

## Taxonomic Revision of Philippine Sun Skinks (Reptilia: Squamata: Scincidae: *Eutropis*), and Descriptions of Eight New Species

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**ABSTRACT:** Species descriptions of reptiles historically have relied exclusively on the use of morphological data; however, these external, phenotypic data do not always co-vary with lineage divergence. Consequently, it has become increasingly clear that species diversity has been underestimated in many evolutionary radiations. With the use of an integrative approach, we examined the genetic and morphological diversity present in a nearly endemic Philippine radiation of *Eutropis*. Results demonstrated that current taxonomy does not reflect evolutionary history and that in many cases, morphological divergence has become decoupled from genetic divergence. As a consequence, species diversity is significantly underestimated. Here, we rectify the major taxonomic problems present in Philippine *Eutropis* by providing formal descriptions for eight new species. Three of the four new species in the *E. multicarinata* species complex are sympatric with (and have long been confused with) previously described subspecies (which we also elevate to full species here). The fourth species is endemic to the Caroline Islands, clearly derived from a long-distance dispersal event from the Philippines. The new species in the *E. indeprensa* species complex are allopatrically or parapatrically distributed across the archipelago. In contrast to the last review of Philippine *Eutropis*, which suggested the endemic radiation was composed of five species (one of which was composed of two subspecies), we demonstrate that this group includes at least 14 distinct evolutionary lineages, with potential for additional diversity to be discovered pending further study.

**Key words:** Cryptic species diversity; *Eutropis borealis* comb. nov.; *Eutropis caraga* sp. nov.; *Eutropis cuprea* sp. nov.; *Eutropis gubataas* sp. nov.; *Eutropis islamaliit* sp. nov.; *Eutropis lapulapu* sp. nov.; *Eutropis multicarinata* comb. nov.; *Eutropis palauensis* sp. nov.; *Eutropis sahulinhangganan* sp. nov.; *Eutropis sibalom* sp. nov.; Island archipelagos; Lizard; *Mabuya*; Morphology; Southeast Asia

THE INCORPORATION of genetic data and statistical phylogenetic methods has improved the evolutionary framework within which taxonomic and systematic studies are conducted. In some cases, genetic data have highlighted the impressive skill of some traditional taxonomists in detecting slight phenotypic differences between populations that are biologically important (Bickford et al. 2007). In others, genetic insights have demonstrated the difficulty of relying exclusively on the use of morphological characters to identify species-level lineages. For example, some studies have resulted in the synonymization of taxa described solely on the basis of morphology (e.g., Andersen et al. 2014; Philips et al. 2015), and others have led to the identification of cryptic species diversity (e.g., Gómez et al. 2002; Stuart et al. 2006). Although the process of speciation is broadly understood to be continuous (de Queiroz 1998), the categorical nature of taxonomy makes it difficult to incorporate uncertainty into taxonomic decisions explicitly (though some authors have used subspecies in this way and others have suggested using candidate species; Vietes et al. 2009). Integrative approaches to taxonomy have been promoted as a means to improve the accuracy of species delimitation studies; however, this ignores the potential for shared biases across data sets, and even when multiple data types are employed, species boundaries may remain unclear and in need of additional data/investigation (Vietes et al. 2009; Schlick-Steiner et al. 2010). Recent arguments in favor of conservative taxonomy highlight the fact that partial taxonomic revisions are desirable when current data cannot conclusively resolve species boundaries within a given clade, but some changes

are clearly needed (Graybeal and Cannatella 1995; Pauly et al. 2009; Bauer et al. 2011; Miralles and Vences 2013).

Because taxonomic descriptions traditionally relied primarily on morphological data, the recognition of taxa based solely on molecular data can be controversial (Leaché and Fujita 2010; Bauer et al. 2011), whereas revisions based solely on morphological data sometimes lack the evolutionary framework within which species boundaries are ideally interpreted. Even when species are described based on morphological data, they may lack diagnostic characters and remain challenging to identify (e.g., many species of *Anolis* or *Aspidoscelis* lizards). Many recent studies have highlighted the diverse set of challenges associated with describing cryptic species (Jörger and Schrödl 2013; Renner 2016). Although standards for describing pseudo-cryptic or fully cryptic taxa have been slow to develop in the field of systematics, it is clear that many future taxonomic descriptions will require novel approaches (that encompass broad geographic and taxonomic sampling, and diverse sources of biological data) so that substantial amounts of diversity across the tree of life are not left unrecognized (Dayrat 2005; Esselstyn 2007), and species boundaries in these groups are accurately and efficiently identified. Perhaps more importantly, studies that embrace diverse data types and focus on the evolutionary processes that have led to species diversification have the potential to provide a deeper understanding of the biology of poorly understood taxonomic groups than do studies that rely on a single source of data (Padial et al. 2010).

Mabuyine skinks are some of the most recognizable lizards worldwide because of their circumtropical distribution, diurnal activity patterns, generalist habitat preferences,

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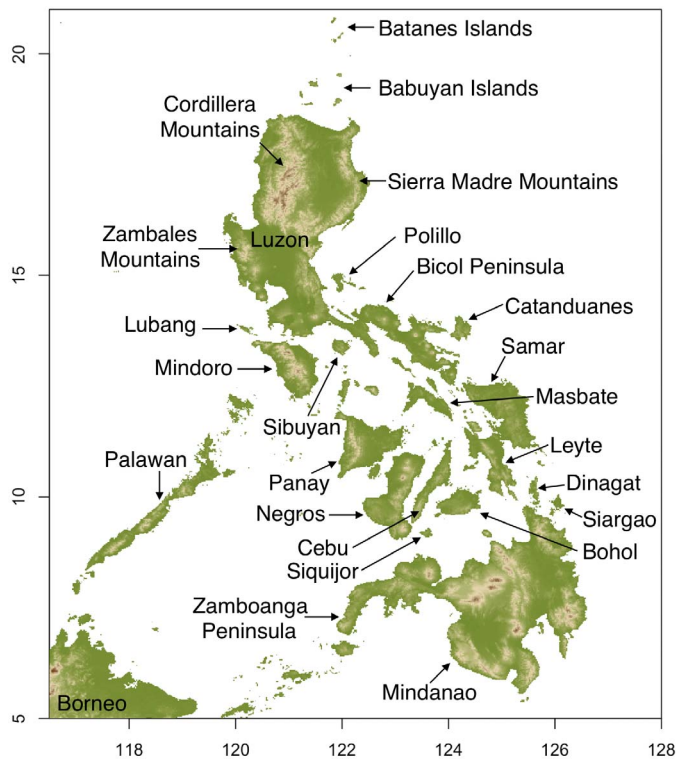


FIG. 1.—Map of Philippine Archipelago with major islands and important geographic areas indicated. A color version of this figure is available online.

high abundances in many regions, and highly generalized external morphology (Miralles et al. 2005; Miralles and Carranza 2010; Sindaco et al. 2012; Pinto-Sánchez et al. 2015). First described by Fitzinger (1826), the genus *Mabuya* has long been considered a waste-bin taxon into which over 100 species from Asia, Africa, the Middle East, Central and South America, and the Caribbean were placed (Greer and Nussbaum 2000). Mausfeld and Schmitz (2003) proposed splitting *Mabuya* into three genera, based on a phylogenetic analysis of mitochondrial DNA for ~40 individuals (~27 species). They found the genera *Apterygodon* and *Dasia* to be nested within *Mabuya*, and rather than subsume them, they placed Asian members of the genus in *Eutropis* (~31 species), New World taxa in *Mabuya* (~60 species), and the Middle East/African taxa in *Euprepis* (~78 species that were subsequently reassigned to *Trachylepis* by Bauer 2003). Despite this taxonomic arrangement creating multiple, new taxonomic problems, most recent authors have adopted it (Howard et al. 2007; Das et al. 2008; Skinner et al. 2011; Datta-Roy et al. 2012). Recent molecular work further split up *Mabuya* by placing the historically problematic taxon *Eutropis novemcarinata* into a new genus (*Toenayar*) and resurrecting the genus *Heremites* for several taxa from the Middle East (Karin et al. 2016).

The conserved morphology of mabuyine skinks has resulted in a complex and chaotic taxonomic history for many species in virtually all genera within this group (Greer and Nussbaum 2000; Bauer 2003; Datta-Roy et al. 2015; Pinto-Sánchez et al. 2015), with the Philippine taxa being one of the most extreme examples of confusing taxonomy and problematic species identification (Taylor 1922; Brown and Alcalá 1980; Barley et al. 2013). Philippine members of

the genus *Eutropis* belong to four lineages, three of which include species with widespread ranges outside the Philippines, which likely invaded the archipelago separately (Barley et al. 2015): *E. multifasciata*, *E. rudis* (Brown and Alcalá 1980) and a newly discovered population of *E. rugifera* (now only known from extreme southwest Mindanao Island; Barley et al. 2015). The fourth lineage was described by Gray (1845) and, as originally conceived, consisted of a single widespread species (*Mabuya multicarinata*) with populations throughout the archipelago (Fig. 1). Subsequently, Taylor (1923, 1925) described two additional species related to this taxon, primarily on the basis of color pattern and body size differences: *E. bontocensis* (described as *Mabuya bontocensis*) he viewed as endemic to the Cordillera mountain range of northeastern Luzon Island, and *E. englei* (described as *Mabuya englei*) from the coast of southeastern Mindanao Island.

The most recent taxonomic treatment of Philippine *Eutropis* was undertaken by Brown and Alcalá (1980), and this work made several important advances. The authors found, for example, that some specimens previously identified as juvenile *E. multicarinata* were actually mature adults with clearly circumscribed distributions. In addition to expanding appreciation for the possibility of dramatic body size transitions within Philippine archipelago lineages, the authors described these distinct populations as *Mabuya cumingi* (= *Eutropis cumingi*; consisting of populations from northern and southwestern Luzon Island) and *M. indepressa* (= *E. indepressa*; consisting of populations from the remainder of the archipelago). Brown and Alcalá (1980) also divided the widespread taxon *E. multicarinata* into two subspecific pattern classes: *E. m. borealis* from numerous islands in northern portions of the archipelago, and *E. m. multicarinata* from the archipelago's southernmost islands. This taxonomic decision was based on color pattern (southern populations with a dark, narrow vertebral stripe and dark blotches under the chin, versus both states usually absent in northern populations) and size of the interparietal scale (southern populations with a relatively long interparietal separating the parietals, versus a short interparietal that incompletely separates the parietals in northern populations; Fig. 2). However, it was clear that these characters were not consistent across all specimens examined and thus, the extent to which they could serve as diagnostic characters was ambiguous. In summary, a century's comprehensive, archipelago-wide review of hundreds of specimens suggested that the Philippine *Eutropis* radiation was relatively unremarkable (in comparison to other vertebrate groups), and possibly composed of just five endemic species plus two additional, widespread taxa shared with the landmasses of Sundaland (Brown and Alcalá 1980; Manthey and Grossmann 1997; Grismer 2011).

More recently, Barley et al. (2013) evaluated species limits in the Philippine *Eutropis* radiation to revisit the question of the archipelago's species diversity and to provide an integrative survey of the genetic and morphological variation. Consistent with the Brown and Alcalá (1980) previous work summarizing morphological data, the Barley et al. (2013) multilocus phylogenetic estimates supported the presence of two distinct species complexes: the *E. indepressa* complex (containing *E. indepressa* and *E. cumingi*) and the *E. multicarinata* complex (containing *E. m. multicarinata*, *E. m.*

