis*) Sumatra, Indonesia: BMNH 1946.8.19.54 (juvenile, type of *Tropidoleptis macrurus*, from Agam), MZB 1921; Lesser Sunda Islands, Indonesia: MZB 10255; Penang, Malaysia: ZSI 2275–77, 2279, 2280; Thailand: ZSI 18071, 18120–21; Myanmar: ZSI 2307, 4633, 4876–79, 11750–51, 12630, 12735, 12835–36, 16731; Assam, India: ZSI 2285–86, 2288, 2306, 2309, 4007, 4625–27, 11416–17; Borneo: ZSI 15329, 15336–37; India: BMNH 1946.8.19.3 (juvenile, type of *Plestiodon sikkimensis*), ZSI 2361–63 (type of *Mabuia monticola*).

*Eutropis rudis*.—Sumatra: BMNH 1946.8.15.26 (syntype), ZMH R10498; Borneo: BMNH 1946.9.7.46 (syntype), ZSI 15330, 15332, 15344–45, 20323, 1946.8.3.57 (holotype of *Mabuia lewisi*); Pulau Miang: ZMH R10497; Myanmar: ZSI 2307, 12680, 12735, 13474, 24795; Thailand: ZSI 18071.

*Eutropis rugifera*.—Camorta, Nicobar Island, India: ZSI 2350 (holotype); Sumatra, Indonesia: ZMB12031 (holotype of *Mabuia quinquecarinata*); Malang, East Java, Indonesia: ZMB 5442, 5442A (syntypes of *Euprepes percarinatus*); Java, Indonesia: ZMH R09975; Bali, Indonesia: UIMZ 0051, 0058, 0062, 0064–65, 0068, 0070; Bawean Island, Indonesia: SMF 55181–3, UIMZ 0105–7, 0111; Kuching, Borneo, Malaysia: BMNH 1946.8.18.22–24 (syntypes of *Mabuia rubricollis*).