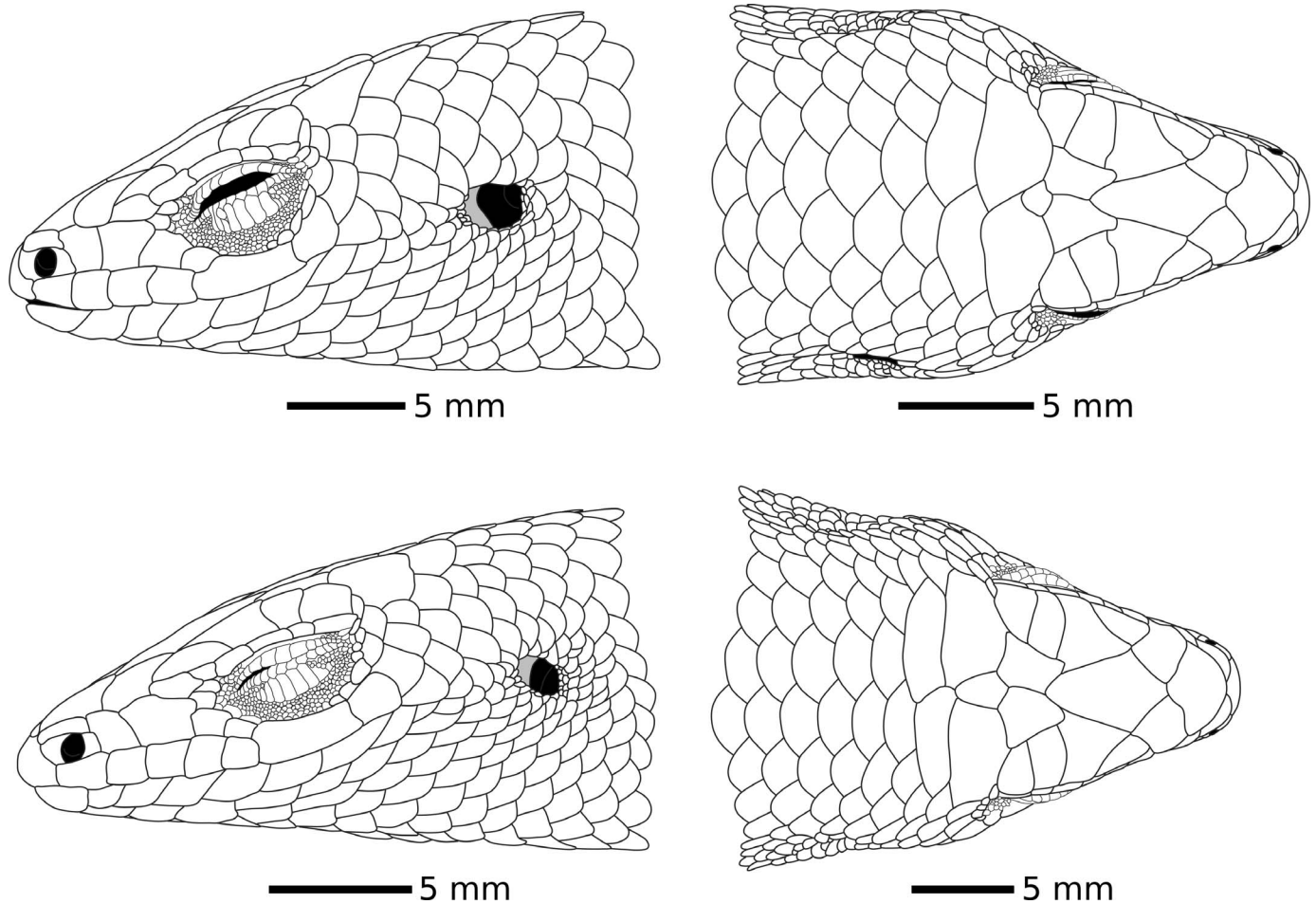


FIG. 2.—Illustration of lateral and dorsal head scalation in *Eutropis borealis* (top) and a new species from the southern Philippines, *E. caraga* (bottom).

*borealis*, and *E. bontocensis*). Within the *E. multicarinata* complex, the northern and southern populations do not appear to represent distinct, monophyletic groups, as hypothesized by Brown and Alcalá (1980). Moreover, data from Barley et al. (2013) suggest that at least eight evolutionary lineages (or nine, if *E. englei* is included, a species for which they lacked sampling) possess strong evidence of species level distinctiveness (several of which occur syntopically in different geographic regions)—and that this includes an additionally undescribed species endemic to Palau (Crombie and Pregill 1999) that is nested within the Philippine radiation. Although Barley et al. (2013) were unable to obtain genetic samples of *E. englei* (a species known only from southwest Mindanao, a region logistically challenging for biologists to access), this species is likely a member the *E. multicarinata* complex based on its phenotype (A.J. Barley, personal observation).

Most of the genetic diversity within the *E. indepressa* complex is structured by geography (Brown et al. 2013a), and major lineages do not exhibit the extensive sympatry that is observed among lineages in the *E. multicarinata* complex (Barley et al. 2013). Genetic data indicate the presence of at least five divergent lineages, only two of which had previously been considered taxonomic units (*E. indepressa* and *E. cumingi*). Populations assigned to *E. indepressa* by Brown and Alcalá (1980) were paraphyletic in phylogenetic analyses, and thus, the taxon *E. indepressa* should be

restricted to the lineage containing the Mindoro populations (the species' type locality), because the other populations are not closely related. The lone *E. indepressa* complex individual sampled by Barley et al. (2013) from Borneo also appears to be part of this Mindoro lineage (the mitochondrial data, but not the nuclear data, show it to be somewhat genetically divergent from the Mindoro populations). From a biogeographic perspective, Borneo populations might be expected to be more closely related to Palawan populations (Heaney 1985; Esselstyn et al. 2004); however, this expectation is rejected by genetic data, which confirm a relationship suggested by Brown and Alcalá (1980) based on morphology. Brown and Alcalá (1980) also showed that individuals from the Palawan populations tended to have lower vertebral scale row counts than other populations of *E. indepressa*, but had referred them to this species because this trait is not diagnostic. Genetic data from Barley et al. (2013) indicate unequivocally that the Palawan populations should be recognized as a distinct species.

In addition to bringing new data (multilocus DNA sequences) and approaches (phylogenetic analysis, biogeographical inference, coalescent analyses) to bear on the problem of species diversity, results from Barley et al. (2013, 2015) demonstrated the way in which mensural and meristic data of external morphology have limitations in delimiting species boundaries in some groups, which may be a consequence of their evolutionarily conserved nature in

*Eutropis*. As such, true species boundaries ( $\sim 14$  evolutionary lineages, *sensu* Barley et al. 2013) are poorly delineated by characters of external morphology (i.e., lacking diagnostic characters)—because diversification in this group has not been accompanied by their evolutionary change. However, this genetic data, in combination with analyses of phenotypic data and geographic range information have begun to clarify the evolutionary history of *Eutropis* and indicate that species diversity within both the *E. indeprensa* and *E. multicaarinata* complexes is significantly underestimated by current taxonomy.

Barley et al. (2013) recommended a conservative approach to revisionary work, emphasizing that additional species-level diversity may exist, but that some genetic variation may also simply correspond to geographic structure (Barley et al. 2013). Recent simulation-based and empirical studies of the performance of coalescent approaches to species delimitation suggest that these conservative recommendations were well-founded (Sukumaran and Knowles 2017; Barley et al. 2018; Luo et al. 2018; Chambers and Hillis 2019). In this paper, we take a major step towards the rectification of the taxonomic problems present in the Philippine *Eutropis* radiation. In doing so, we formally describe eight new species, five in the *E. multicaarinata* complex, and three from the *E. indeprensa* complex. Additionally, we discuss areas of investigation for future research that would help to more comprehensively elucidate the evolutionary history of this uniquely diverse radiation of island archipelago sun skink lizards.

#### MATERIALS AND METHODS

We follow the general metapopulation lineage (de Queiroz 1998, 1999) concept of species (a logical extension of the evolutionary species concept; Simpson 1961; Wiley 1978; Frost and Hillis 1990). Previous attempts to delimit species in Philippine *Eutropis* exclusively using morphological data have had mixed success: In some cases, these taxa have not corresponded to distinct evolutionary lineages (Brown and Alcalá 1980; Barley et al. 2013) and available species comparisons included nondiagnostic (overlapping) ranges of numerous character states, making practical identification of named species problematic (Brown and Alcalá 1980). This appears to be the result of the extensive morphological conservatism or convergence in this group, a common challenge in scincid lizard taxonomy (Austin 1995; Bruna et al. 1996). Therefore, we identify species-level lineages based on a combination of evidence from molecular data, morphological data (when phenotypic differentiation is present), and geography. Here, we describe lineages that are: (1) geographically isolated and genetically/phenotypically distinct; or (2) sympatric, and genetically/phenotypically distinct—thus, taking an integrative approach relying on multiple lines of evidence.

#### Genetic Data

Genetic diversity within Philippine *Eutropis* was previously evaluated by Barley et al. (2013). As is commonly the case, the mitochondrial locus in that study was by far the most informative genetic marker. The problems associated with making taxonomic decisions solely (or primarily) based on mitochondrial data have been previously recognized

(Ballard and Whitlock 2004; Hinojosa et al. 2019). Because in this system, taxonomic decisions are likely to rely heavily on molecular data, here we only describe lineages that also are strongly supported by nuclear data (as well as information that is available about morphology and geographic distributions). We performed separate Bayesian phylogenetic analyses for the *E. multicaarinata* and *E. indeprensa* species complexes using MrBayes v3.2.6 (Ronquist et al. 2012). Models of molecular evolution were selected (from among the 20 commonly implemented in MrBayes) and the optimal partitioning strategy was identified using AICc in PartitionFinder v2.1.1 (Lanfear et al. 2014). MrBayes analyses (consisting of two runs with four chains each) were run for 10 million generations, sampling every 1000 generations, and convergence was assessed using the average standard deviation of split frequencies and potential scale reduction factor diagnostics in MrBayes, and in Tracer v1.6 (Rambaut et al. 2014) by ensuring that all parameters had ESS values  $> 1000$ . Topological convergence was assessed using the R package RWTY (Warren et al. 2017).

#### Morphological Data

We collected specimens primarily by hand between 1991 and 2016, and examined older historical specimens (including types of all Philippine endemic taxa) simultaneously for the same characters. We fixed all specimens in 10% buffered formalin and subsequently placed them in 70% ethanol for long-term storage. We use the museum acronyms of Sabaj (2016) in reference to specimen numbers. We took measurements of specimens with digital calipers (to a precision of 0.01 mm) and determined sex by gonadal inspection. We examined data for male and female specimens separately and then combined data when no significant differences were detected other than slight differences in size (as seen in other groups of mabuyine skinks; Hedges and Conn 2012). To eliminate interobserver error, AJB collected all data.

We measured a series of standard morphological characters that have previously been shown to be of systematic importance in *Eutropis* (Brown and Alcalá 1980). We measured snout–vent length (SVL) from the tip of the snout to the cloacal opening, and axilla–groin distance from the posterior insertion of the forelimb to the anterior insertion of the hindlimb on the lateral side of the body. We measured head length from the tip of the snout to the anterior edge of the auricular opening, and head width at the anterior edge of the auricular opening. We measured forelimb and hindlimb length in two segments on the right side: (1) forelimb length included humerus length (from body insertion to center of the elbow) and forearm length (from elbow to where differentiated palmar scales begin on the posterolateral edge) and (2) hindlimb length included femur length (from body insertion to the center of the knee) and tibia length (from knee to where differentiated scales of plantar surface begin on the anterior lateral edge). Our scale counts included: number of subdigital lamellae below each toe on the right foot (including the unguis scale and all lamellae beneath each digit distal to the interdigital skin), upper and lower labial scale counts (including all differentiated labials), ventral scale rows between limbs (counted as the number of scale rows along the venter between the midpoints of

insertion of the fore- and hindlimbs), vertebral scale rows (the number of scale rows between parietals and base of the tail to the point opposite the cloacal opening), midbody scale rows (the number of scale rows around body at midpoint between insertion of fore- and hindlimbs), the number of supraciliaries, the number of scales on the upper edge of the lower eyelid, and the number of keels per scale on the dorsum (counted for 10 randomly selected scales). We also counted the number of primary temporal scales and enlarged pretemporal scales following Greer and Nussbaum (2000). See descriptions below and Appendix 1 for specimens examined.

## RESULTS

Previous work with morphological data has highlighted the largest phenotypic differences among lineages of Philippine *Eutropis* (Fig. 3; Taylor 1923, 1925; Brown and Alcala 1980; Barley et al. 2013). The most obvious of such characters is the substantial body size difference between taxa in the reciprocally monophyletic, *E. multica rinata* and *E. indepre nsa* species complexes (with adults, on average, being  $\sim 1.5\times$  larger in *E. multica rinata* lineages). Species in the *E. indepre nsa* complex also appear to be distinctive in having adult males with brightly colored red chins and more distinctive dorsolateral striping than is typical of lineages in the *E. multica rinata* complex. When considered broadly, both of these complexes span the entirety of the Philippine Archipelago, and virtually all regions that have been surveyed extensively have been found to contain a lineage from each complex (AJB, personal observation). This makes ecological sense, as lizard species with contrasting body sizes can, at the very least, readily exploit distinct dietary niches, and thus ecological competition between species might be limited, or at least sufficiently reduced so as to allow coexistence (Vitt 2000; Meiri 2008). The most phenotypically distinct, individual Philippine species of *Eutropis* are *E. bontocensis* and *E. englei*, both of which have unique and striking dorsolateral striping patterns, and appear to be largely habitat specialists (Fig. 3; with *E. bontocensis* restricted to high elevation in the Cordillera Mountains and several small islands north of Luzon, and *E. englei* being restricted to coastal beaches and river mouth habitats in southeastern Mindanao). Available genetic data also support these conclusions (Figs. 4 and 5).

The remaining populations of Philippine *Eutropis* exhibit some phenotypic variation (detailed in Tables 1 and 2, and in the Taxonomic Accounts); however, the current evidence for their recognition as distinct species lies overwhelmingly in their genetic distinctiveness. For example, of the five genetically distinct lineages identified within the *E. indepre nsa* complex by Barley et al. (2013) the two that are most closely related actually correspond to the only previously described species within the complex (Figs. 4 and 6; *E. cumingi* and *E. indepre nsa*). The two most divergent lineages within the complex (which were reciprocally monophyletic at all six nuclear loci examined) both occur in western Panay, and the lack of a significant biogeographic barrier in this region should provide extensive opportunity for gene flow, although none appears to occur between these lineages (Fig. 4). We describe these two lineages as new species here. The

final lineage within the *E. indepre nsa* complex, which we describe later, appears to be endemic to Palawan Island.

Within the *E. multica rinata* complex, several highly genetically distinct lineages occur syntopically, clearly illustrating they are distinct species. In neither case are they even sister taxa, and they are reciprocally monophyletic clades in multiple nuclear gene trees, providing clear evidence that there has not been recent gene flow between these lineages (Figs. 5–7). For example, one pair of highly phenotypically similar taxa occur together in northern Luzon, and another pair occur together in northeastern Mindanao, Samar, and Dinagat islands. Here, we assign one from each region to previously used taxonomic names and provide new descriptions for the others below.

Finally, Barley et al. (2013) identified two additional species that are clearly genetically distinct that we describe here, although future work is needed to help better understand these taxa, as very few specimens have been collected. The first has an intriguing distribution (only currently known from Lubang, Semirara, Samar, and Borneo islands), and does appear to have several distinctive phenotypic characteristics (see the following), though we are unable to assess variation comprehensively because of limited sampling. The second is a new lineage from southwestern Mindanao, which appears to be the sister lineage to the entire *E. multica rinata* complex and may occur sympatrically with three other species of *Eutropis* from the Philippine radiation. The natural history and distributions of these and several other unresolved or poorly understood taxa with biogeographically anomalous distributions must, for the present, remain questions for future studies, when sufficient sample sizes of voucher specimens (with corresponding genetic samples) are available for study.

## TAXONOMIC ACCOUNTS

### *Eutropis caraga* sp. nov.

#### *Mabuya multica rinata*:

Taylor 1918:247 [in part, misidentification].

*Mabuya multica rinata multica rinata*: Brown and Alcala 1980:126 [in part, misidentification].

*Eutropis multica rinata multica rinata*: Mausfeld and Schmitz 2003:168 [by implication].

*Eutropis* Clade E Barley et al. 2013:3563.

**Holotype**.—Female (PNM 9845, formerly KU 334226), collected by R.M. Brown, 13 July 2012 on Mount Lumot at 410 m, Municipality of Gingoog City, Misamis Oriental Province, Mindanao Island, Philippines (8.7216°N, 125.0794°E; datum = WGS84 in all cases).

**Paratypes (paratopotypes)**.—KU 334225, 334227–334229, collected by RMB, M.B. Sanguila, and V. Yngente 16 July 2012, bearing the same locality data as the holotype.

**Other paratypes**.—Seven specimens, all from Philippines. KU 314106, collected by J.B. Fernandez, 13 May 2008, Barangay San Marcos, Municipality of Bunawan, Agusan del Sur Province, Mindanao Island. KU 315009, collected by RMB, 18 July 2008 at 760 m, Pasonanca Natural Park, Sitio Kalinga, Barangay Baluno, Municipality of Pasonanca, Zamboanga City Province, Mindanao Island (7.10759°N, 122.02885°E). KU 320028, 320030, collected by A. Diesmos and M.B. Sanguila, 1 November 2008 at 430



FIG. 3.—Photos illustrating phenotypic variation among species of *Eutropis* from the endemic Philippine radiation. Note the distinctive dorsolateral striping patterns that characterize *E. bontocensis* from the Babuyan Islands (A and B) and the Cordillera Mountain Range (C, KU 335123, SVL = 62 mm), as well as (D) *E. englei* (MCZ 26289, SVL = 69 mm; holotype). Adult body sizes of species in the (E) *E. multicaudata* complex (exemplified here by *E. borealis* from Mount Cagua, Luzon Island) are substantially larger than those of species in the (F) *E. indeprensa* complex where adult males frequently have bright orange coloration on the anterior portion of the body (exemplified here by *E. cumingi* from Lubang Island). All photos by RMB except (C) by AJB, and (D) courtesy of MCZ and Harvard University. A color version of this figure is available online.

m, Mt. Magdiwata, Barangay Bagusan, Municipality of San Francisco, Agusan del Sur Province, Mindanao Island (8.473083°N, 125.986317°E). KU 332773, collected by J.B. Fernandez and V. Yngente, 21 May 2012 at 500 m, Rajah Sikatuna Protected Landscape, Sitio Napo, Barangay Omjon, Municipality of Valencia, Bohol Province, Bohol Island (9.726°N, 124.224°E). KU 344229, 344242, collected by RMB and J.B. Fernandez 4 April 2016 at 130 m, Kaantulan

River Drainage, Sitio Bangon, Barangay Guinmaayohan, Municipality of Balangiga, Eastern Samar Province, Samar Island (11.2074°N, 125.3672°E).

**Referred specimens.**—Fourteen specimens, all from the Philippines. Dinagat Island, Dinagat Islands Province, Municipality of Loreto, Barangay Santiago, Sitio Cambinlia, Mount Cambinlia: KU 310152, 310154. Barangay San Juan near Venus Dias Cave: KU 310156. Mindanao Island,

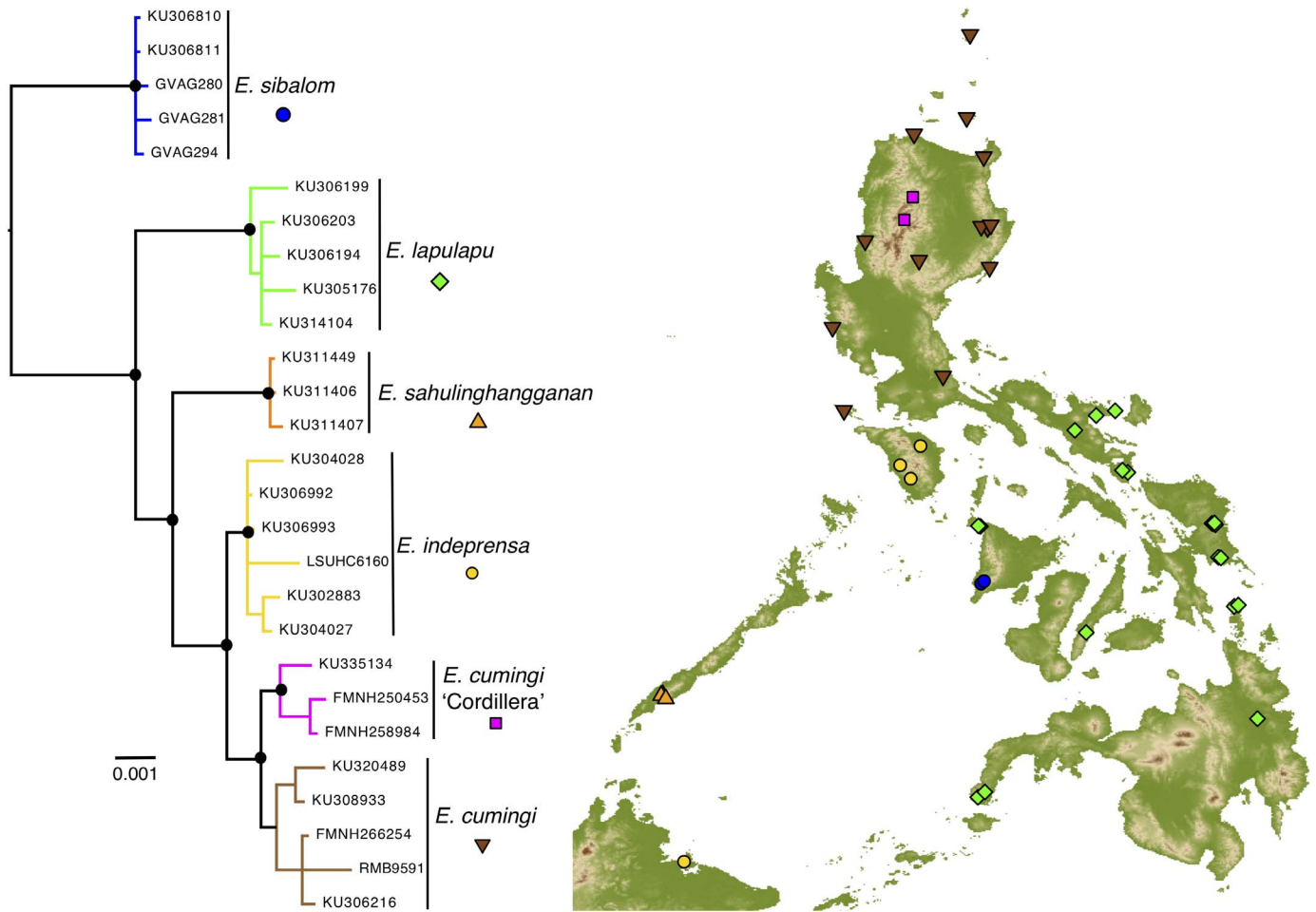


FIG. 4.—Phylogeny of *Eutropis indeprensa* species complex based on nine nuclear genes (left) and known localities of each lineage (right). Circles at nodes indicate posterior probability > 0.95. Data are from Barley et al. (2013, 2015). A color version of this figure is available online.

Agusan del Sur Province, Municipality of Bunawan, Barangay San Marcos: KU 314098, 314105. Zamboanga City Province, Municipality of Pasonanca, Pasonanca Natural Park, Barangay Baluno: KU 315011, 315012. Siargao Island, Surigao del Norte Province, Municipality of Dapa: KU 335269, 335270, 335272. Municipality of Bilar: KU 335273–335275. Municipality of Del Carmen: KU 335271.

**Diagnosis.**—A species of *Eutropis* distinguished by the following combination of characters: (1) body medium-sized (SVL 64–84 mm in adults); (2) interparietal long, narrow, separating parietals; (3) paravertebrals 37–43; (4) sum of subdigital lamellae on all five toes of one foot 80–91; (5) ventral scale rows 26–30; (6) midbody scale rows 27–34; (7) keels on dorsal and lateral body scales moderately defined, 5–10 per scale; (8) lower eyelid scaly; (9) supraciliaries 6 or 7; (10) prefrontals separated; (11) primary temporal scales two; (12) dorsal and lateral body surface with relatively uniform bronze and dark brown coloration, respectively, without pronounced light stripes (Fig. 7).

**Comparisons.**—Critical comparisons for *Eutropis caraga* include other Philippine species of *Eutropis*, particularly those known from the southern islands of the archipelago. *Eutropis caraga* can be distinguished from *E. rudis* and *E. multifasciata* by its smaller size (adult SVL 64–84 mm), more slender body (vs. a larger, more robust body; adult SVL 101–

141 mm in *E. multifasciata* and 76–92 in *E. rudis*) and the presence of more numerous (5–10) moderate keels on its dorsal scales (vs. 3 weak keels in *E. multifasciata* and 3 strong keels in *E. rudis*; Fig. 8). *Eutropis caraga* has more numerous (5–10) keels on the trunk dorsals than *E. rugifera* (which has 3–7 more raised and sharply defined keels), a slightly larger (64–84 mm adult SVL) body size (vs. 49–66 mm in *E. rugifera*), a large interparietal scale that separates the parietals (vs. a smaller interparietal, with parietals in contact posteriorly), and a broad, dark dorsolateral band (absent in *E. rugifera*). The new species can be readily distinguished from *E. englei* by color pattern, as *E. caraga* has a relatively uniform brown to olive-green dorsum (vs. a prominent series of five dark brown and four bluish-white stripes on the dorsum in *E. englei*). It can be distinguished from species in the *E. indeprensa* complex (such as *E. lapulapu*, with which it occurs sympatrically) by its larger (64–84 mm SVL) adult body size (vs. 45–70 mm in *E. lapulapu*), and typically more numerous subdigital toe lamellae (80–91 vs. 70–80 total subdigital toe lamellae). This species is morphologically very similar to *E. multicarinata* despite the fact that they occur sympatrically and are highly distinctive genetically (Fig. 5), although *E. caraga*, on average, does have more subdigital toe lamellae than *E. multicarinata* (80–91 vs. 74–80).

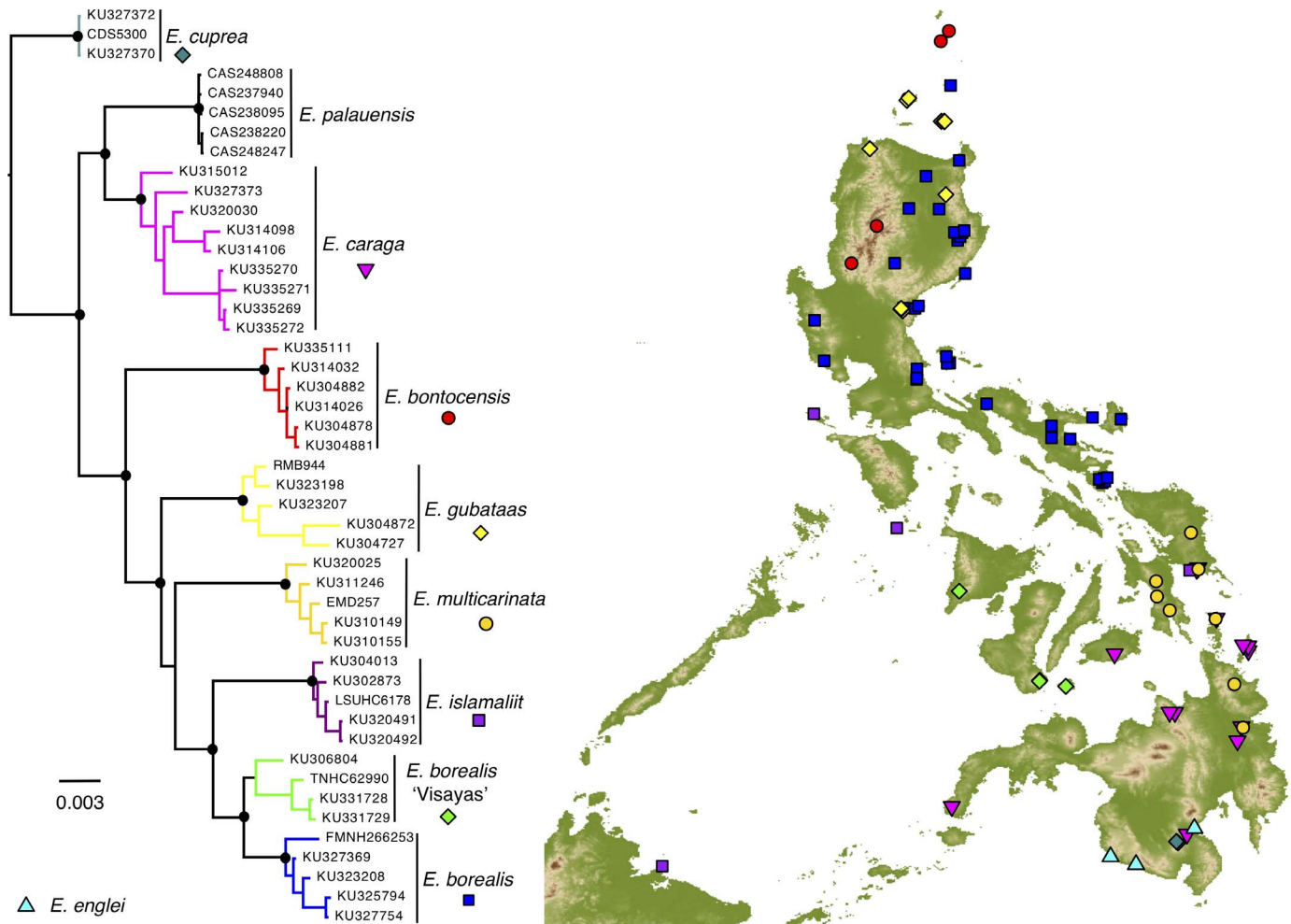


FIG. 5.—Phylogeny of *Eutropis multicarinata* species complex based on nine nuclear genes (left) and known localities of each lineage (right). *Eutropis englei* localities based on specimens collected by Taylor (1922) and Brown and Alcalá (1980). Circles at nodes indicate posterior probability > 0.95. Data are from Barley et al. (2013, 2015). A color version of this figure is available online.

**Description of holotype.**—A large male (SVL 79.9 mm) with hemipenes everted; body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.3; forelimb length/SVL = 0.2); tail long (SVL/tail length = 0.5); head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.9); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated by prefrontal and frontal, contacting anterior and posterior loreals, first supraocular, frontal and frontonasal; two loreal scales; frontal longer than wide, in contact with first and second supraoculars; supraoculars four, second largest; supraciliaries five, third supraciliary distinctly elongate; frontoparietals not fused, in contact with second, third, and fourth supraoculars; interparietal long and narrow, separating parietals; head scales embossed; one pair of enlarged nuchals; eye relatively large, diameter 19.0% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; six supralabials fifth elongate (from anterior to posterior), beneath center of eye; infralabials six;

primary temporals two; enlarged pretemporals six, primary and upper secondary in contact with parietal; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 51.6% of eye diameter; body elongate, paravertebrals 38, midbody scale rows 34, ventral scale rows 29; dorsal and lateral scales with 8–11 keels, ventral scales smooth; tail elongate, 1.7× body length; limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales smaller than body scales, keeled; relative finger lengths with subdigital lamellae in parentheses (left/right): IV(17/17) = III(18/18) > II(13/12) > V(12/12) > I(8/8); hindlimbs moderate (hindlimb length/axilla–groin distance = 0.6); relative toe length with lamellae (L/R) in parentheses: IV(25/–) > III(21/–) > V(18/18) > II(13/13) > I(9/8).

**Measurements of holotype (in mm).**—SVL 79.9; tail length 155.6; axilla–groin distance 39.2; hindlimb length 23.6; forelimb length 17.2; snout–forelimb length 27.7; head



TABLE 1.—Summary of morphometric and meristic data for species in the *Eutropis multicarinata* complex. Values are ranges, with mean and standard deviation in parentheses.

	<i>E. bontocensis</i> (n = 21)	<i>E. borealis</i> (n = 25)	<i>E. caraga</i> (n = 20)	<i>E. gabatans</i> (n = 13)	<i>E. multicarinata</i> (n = 7)	<i>E. islamahit</i> (n = 9)	<i>E. polanenensis</i> (n = 20)
Adult SVL	40.1–61.2 mm	64.1–82.5 mm	64.5–83.9 mm	60.5–78.7 mm	61.1–71.3 mm	70.1–96.4 mm	44.7–79.6 mm
Head width/length	0.64–0.81 (0.72 ± 0.04)	0.68–0.85 (0.74 ± 0.04)	0.63–0.92 (0.77 ± 0.08)	0.67–0.89 (0.76 ± 0.06)	0.74–0.85 (0.77 ± 0.04)	0.67–0.90 (0.77 ± 0.07)	0.66–0.84 (0.74 ± 0.06)
Head length/SVL	0.19–0.24 (0.20 ± 0.01)	0.19–0.25 (0.22 ± 0.01)	0.20–0.23 (0.21 ± 0.01)	0.18–0.24 (0.22 ± 0.02)	0.21–0.23 (0.22 ± 0.01)	0.20–0.23 (0.21 ± 0.01)	0.19–0.25 (0.22 ± 0.01)
Forelimb length/SVL	0.19–0.24 (0.22 ± 0.02)	0.17–0.27 (0.23 ± 0.02)	0.19–0.24 (0.22 ± 0.02)	0.19–0.25 (0.22 ± 0.02)	0.22–0.26 (0.24 ± 0.01)	0.23–0.25 (0.24 ± 0.01)	0.19–0.27 (0.24 ± 0.02)
Hindlimb length/SVL	0.23–0.31 (0.27 ± 0.02)	0.23–0.35 (0.29 ± 0.03)	0.26–0.30 (0.28 ± 0.01)	0.25–0.30 (0.28 ± 0.02)	0.28–0.34 (0.31 ± 0.02)	0.30–0.33 (0.31 ± 0.01)	0.25–0.33 (0.29 ± 0.02)
Axilla–groin/SVL	0.45–0.54 (0.49 ± 0.02)	0.40–0.54 (0.47 ± 0.03)	0.42–0.51 (0.47 ± 0.02)	0.43–0.52 (0.47 ± 0.03)	0.46–0.52 (0.48 ± 0.03)	0.39–0.50 (0.46 ± 0.04)	0.45–0.48 (0.47 ± 0.01)
Total toe lamellae	67–76 (71 ± 2)	80–89 (86 ± 2)	80–91 (85 ± 3)	78–90 (82 ± 3)	74–80 (77 ± 2)	86–92 (88 ± 2)	76–90 (84 ± 3)
Vertebral scale rows	44–50 (45 ± 2)	37–42 (39 ± 1)	37–43 (39 ± 1)	37–44 (41 ± 2)	34–39 (36 ± 2)	41–44 (42 ± 1)	39–46 (43 ± 2)
Ventral scale rows	29–33 (31 ± 1)	25–30 (27 ± 1)	26–30 (27 ± 1)	27–31 (28 ± 1)	24–29 (27 ± 2)	30–32 (31 ± 1)	26–30 (28 ± 1)
Midbody scale rows	29–34 (30 ± 1)	28–33 (29 ± 1)	27–34 (30 ± 2)	30–34 (32 ± 1)	30–33 (31 ± 1)	31–33 (32 ± 1)	30–34(32 ± 1)
Upper, lower labials	6,6	6,6	6–7, 5–6	6–7, 6–7	6–7, 6	7, 6–7	6–7, 6–7
Dorsal scale keels	5–9 (7 ± 1)	6–11 (7 ± 1)	5–10 (7 ± 1)	5–12 (8 ± 2)	5–10 (7 ± 1)	5–10 (7 ± 1)	5–9 (7 ± 1)
Primary temporals	1	1	2	1,2	2	1–2	1–2
Enlarge pretemporals	6	5–6	6–7	6–7	6–7	6–7	5–6
Supraciliaries	4–5	5	6–7	5	4–5	5–7	5–7
Lower eyelid scales	17–19	17–22	16–22	16–23	17–21	21–22	17–20
Supralabials contacting anterior loreal	1,2	(1,2) (1,2,3)	(1,2) (1,2,3) (2) (2,3)	(1,2,3) (1,2)	(1,2,3) (1,2)	1,2,3	(1,2) (1,2,3) (2,3)
Interparietal, parietals	Interparietal small, parietals in contact	Interparietal small, parietals in contact	Interparietal small, parietals not in contact	Interparietal small, parietals in contact	Interparietal large, parietals not in contact	Interparietal medium, parietals in contact	Interparietal large, parietals not in contact

length 16.3; head width 14.6; interorbital distance 9.6; internarial distance 3.8; eye diameter 3.1; auricular opening diameter 1.6.

**Coloration in preservative.**—The following color description was written in 2013 following 1 yr of storage in 70% ethanol. Dorsal ground color dark greenish olive to brown, with dark brown spots randomly interspersed down the length of the body. Scales on the margins of the dorsum are slightly lighter on the anterior portion of the body. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Venter grayish tan to bluish, with lighter chin and preloacals, and dark flecks, randomly dispersed (primarily on the margins) and extending from the chin and throat, all the way down the length of the tail. Margins of ventral scales dark, gray, with central portions light tan.

On lateral surfaces of body, ventral coloration intergrades into dark brown; a faint, broken, light stripe from the upper labials extends down the lateral surface of the body until approximately just past the axilla. Dorsal surfaces of limbs and digits greenish olive brown, mottled with dark brown spots. Ventral surfaces of limbs mostly light grayish to blue, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Head scales uniformly greenish olive brown, as in the dorsal ground color. Upper portion of supralabials dark brown, lower portion light gray to bluish, lower labials also gray to bluish with several dark flecks.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, usually with scattered dark brown flecks; head and neck brown. The lateral surfaces contain a thick, dark brown band that extends from the eye to the hindlimb. Chin creamy white with dark markings. Dorsal surfaces of forelimbs, hindlimbs, and digits dark with indistinct spots. Frequently there are traces of light lines above and below the lateral brown stripes.

**Variation.**—*Eutropis caraga* varies in the number of subdigital lamellae beneath the toes (Toe I 8–10 [9 ± 1], Toe II 14–16 [15 ± 1], Toe III 19–23 [21 ± 1], Toe IV 22–27 [26 ± 1], Toe V 14–19 [17 ± 1]), and third finger (16–19 [18 ± 1]). Supralabials (6 or 7), infralabials (5 or 6), supraciliaries (6 or 7), ventrals (26–30 [28 ± 1]), paravertebrals (37–43 [39 ± 2]), and midbody scale rows (27–34 [31 ± 2]) all vary slightly. The number of keels on the dorsal scales is also highly variable, both within and among individuals (5–10). The number of enlarged/differentiated primary temporals is either one (KU 310152) or two (KU 310154, 314106, 320028, 332773, 334229, 335273) and pretemporals range from six (KU 334229, 335270) to seven (KU 314106, 320028). The number of scales lining the lower eyelid also varies (16–22 [19 ± 2]) and anterior loreals contact only the second supralabial in some individuals (KU 314106), the first and second in others (KU 334228, 334229), the second and third in others (KU 335270, 335275), and the first three supralabials in KU 332773. The new species' dorsal color pattern varies slightly in the degree of dark brown streaking/flecking present, as some individuals have a nearly continuous middorsal line (KU 335270) and/or flecking that extends nearly the entire length of the body (KU 315009, 335273), whereas this is highly reduced in other individuals (KU 310152, 314098, 314107). The amount of dark flecking on

TABLE 2.—Summary of morphometric and meristic data for species in the *Eutropis indeprensa* complex. Values are ranges, with mean and standard deviation in parentheses.

	<i>E. cumingi</i> (n = 18)	<i>E. indeprensa</i> (n = 11)	<i>E. lapulapu</i> (n = 23)	<i>E. sahulinghangganan</i> (n = 15)
Adult SVL	43.5–60.0 mm	48.8–63.8 mm	45.6–69.7 mm	40.4–62.9 mm
Head width/length	0.65–0.85 (0.74 ± 0.05)	0.69–0.82 (0.76 ± 0.05)	0.65–0.93 (0.76 ± 0.08)	0.75–0.92 (0.82 ± 0.06)
Head length/SVL	0.18–0.23 (0.20 ± 0.01)	0.19–0.23 (0.21 ± 0.01)	0.17–0.23 (0.21 ± 0.02)	0.19–0.24 (0.21 ± 0.01)
Forelimb length/SVL	0.16–0.22 (0.19 ± 0.02)	0.20–0.25 (0.22 ± 0.02)	0.17–0.25 (0.22 ± 0.02)	0.17–0.25 (0.21 ± 0.02)
Hindlimb length/SVL	0.18–0.26 (0.23 ± 0.02)	0.26–0.32 (0.28 ± 0.02)	0.24–0.30 (0.27 ± 0.02)	0.24–0.32 (0.27 ± 0.02)
Axilla–groin/SVL	0.32–0.53 (0.47 ± 0.06)	0.44–0.50 (0.47 ± 0.02)	0.43–0.53 (0.48 ± 0.03)	0.37–0.56 (0.46 ± 0.05)
Total toe lamellae	59–70 (65 ± 3)	71–83(75 ± 4)	70–80 (74 ± 4)	63–77 (69 ± 5)
Vertebral scale rows	42–47 (45 ± 2)	41–47 (45 ± 2)	39–45 (41 ± 2)	38–42 (40 ± 1)
Ventral scale rows	28–32 (29 ± 2)	28–31 (30 ± 1)	25–30 (27 ± 1)	26–30 (28 ± 1)
Midbody scale rows	26–33 (30 ± 2)	30–33 (32 ± 1)	27–33 (31 ± 2)	28–33 (30 ± 1)
Upper, lower labials	6,6–7	6–7,6	6,6	6,6–7
Dorsal scale keels	5–10 (7 ± 1)	5–8 (6±1)	5–9 (7 ± 1)	5–10 (7 ± 1)
Primary temporals	1–2	2	1–2	2
Enlarged pretemporals	5–6 (usually 5)	6	6–7	5–7
Supraciliaries	5–6	5–6	5–6	5–6
Lower eyelid scales	14–19	16–21	16–19	17–22
Supralabials contacting anterior loreal	1,2	(1,2) (2) (2,3)	(1,2,3) (1,2) (2)	(1,2,3) (2) (1,2)
Interparietal, parietals	Interparietal large, parietals not in contact	Interparietal large, parietals not in contact	Interparietal large, parietals not in contact	Interparietal large, parietals not in contact

the ventral surface varies from dispersed across the venter (KU 310154, 315009, 334229), concentrated on the throat (KU 320228) to almost none (KU 310152, 332773). The thickness of the dark, lateral bands and distinctiveness of the light dorsolateral stripes extending down the side of the body also varies, with some individuals having pronounced light stripes and thick, dark bands (KU 332773, 334229), whereas in others the band is thinner, and the stripe is less pronounced (KU 335272, 335275).

**Distribution.**—*Eutropis caraga* is known from several localities throughout Mindanao Island, as well as Bohol, Dinagat, Samar, and Siargao islands.

**Habitat and natural history.**—*Eutropis caraga* inhabits primary and second-growth midmontane forest throughout its range, as well as the natural bonsai forest present on Dinagat Island. It also appears to be able to tolerate some disturbance, as it has been found in disturbed, agricultural areas, coconut groves, and residential areas near forest. It is a diurnally active, abundant species that has been collected in leaf litter on the forest floor, in open habitats near forest, on saplings, and under logs from sea level to 1,500 m. This species is oviparous, with female specimens having been reported to contain 2–3 eggs, which they lay in leaf litter or under the bark of fallen logs (Taylor 1922; Brown and Alcalá 1980; Smith 1993). Examination of specimen stomachs by Smith (1993) suggest they are generalist insectivores, and documented predators include *Cyclocorus nuchalis*. This species can be found sympatrically with *E. islamlaii*, *E. lapulapu*, and *E. multifasciata*. It has been found to occur syntopically at multiple sites across northeastern Mindanao, Samar, and Dinagat islands with the morphologically similar *E. multicarinata*. *Eutropis rugifera* is also known from nearby localities on the Zamboanga Peninsula, so it seems likely the two could be also found syntopically at some sites in extreme western Mindanao Island.

**Etymology.**—The new name *caraga* is a feminine noun in apposition derived from the Caraga Region of northeastern Mindanao Island and the immediate offshore islands of Dinagat and Siargao, which includes the type locality. Suggested common name: Caraga Sun Skins.

### *Eutropis gubataas* sp. nov.

*Eutropis* Clade F Barley et al. 2013:3563.

**Holotype.**—Male (PNM 9846, formerly KU 304620), collected by R.M. Brown and J.B. Fernandez, 7 March 2006 near Barangay Balatubat, in an area known locally as “Limandok” at 320 m, Municipality of Calayan, Cagayan Province, Camiguin Norte Island, Philippines (18.92927°N, 121.89881°E).

**Paratypes (paratopotypes).**—Six specimens, bearing the same locality and collector data as the holotype, only differing by the dates of collection: KU 304618, collected 6 March 2006; KU 304642, collected 7 March 2006; KU 304688, KU 304689, collected 9 March 2006; KU 304727, KU 304750, collected 10 March 2006.

**Other paratypes.**—Three specimens, all from Philippines. KU 304940, collected by RMB and J.B. Fernandez, 22 March 2006 at 300 m, Barangay Magsidel, municipality of Calayan, Cagayan Province, Calayan Island (19.331°N, 121.439°E). KU 323224, collected by A.C. Diesmos and RMB, 2 June 2009, Aurora Memorial National Park, Municipality of Maria Aurora, Aurora Province, Luzon Island (15.66713°N, 121.305183°E). KU 329521, collected by RMB, 28 June 2011 at 475 m, Barangay Adams, Municipality of Adams, Ilocos Norte Province, Luzon Island (18.449°N, 120.894°E).

**Referred specimens.**—Nine specimens, all from Philippines. Camiguin Norte Island, Cagayan Province, Municipality of Calayan, Barangay Balatubat: KU 304641, 304767, 308074. Calayan Island, Cagayan Province, Municipality of Calayan, Barangay Magsidel: KU 304871–304872. Luzon Island, Aurora Province, Municipality of Maria Aurora, Barangay Villa Aurora, Aurora Memorial National Park: KU 323198, 323207. Ilocos Norte Province, Municipality of Adams, Barangay Adams, Mount Pao: KU 329522–329523.

**Diagnosis.**—A species of *Eutropis*, distinguished by the following combination of characters: (1) body medium-sized (SVL 60–79 mm in adults); (2) interparietal small, parietals in contact posteriorly; (3) paravertebrals 37–44; (4) sum of



FIG. 6.—Photos of species in the *Eutropis indepressa* complex: (A) *E. cumingi* (Balbalasang, Cordillera Mountains, Luzon Island), *E. lapulapu* (B–C, Camaroan Peninsula, Luzon Island), and *E. sahulinghanganan* from Palawan (D–E). *Eutropis gubataas* is a new species in the *E. multicarinata* complex that was long confused with *E. m. borealis* (F, Luzon Island). Photos by RMB, except (D) by Maia Tanedo and (E) by Bogdan Nita.

subdigital lamellae on all five toes of one foot 78–90; (5) ventral scales rows 27–31; (6) midbody scale rows 30–34; (7) keels on the dorsal and lateral body scales moderately defined, 5–12; (8) lower eyelid scaly; (9) supraciliaries five; (10) prefrontals separated; (11) primary temporal scales one or two; (12) dorsal and lateral body surfaces having relatively uniform bronze and dark brown coloration, respectively, without pronounced light stripes (Fig. 6).

**Comparisons.**—Critical comparisons for *E. gubataas* include other Philippine species of *Eutropis*, particularly

those known from the northern islands of the archipelago. *Eutropis gubataas* can be distinguished from species in the *E. indepressa* complex (such as *E. cumingi*, with which it occurs sympatrically) by its larger maximum body size (adult SVL 60–79 mm vs. 43–60 mm in *E. cumingi*), and more numerous subdigital toe lamellae (78–90 vs. 59–70). *Eutropis gubataas* can be readily distinguished from *E. bontocensis* by color pattern, as it either lacks lateral stripes or has faint, lateral, light stripes limited to only the anterior portion of the body (compared to two prominent, light stripes on the lateral



FIG. 7.—Photos of species in the *Eutropis multicarinata* complex: *E. caraga* from (A) Mount Lumot and (B) the Zamboanga Peninsula, Mindanao Island, (C) *E. borealis* from the Visayan Islands (Siquijor Island), (D) *E. palauensis* (Ngarchelong, Palau), and *E. islamaliit* from Lubang Island (E–F, KU 304013, an adult female, SVL = 79 mm). Photos by RMB except (D) by Thibaud Aronson.

surface that extend the length of the body in *E. bontocensis*). It can also be readily distinguished from *E. bontocensis* by more strongly keeled (vs. lightly keeled) dorsal body scales. *Eutropis gubataas* can be distinguished from *E. multifasciata* by its smaller maximum body size (adult SVL 60–79 vs. 101–141 mm), and more numerous (5–12 vs. 3) and more pronounced keels on the trunk dorsals (vs. lightly to barely keeled). Interestingly, this species does not appear to be readily distinguishable from the broadly sympatric *E. borealis* using external morphology, although *E. borealis*

has a single primary temporal scale, whereas *E. gubataas* tends to have two. Both are known to inhabit northern Luzon (Brown et al. 2012, 2013b) and the Babuyan Island Group (Oliveros et al. 2011), however, they can readily be distinguished using genetic data—and are not sister taxa within the *E. multicarinata* complex (Fig. 5).

**Description of holotype.**—A large male (SVL 77.9 mm) with hemipenes everted; body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.2; forelimb length/SVL = 0.2); tail long (SVL/tail length =

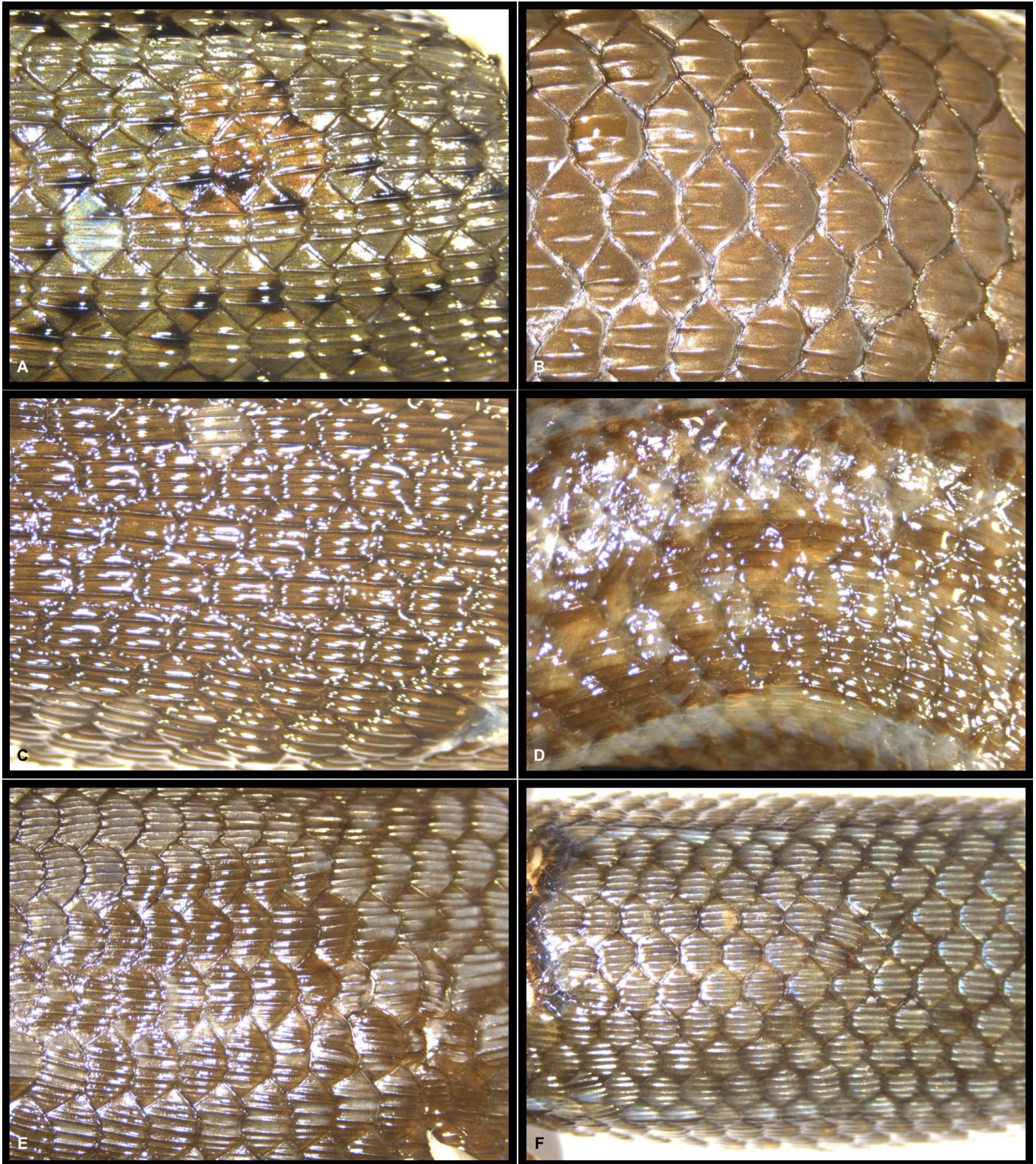


FIG. 8.—Visualization of different dorsal scale types in Philippine *Eutropis*. Dorsal scales of *E. rudis* have three strong keels (A, CAS 259836, Borneo) compared to three weak keels in *E. multifasciata* (B, CAS 185954, Negros). Dorsal scales of *E. rugifera* have 3–7 strong keels (C, CAS 259781, Borneo). Dorsal scales in *E. bontocensis* have 5–7 weak keels (D, CAS 61344, Luzon). Species in the *E. multicarinata* (*E. caraga*, CAS 145890, Mindanao) and *E. indeprensa* (*E. sahulinghanganan*, CAS 157302, Palawan) species complexes have 5–12 or 5–10 moderate keels on their dorsal scales, respectively. A color version of this figure is available online.

0.6); head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.8); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated, contacting anterior and posterior loreals, first and second supraoculars, frontal, frontonasal, and first supraocular; two loreal scales, anterior loreal in contact with first, second, and third supralabial; frontal longer than wide, in broad contact with second supraocular; supraoculars four, second largest; supraciliaries five, third supraciliary distinctly elongate; frontoparietals not fused, in contact with second, third, and fourth supraoculars; interparietal small; parietals in contact posteriorly; head scales embossed; one pair of enlarged nuchals; eye relatively large, diameter 22.8% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; six supralabials, fifth elongate (from anterior to posterior), beneath center of eye; primary temporals two; enlarged pretemporals six, primary and upper secondary in contact with parietal; infralabials seven; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, auricular opening 41.7% of eye diameter, without lobules. Body elongate, paravertebrals 40, midbody scale rows 34, ventral scale rows 30; dorsal and lateral scales with 8–11 keels, ventral scales smooth; tail elongate,  $1.7 \times$  body length; all limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales smaller than body scales, keeled; relative finger length with subdigital lamellae in parentheses (L/R):  $IV(17/19) = III(18/16) > II(13/13) > V(11/11) > I(7/7)$ ; hindlimbs moderate (hindlimb length/axilla–groin distance = 0.5), scales smaller than body scales, keeled; relative toe length with subdigital lamellae (L/R) in parentheses:  $IV(24/25) > III(20/20) > V(16/17) > II(14/13) > I(8/9)$ .

**Measurements of holotype (in mm).**—SVL 77.9; tail length 130.4; axilla–groin distance 37.7; hindlimb length 18.5; forelimb length 17.0; snout–forelimb length 26.6; head length 15.8; head width 13.1; interorbital distance 7.8; internarial distance 3.7; eye diameter 3.6; auricular opening diameter 1.5.

**Coloration in preservative.**—The following holotype color description was written in 2013 following 7 yr of storage in 70% ethanol. Dorsal ground color dark greenish olive to brown, with some interspersed dark streaks of brown. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Venter grayish tan to bluish, with lighter chin and preloacals. Margins of ventral scales dark, gray, with central portions light tan. On lateral surfaces of body, ventral coloration intergrades into dorsal coloration in a mottled pattern; a faint, light stripe from the upper labials extends down the lateral surface of the body until approximately halfway between the axilla and groin.

Dorsal surfaces of limbs and digits greenish olive brown, mottled with dark brown spots. Ventral surfaces of limbs mostly light grayish to blue, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Head a relatively uniform greenish olive brown, with several dark brown blotches posteriorly, which are particularly prominent on the parietals. Upper labials dusky brown, lower labials lighter in color with dark splotches.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent olive brown to gray with scattered dark flecks; head and neck brown. The lateral surfaces with a thick, dark brown band extending from the eye to the hindlimb. Chin creamy white with dark markings. Dorsal surfaces of forelimbs, hindlimbs, and digits dark with indistinct spots. A faint, light line on the anterior portion of the body above the lateral brown stripe; a more distinct light stripe below, extending nearly to the hindlimb.

**Variation.**—*Eutropis gubataas* varies in the number of subdigital toe lamellae (Toe I 8–10 [ $9 \pm 1$ ], Toe II 12–16 [ $14 \pm 1$ ], Toe III 18–22 [ $21 \pm 1$ ], Toe IV 23–27 [ $25 \pm 1$ ], Toe V 14–18 [ $16 \pm 2$ ]), and Finger III lamellae (16–19 [ $17 \pm 2$ ]). Both supralabials and infralabials vary (6 or 7), as do ventrals (27–31 [ $28 \pm 1$ ]), paravertebrals (37–44 [ $41 \pm 2$ ]), and midbody scale rows (30–34 [ $32 \pm 1$ ]). The number of keels on the trunk dorsals is also highly variable, both within and among individuals (5–12). The number of differentiated/enlarged primary temporals is either one (KU 304689, 329522) or two (KU 304618, 304620, 304688, 329521) and pretemporals vary between six (KU 329522) and seven (KU 329521). The number of scales lining the lower eyelid also varies (16–23) and anterior loreal scales either contact the first two (KU 304688) or three supralabials (KU 304618, 329521). In some individuals, the interparietal is fused to one of the parietal scales (KU 304618, 304688). Dorsal color pattern varies slightly in the degree of dark-brown streaking present. Some individuals exhibit a light stripe beneath the thick dark brown lateral band, starting just behind the head, and extending down past the forelimbs (KU 304689, 323224); however, the extent and distinctiveness of this stripe is variable among specimens (being less distinct in KU 304750, 329521, 329522). The extent to which ventral scales change from light on the anterior portion of the chin to dark on the posterior is also variable (e.g., KU 323224 has mostly dark chin scales vs. KU 304618, in which they are much lighter), as is the presence of dark blotches on the posterior of the head (KU 304767 has extensive blotching vs. nearly absent in KU 304727, 304872).

**Distribution.**—*Eutropis gubataas* is known exclusively from several islands in the northern Philippines: from Calayan and Camiguin Norte islands in the Babuyan Island Group (Oliveros et al. 2011), as well as northeastern Luzon Island from Cagayan and Aurora Provinces, and northwestern Luzon from Ilocos Norte Province (Brown et al. 2000, 2012, 2013b; Siler et al. 2011). This species appears to be patchily distributed across northern Luzon, and the extent of its range is not well characterized. It may be restricted from mid- to high-elevation regions in the northern Cordillera and Sierra Madre mountain ranges, with a genetically divergent but morphologically similar species (*E. borealis*) occurring at lower elevations in these same general areas. However, there is at least one locality where the two species have been

collected syntopically in the Sierra Madre (Brown et al. 2000; Siler et al. 2011). This species may potentially occur on additional islands in the Babuyan Island Group (where *E. borealis* also occurs), as well as the Batanes Island Group; however, additional survey work will be needed to clarify this possibility.

**Habitat and natural history.**—*Eutropis gubataas* is known from primary and second-growth forest from sea level to 1000-m elevation. The new species apparently tolerates moderate habitat disturbance, and specimens have been collected from agricultural and residential areas at the edge of forests, and in selectively logged areas. *Eutropis gubataas* can be found diurnally active in leaf litter on the forest floor, on the trunks of trees, on shrubs, and on rocky stream banks. This species can be found sympatrically with four other species of *Eutropis*: *E. bontocensis*, *E. cumingi*, *E. borealis*, and *E. multifasciata*.

**Etymology.**—The specific epithet is an adjectival derivation from the Tagalog noun *gubat* (meaning forest) and adjective *mataas* (meaning “high” or “up high”) in reference to the new species’ preference for montane forested habitats. The specific epithet is feminine in gender. Suggested common name: Upland Sun Skinks.

*Eutropis islamaliit* sp. nov.

*Mabuya multicarinata borealis*: Brown and Alcala 1980:128 [in part, misidentification].

*Eutropis multicarinata borealis*: Mausfeld and Schmitz 2003:164 [by implication].

*Eutropis* Clade G Barley et al. 2013:3563.

**Holotype.**—Male (PNM 9847, formerly KU 302873), collected by C.D. Siler, 18 November 2000 near Barangay Tinogboc, Municipality of Caluya, Antique Province, Semirara Island, Philippines.

**Paratypes.**—KU 304013, collected by RMB, CDS, V. Yngente, and C.W. Linkem, 12 December 2005, near Barangay Vigo, Municipality of Lubang, Occidental Mindoro Province, Lubang Island. KU 320491, collected by CDS, V. Yngente, and J.B. Fernandez, near Sitio Dangay, Barangay Vigo, Municipality of Lubang, Occidental Mindoro Province, Lubang Island at 210 m (13.78885°N, 120.16393°E). CAS 127862 (collected 10 May 1970), CAS 127867–127868 (collected 11 May 1970), collected by L. Alcala, near Barrio Alegria, Bolagsong, Antique Province, Semirara Island at 300–400 ft. KU 344231, collected by RMB and J.B. Fernandez, 9 April 2016, in the Kaantulan River Drainage, near Sitio Bangon, Barangay Guinmaayohan, Municipality of Balangiga, Eastern Samar Province, Samar Island at 145 m (11.2091°N, 125.3759°E).

**Referred specimens.**—Philippines, Lubang Island, Occidental Mindoro Province, Municipality of Lubang, Barangay Vigo, Sitio Dangay: KU 320490, 320492. Malaysia, Sabah, Turtle Island: LSUHC 6178.

**Diagnosis.**—A species of *Eutropis*, distinguished by the following combination of characters: (1) adult body medium-sized (SVL 70–96 mm); (2) interparietal medium-sized, parietals in contact posteriorly; (3) paravertebrals 41–44; (4) sum of subdigital lamellae on all five toes of one foot 86–92; (5) ventral scales rows 30–32; (6) midbody scale rows 31–33; (7) keels on the dorsal and lateral body scales moderately defined, 5–10; (8) lower eyelid scaly; (9) supraciliaries 5–7;

(10) prefrontal separated; (11) primary temporal scales one or two; (12) lateral band sharply defined, lacking dark, mottled coloration, and highlighted below by a crisp transition to light, ventral coloration (Fig. 7).

**Comparisons.**—Critical comparisons for *E. islamaliit* include other Philippine species of *Eutropis*, particularly those known from the central islands of the archipelago. *Eutropis islamaliit* can be readily distinguished from species of the *E. indeprensa* complex by its high total number (86–92) of subdigital toe lamellae (vs. 71–83 in *E. indeprensa*, 59–70 in *E. cumingi*, or 63–77 in *E. sahulinghanganan*) and larger (SVL 70–97 mm) adult body size (vs. 48–64 mm in *E. indeprensa*, 43–60 mm in *E. cumingi*, or 40–63 mm in *E. sahulinghanganan*). It can be distinguished from *E. multifasciata* by its smaller maximum body size (adult SVL 70–97 mm vs. 101–141 mm), and its more strongly keeled (vs. lightly or barely keeled) and numerous (6–9 vs. 3) keels on the trunk dorsals. It can be distinguished from *E. borealis* (its sister species) by the presence of a crisply defined lateral band (vs. a dark, mottling coloration below causing a gradual transition to the light ventral coloration). *Eutropis islamaliit* also appears to exhibit a slightly larger body size, more vertebral and ventral scale rows, and a larger interparietal than *E. borealis* (though our specimen sample size is small, and there is overlap in these characters; Table 1). It can be distinguished from *E. multicarinata* and *E. caraga* by the presence of a crisply defined lateral band (vs. a dark, mottling coloration below causing a gradual transition to the light ventral coloration; Fig. 7) and a smaller interparietal scale that does not completely separate the parietals (vs. a large interparietal scale completely separating the parietals). It can also be distinguished from *E. multicarinata* by the presence of more total toe lamellae (86–92 vs. 74–80) and its slightly larger body size (70–97 mm. vs. 61–72).

**Description of holotype.**—A large male (SVL 88.6 mm); body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.3; forelimb length/SVL = 0.3); tail long (SVL/tail length = 0.5); head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.9); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated, contacting anterior and posterior loreals, first supraocular, frontal and frontonasal; two loreal scales, anterior loreal contacting first, second, and third supralabials; frontal longer than wide, in broad contact with second supraocular, fused with frontoparietals; supraoculars four, second largest; supraciliaries five, third supraciliary distinctly elongate; frontoparietals fused, in contact with second, third, and fourth supraoculars; interparietal medium-sized; parietals touching posteriorly; head scales embossed; one pair of enlarged nuchals; eye relatively large, diameter 21.7% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; seven supralabials, sixth elongate (from anterior to posterior), beneath center of eye; infralabials seven; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in

contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 36.8% of eye diameter; body elongate, with 44 paravertebrals, midbody scale rows 32, ventral scale rows 32; dorsal and lateral scales with 6–9 keels, ventral scales smooth; tail elongate,  $1.9 \times$  body length; all limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales keeled, smaller than body scales; relative finger length with subdigital lamellae in parentheses (L/R):  $IV(20/20) = III(18/19) > II(13/14) > V(12/12) > I(8/8)$ ; hindlimbs moderate (hindlimb length/axilla–groin distance = 0.7), scales smaller than body scales, keeled; relative toe length with lamellae (L/R) in parentheses:  $IV(28/28) > III(22/22) > V(17/18) > II(13/14) > I(8/9)$ .

**Measurements of holotype (in mm).**—SVL 88.6; tail length 171.7; axilla–groin distance 41.2; hindlimb length 27.3; forelimb length 22.2; snout–forelimb length 31.2; head length 17.5; head width 12.2; interorbital distance 9.9; internarial distance 4.0; eye diameter 3.8; auricular opening diameter 1.4.

**Coloration in preservative.**—The following color description was written in 2013 following 6 yr of storage in 70% ethanol. Dorsal ground color dark greenish olive to brown, with some interspersed dark streaks of brown. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Above these bands, some light scales are interspersed that separate the brown bands from the dorsal ground color. Venter grayish tan to bluish, with lighter chin and preloacals, as well as some dark mottling under the chin and head. On lateral surfaces of body, ventral coloration sharply transitions to darker dorsal and lateral dark brown coloration; the ventral coloration stretches from the upper labials to the groin bordering the dark brown lateral bands.

Dorsal surfaces of limbs and digits greenish olive brown, with some mottling of dark brown spots on the pes and manus. Ventral surfaces of limbs mostly light grayish to blue with tan and dark brown coloring in some regions, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits brown to grayish, palmar surface of manus and plantar surface of pes tan to ivory. Head scales a relatively uniform greenish olive brown color. Upper portion of supralabials dusky brown, lower portion tan to ivory, with dark bars separating each scale. Anterior lower labial scales ivory to tan, posterior lower labials becoming grayish brown with dark bars.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, with scattered dark flecks; head and neck brown. The lateral surfaces contain a thick, brown band with darker edges that extends from the eye to the hindlimb. Ventral surface a striking bluish-white coloration that borders lateral band. Dorsal surfaces of forelimbs, hindlimbs, and digits bronze with indistinct spots. Chin cream with dark markings.

**Variation.**—*Eutropis islamaliit* varies in the number of subdigital toe lamellae (Toe I 8–10 [ $9 \pm 1$ ], Toe II 13–15 [ $14 \pm 1$ ], Toe III 20–22 [ $21 \pm 1$ ], Toe IV 25–29 [ $26 \pm 1$ ], Toe V 17–20 [ $18 \pm 1$ ]), and Finger III lamellae (17–19 [ $18 \pm 1$ ]). Infralabials vary (6 or 7), as do supraciliaries (5 or 6), ventrals

(30–32 [ $31 \pm 1$ ]), paravertebrals (41–44 [ $42 \pm 1$ ]), and midbody scale rows (31–33 [ $32 \pm 1$ ]). Keels on dorsal scales ranges within and among individuals (5–10). Additionally, although the frontoparietals are fused in the holotype, this is the only specimen to exhibit this condition (all others have frontoparietals separate). The number of enlarged/differentiated primary temporals (one or two) and pretemporals vary; the latter from four (CAS 127868) to six (KU 304013, 320491, 320492; CAS 127862, 127867) or seven (KU 302873). The number of scales that line the lower eyelid vary (21–22 [ $21 \pm 1$ ]). Dorsal color pattern varies slightly, in the degree of dark brown streaking present (being more extensive in KU 320491 vs. KU 304013). The color of the dark-brown lateral bands also varies, with KU 304013 having more dark, mottled coloration on the anterior portion than KU 320491. The amount of dark flecking on the dorsum also varies, being extensive in some individuals (KU 344231) and very limited in others (KU 304013).

**Distribution.**—*Eutropis islamaliit* has an intriguing distribution. Thus far, it has only been found on Lubang, Semirara, and Samar island in the Philippines and few specimens have been collected. It has also been found on Turtle Island, Sabah, Malaysia. Presumably this species also occurs on many of the intervening large islands in the Central Philippines, however, it is also possible that it now exhibits a relictual distribution or is a beach coastal forest obligate. This species' curious distribution leaves questions for future research and highlights the need for natural history and ecological studies of Philippine *Eutropis* in a variety of overlooked habitats, in combination with fine-scale studies of distributions on large land masses as well as the virtually unstudied small islands of the archipelago.

**Habitat and natural history.**—This species is known from very few specimens; however, it has been found in both primary and second-growth forest. Specimens have been collected when found active on stream banks, tree trunks, and the forest floor. *Eutropis islamaliit* is known to occur sympatrically with *E. caraga*, *E. cumingi*, *E. lapulapu*, *E. multicaerinata*, and *E. multifasciata*. It may also occur sympatrically with *E. borealis* on some islands in the central Philippines where distributions of the *E. multicaerinata* complex species are poorly documented; further survey work is needed. For example, one or more *E. multicaerinata* complex species would be expected to occur on both Palawan and Mindoro islands, but no specimens have been collected. Based on their known distributions, *E. islamaliit* might be expected to occur on Palawan, and both *E. islamaliit* and *E. borealis* on Mindoro Island.

**Etymology.**—The specific epithet is an adjectival derivation from the Tagalog noun *isla* (meaning island) and adjective *maliit* (meaning small) in reference to fact that most specimens that have been collected are from small, offshore islands. We name this species to draw attention to the importance of these small peripheral islands, which are usually disregarded in Philippine government and nongovernment organization conservation management planning (Oliveros et al. 2011; Brown et al. 2013a; Siler et al. 2014). The species' epithet is feminine in gender. Suggested common name: Striking Philippine Sun Skinks (because of its unique color pattern in comparison to other Philippine *Eutropis*).



*Eutropis cuprea* sp. nov.

*Eutropis* Clade A Barley et al. 2013:3563.

**Holotype.**—Female (PNM 9868, formerly KU 327372), collected by J.B. Fernandez, 17 August 2009, Barangay Tablu, Sitio Datal Mangisi, Municipality of Tampakan, South Cotabato Province, Mindanao Island, Philippines.

**Paratypes (paratopotypes).**—Two juveniles (KU 327370, 327371) bearing the same locality data as the holotype.

**Diagnosis.**—A species of *Eutropis* distinguished by the following combination of characters: (1) adult body medium-sized (one specimen measures 83 mm); (2) interparietal large, separating parietals; (3) paravertebrals 38; (4) sum of subdigital lamellae on all five toes of one foot 76–78; (5) ventral scale rows 27–30; (6) midbody scale rows 30–31; (7) keels on dorsal and lateral body scales moderately defined, 9–12; (8) lower eyelid scaly; (9) supraciliaries six; (10) prefrontals in contact or barely separated; (11) primary temporal scales one; (12) dorsal and lateral body surface having relatively uniform bronze and dark brown coloration, respectively, without pronounced light stripes.

**Comparisons.**—Critical comparisons for *E. cuprea* include other Philippine *Eutropis* from southern portions of the archipelago. *Eutropis cuprea* can be distinguished from *E. multifasciata* by its smaller size, more slender body, and the presence of more numerous keels on trunk dorsals (adult SVL ~80 mm with 9–12 dorsal scale keels in *E. cuprea* vs. adult SVL 101–141 mm with 3 dorsal scale keels in *E. multifasciata*). As a member of the *E. multicarinata* complex, *E. cuprea* can be distinguished from *E. lapulapu* by having a larger adult body size (adult SVL ~80 mm in *E. cuprea* vs. 45–70 mm in *E. lapulapu*) and from *E. englei* by having relatively uniform dorsal and lateral coloration (vs. prominent series of five dark brown and four bluish-white stripes in *E. englei*). Because this species is only known from a single adult specimen, we are unable to assess variation for comparisons to other species confidently. This individual has a single primary temporal scale and the prefrontal scales are barely separated (whereas *E. caraga* has two primary temporal scales and prefrontals that are more widely separated), but it is certainly possible these traits are not diagnostic of the species.

**Description of holotype.**—A large female (SVL 83.0); body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.3; forelimb length/SVL = 0.2); tail recently broken, not regenerated; head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.9); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals barely separated, contacting anterior and posterior loreal, first supraocular (and second supraocular on left side), frontal, frontonasal, and first supraciliary; frontal longer than wide, in contact with second supraocular (and first supraocular on right side); supraoculars four, second largest; six supraciliaries; frontoparietals not fused, in contact with second, third, and fourth supraoculars; scales on posterior of head missing due to damage; head scales embossed; eye relatively large, diameter 24.7% of head

length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; six supralabials, fifth elongate (from anterior to posterior), beneath center of eye; infralabials seven; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 39.4% of eye diameter; body elongate, paravertebrals 38, midbody scale rows 30, ventral scale rows 30; dorsal and lateral scales with 9–12 keels, ventral scales smooth; tail elongate, recently severed; limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales smaller than body scales, keeled; relative finger lengths with subdigital lamellae in parentheses (L/R): IV(15/16) = III(16/17) > II(12/10) > V(11/11) > I(6/7); hindlimbs moderate (hindlimb length/axilla–groin distance = 0.5); relative toe length with lamellae (L/R) in parentheses: IV(23/23) > III(19/19) > V(16/17) > II(12/14) > I(8/8).

**Measurements of holotype (in mm).**—SVL 83.0; axilla–groin distance 42.6; hindlimb length 22.1; forelimb length 17.6; snout–forelimb length 26.7; head length 15.4; head width 13.6; interorbital distance 8.7; internarial distance 4.0; eye diameter 3.8; auricular opening diameter 1.5.

**Coloration in preservative.**—The following color description was written in 2018 following 9 yr of storage in 70% ethanol. Dorsal ground color uniformly dark greenish olive to brown, except at edges where scales are slightly lighter in color. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Dorsal edge of band is pronounced by a narrow, dark line. Venter grayish tan to bluish, with lighter chin and preloacals. Margins of ventral scales have a dark, gray mottled coloration that is more prominent on the posterior portion of the venter, and the central portions of the ventral scales are light tan. The venter also has several, randomly dispersed, dark streaks throughout.

On lateral surfaces of body, ventral coloration intergrades into dark brown with several dark streaks on the gular region; a faint, broken, light stripe from the upper labials extends down the lateral surface of the body until approximately just past the axilla. Dorsal surfaces of limbs and digits a uniform brown coloration. Ventral surfaces of limbs mostly grayish to blue with dark mottling, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes have a mottled tan, gray, and ivory coloration. Head scales uniformly greenish olive brown, as in the dorsal ground color. Upper portion of supralabials dark brown, lower portion light gray to bluish, lower labials also gray to bluish. Edges of labial scales are highlighted by dark brown coloration. Lower eyelid scales and supraciliaries are tan in color; upper eyelid scales are dark brown, as are the upper portions of the lower preoculars and fifth supralabial, which form a dark semicircle around the eye.

**Coloration in life.**—Remains unrecorded, but in our experience, *Eutropis* coloration in preservative is usually

quite similar to that in life, with only minor fading, reduction in brilliance and stark contrasts of light and dark adjacent color features, and loss of vibrant reds, blues, and yellows.

**Distribution.**—*Eutropis cuprea* is only known from the Municipality of Tampakan, South Cotobato Province, in southwestern Mindanao Island in the Philippines.

**Habitat and natural history.**—The few available specimens were collected in second-growth, regenerating forest. Specimens were collected either on top of leaf litter on the forest floor or on a stream bank in the forest. Although no other species of *Eutropis* were collected at this particular site, several other species are known to occur nearby and likely occur sympatrically, including *E. caraga*, *E. lapulapu*, *E. multifasciata*, and potentially *E. englei*.

**Etymology.**—The species name is a Latin adjective meaning “copper,” in reference to this species only being known from near Tampakan, Mindanao (which is the location of one of the largest copper deposits in the world), as well as the general copper coloration of the dorsum in species of the *E. multicolorata* complex, such as this one. Suggested common name: The Copper Sun Skinks.

**Remarks.**—Southwestern Mindanao Island appears to be a hotspot of *Eutropis* diversity (Mindanao has previously been regarded as a hotspot of reptile and amphibian diversity more generally; Sanguila et al. 2016). In addition to the new species, three widespread species (that occur throughout Mindanao) are present there: *E. lapulapu*, *E. caraga*, and *E. multifasciata*. Two additional species that are distributed throughout the Indo-Malayan Archipelago have also invaded the Zamboanga Peninsula: *E. rudis* and *E. rugifera*. Taylor (1925:102) described an additional species (*E. englei*) from the Cotabato Coast (from “low vegetation on sandy beaches” and “open places along rivers near their mouths”) from Tatayan Island and Saub. Brown and Alcalá (1980) assigned three additional specimens they collected from near Digos City to *E. englei* based on vertebral scale count, despite the fact that they differ significantly in terms of color pattern (three dark brown stripes on the dorsum vs. five in other *E. englei* specimens). Biogeographically, this locality is also separated substantially from the Taylor localities, and the specimens were collected in a different microhabitat (“in debris on the floor of coconut groves at sea level,” Brown and Alcalá 1980:122). Based on this information and our examination of the specimens, we think it is unlikely that these specimens (CAS 124842, 124844) correspond to any currently described species (and thus may represent a fourth *E. multicolorata* complex taxon in southwestern Mindanao). Clearly the *Eutropis* of southwestern Mindanao warrant further study.

*Eutropis palauensis* sp. nov.

*Mabuia multicolorata*: Sternfeld 1920:395 [in part, misidentification, misspelling].

*Mabuia multicolorata multicolorata*: Brown and Alcalá 1980:126 [in part, by implication].

*Mabuia* sp.: Crombie and Pregill 1999:59 [misidentification].

*Eutropis* sp.: Mausfeld and Schmitz 2003:165 [misidentification].

**Holotype.**—Male (CAS 248251), collected by R.I. Crombie, 29 August 2007 on west coast road north of

Dilong Village, Ngcheangel Atoll, Ngcheangel Island, Kayangel State Caroline Islands, Palau (8.089436°N, 134.7159°E)

**Paratypes.**—Thirteen specimens, all from Palau. CAS 238095, 238097, 238098, 238099, 238100, 238101, collected by R.I. Crombie, 27 March 2006, Ngercheu Island, Belau Caroline Islands. CAS 254721, collected by R.I. Crombie, 17 June 2012, Ulimang village, Babeldaob Island, Ngaraad State (7.622533°N, 134.6425°E). CAS 237940, 237941, collected by R.I. Crombie, 25 November 2005, Carp Island, Ngercheu Islands. CAS 238220, collected by R.I. Crombie, 1 June 2006, Dilong Village, Ngerebelas Island, Ngcheangel Atoll (8.082583°N, 134.7176°E). CAS 248808, collected by R.I. Crombie, 27 April 2008, Ulimang village, Babeldaob Island, Ngaraad State (7.622283°N, 134.6427°E). CAS 248247, 248248, collected by R.I. Crombie, 28 August 2007, Dilong village, Ngcheangel Island, Ngcheangel Atoll (8.082717°N, 134.7174°E).

**Diagnosis.**—A species of *Eutropis* distinguished by the following combination of characters: (1) body medium-sized (SVL 45–80 mm in adults); (2) interparietal large, separating parietals; (3) paravertebrals 39–46; (4) sum of subdigital lamellae on all five toes of one foot 76–90; (5) ventral scale rows 26–30; (6) midbody scale rows 30–34; (7) keels on dorsal and lateral body scales moderately defined, 5–10 per scale; (8) lower eyelid scaly; (9) supraciliaries 5–7; (10) prefrontals separated; (11) primary temporal scales one or two; (12) dorsal and lateral body surface with relatively uniform bronze to olive coloration, respectively, usually without extensive, pronounced light or dark stripes (Fig. 7).

**Comparisons.**—*Eutropis palauensis* appears to be the only species of *Eutropis* found in the Palau and Caroline Archipelagos. Although some museum specimens have previously been erroneously identified as the widespread species *E. multifasciata*, this species does not appear to be present, and can be distinguished by having fewer keels on the trunk dorsals (3 in *E. multifasciata* vs. 5–9 in *E. palauensis*; Crombie and Pregill 1999). As a member of the *E. multicolorata* complex, *E. palauensis* can be distinguished from species in the *E. indepressa* complex by its larger (45–80 mm SVL) adult body size (vs. 45–70 mm in *E. lapulapu* and 48–64 mm in *E. indepressa*) and typically more numerous toe lamellae (76–90 vs. 70–80 in *E. lapulapu* and 71–83 in *E. indepressa*). Within the *E. multicolorata* complex, *E. palauensis* is most closely related to *E. caraga* (Fig. 5). Compared to that species (and others in the complex), the dark lateral band is generally more reduced (being distinct and extending from the eye to the hindlimb in *E. caraga* vs. less distinct and only extending to the forelimb in *E. palauensis*; Fig. 7). The prefrontal scales in *E. palauensis* also tend to be more widely separated than species in the *E. multicolorata* complex. The sister relationship between *E. caraga* and *E. palauensis* makes biogeographic sense (given that Mindanao is the most geographically proximate Philippine Island); however, these two species are highly genetically distinct (Barley et al. 2013) and geographically separated by >500 miles, and thus, are clearly on distinct evolutionary trajectories.

**Description of holotype.**—A large male (SVL 79.3 mm) with hemipenes everted, body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.3; forelimb length/SVL = 0.2); tail long (SVL/tail length =

0.5); head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.7); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated, contacting anterior and posterior loreals, first supraocular, frontal, and frontonasal; two loreal scales; frontal longer than wide, in broad contact with second supraocular; supraoculars four, second largest; supraciliaries five; frontoparietals not fused, in contact with second, third, and fourth supraoculars; interparietal long and narrow, separating parietals; head scales embossed; one pair of enlarged nuchals; eye relatively large, diameter 17.6% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; six supralabials, fifth elongate (from anterior to posterior), beneath center of eye; infralabials seven; primary temporals two; enlarged pretemporals five, primary and upper secondary in contact with parietal; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 54.5% of eye diameter; body elongate, paravertebrals 43, midbody scale rows 32, ventral scale rows 29; dorsal and lateral scales with 6–9 keels, ventral scales smooth; tail elongate,  $1.9 \times$  body length; limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales smaller than body scales, keeled; relative finger lengths with subdigital lamellae in parentheses (L/R): IV(14/16) = III(15/17) > II(12/–) > V(12/) > I (8/–); hindlimbs moderate (hindlimb length/axilla–groin distance = 0.7); relative toe length with lamellae (L/R) in parentheses: IV(25/25) > III(20/20) > V(16/15) > II(13/15) > I(10/10).

**Measurements of holotype (in mm).**—SVL 79.3; tail length 152.2; axilla–groin distance 37.0; hindlimb length 24.3; forelimb length 21.9; snout–forelimb length 27.7; head length 18.8; head width 12.8; interorbital distance 9.0; internarial distance 3.8; eye diameter 3.3; auricular opening diameter 1.8.

**Coloration in preservative.**—The following color description was written in 2019 following 12 yr of storage in 70% ethanol. Dorsal ground color dark greenish olive to brown, with few dark brown spots randomly interspersed down the length of the body. Dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to just past the insertion of the forelimb where they blend into the greenish-brown dorsal coloration. Venter grayish tan to bluish, with lighter chin and preloacals, and dark flecks, randomly dispersed, primarily on the chin and throat. Margins of ventral scales dark, gray, with central portions light tan.

On lateral surfaces of body, ventral coloration intergrades into dark brown. Dorsal surfaces of limbs and digits greenish olive brown, mottled with dark brown spots. Ventral surfaces of limbs mostly light grayish to blue, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of

digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Head scales greenish olive brown as in the dorsal ground color, with several dark brown flecks. Upper portion of supralabials dark brown, lower portion light gray to bluish, lower labials also gray to bluish with several dark flecks.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, with few dark brown flecks, lighter on lateral edge; head and neck brown. The lateral surfaces contain a mottled, dark brown band extending from the eye posteriorly, becoming broken and fading past the forelimb. Chin and venter bluish to creamy with few dark markings. Dorsal surfaces of forelimbs, hindlimbs, and digits bronze to brown with indistinct spots.

**Variation.**—*Eutropis palauensis* varies in the number of subdigital lamellae on the toes (Toe I 9–13 [ $10 \pm 1$ ], Toe II 10–16 [ $14 \pm 1$ ], Toe III 18–21 [ $20 \pm 1$ ], Toe IV 23–26 [ $25 \pm 1$ ], Toe V 13–17 [ $15 \pm 1$ ]), and Finger III (15–17). Supralabials (6 or 7), infralabials (6 or 7), supraciliaries (5–7), ventrals (26–30 [ $28 \pm 1$ ]), paravertebrals (39–46 [ $43 \pm 2$ ]), and midbody scale rows (30–34 [ $32 \pm 1$ ]) all vary slightly. The number of keels on the dorsal scales is also highly variable, both within and among individuals (5–9). The number of enlarged/differentiated primary temporals is either one (CAS 238095, 238220, 238101, 248808, 238096, 251937) or two (CAS 237940, 238100, 238098, 238099, 248248, 238097, 237941, 254721) and pretemporals range from five (CAS 237940, 248251, 248247) to six (CAS 238095, 238100, 248248). The number of scales lining the lower eyelid also varies (17–20 [ $19 \pm 1$ ]) and anterior loreal contacts the first and second supralabials in some individuals (CAS 237940, 238220), the second and third in others (CAS 257895), and the first three supralabials in other specimens (CAS 238095, 238100, 238098). The new species' dorsal color pattern varies slightly in the degree of dark brown streaking/flecking present, as some individuals have very few dark flecks or lines (CAS 238097, 238099, 238100), whereas it is more extensive in others (CAS 238095, 238101). The thickness of the dark stripe extending down the lateral side of the body also varies, with some individuals having a more prominent stripe extending down the length of the body (CAS 238095, 238101), whereas in others it starts to fade just past the axilla (CAS 238099, 238100).

**Distribution.**—*Eutropis palauensis* is known from islands throughout the Palau Archipelago (including Babeldaob, Beliliou, Ngcheangel, Ngercheu, Oreor, Pulo Anna, and Sonsorol), as well as Fais Island and Ulithi Atoll in the Caroline Islands.

**Habitat and natural history.**—No formal studies of the natural history of this species have been published; however, it presumably exhibits an ecology that is similar to the other Philippine *Eutropis multicarinata* complex species. *Eutropis palauensis* is a diurnally active species that appears to be able to tolerate some disturbance and has been successfully collected using sticky trapping in and adjacent to villages (Crombie and Pregill 1999). It is the only species of *Eutropis* that occurs in Palau.

**Etymology.**—We derive the new species' specific epithet from the Republic of Palau from which this species is known. The species' epithet is feminine in gender. Suggested common name: Palau Sun Skins.

*Eutropis multicarinata* comb. nov.

*Tiliqua multicarinata* Gray 1845:109. Holotype (BMNH 1946.8.15.13) from “Philippines” [not examined].

*Mabuia multicarinata*: Boulenger 1887:185 [in part, misspelling].

*Mabuya multicarinata*: Taylor 1922:156 [in part].

*Mabuya multicarinata multicarinata*: Brown and Alcalá 1980:126 [in part].

*Eutropis multicarinata multicarinata*: Mausfeld and Schmitz 2003:164 [misidentification, by implication].

**Holotype.**—BMNH 1946.8.15.13, collected by H. Cuming, with locality data listed solely as Philippines.

**Referred specimens.**—Thirteen specimens, all from the Philippines. Dinagat Island, Dinagat Islands Province, Municipality of Loreto, Barangay Santiago, Sitio Cambinlia, Mount Cambinlia: KU 310149, 310151, 310153, 310155, 310371–72. Leyte Island, Leyte Province, Municipality of Baybay, Pilim, San Vicente: KU 311246. Municipality of Burauen: CAS-SU 24657. Barangay Dinaayan: KU 343900. Mindanao Island, Agusan del Sur Province, Municipality of San Francisco, Barangay Bagusan, Mount Magdiwata: KU 320025–26. Samar Island: Eastern Samar Province, Municipality of Balangiga, Barangay Guinmaayohan, Sitio Bangon, Kaantulan River Drainage: KU 344245. Municipality of Taft, Barangay San Rafael, Kadakan River: KU 337426.

**Diagnosis.**—A species of *Eutropis*, distinguished by the following combination of characters: (1) body medium-sized (SVL 61–72 mm in adults); (2) interparietal large, parietals not in contact, or in some cases, interparietal fused to nuchal; (3) paravertebrals 34–39; (4) sum of subdigital lamellae on all five toes of one foot 74–80; (5) ventral scales rows 24–29; (6) midbody scale rows 30–33; (7) keels on dorsal and lateral body scales moderately defined, 5–10; (8) lower eyelid scaly; (9) supraciliaries 4–5; (10) prefrontals separated or in contact; (11) primary temporal scales two; (12) dorsal and lateral body surface having relatively uniform bronze and dark brown coloration, respectively, without pronounced light stripes.

**Comparisons.**—Critical comparisons for *Eutropis multicarinata* include other Philippine *Eutropis*, particularly species from the archipelago’s southern islands. *Eutropis multicarinata* can be distinguished from members of the *E. indepressa* complex (such as *E. lapulapu*, with which it occurs sympatrically) by its larger (61–72-mm adult SVL), more robust body (vs. 45–70-mm adult SVL in *E. lapulapu*) and fewer vertebral scale rows (34–39 vs. 39–45). *Eutropis multicarinata* can be readily distinguished from *E. englei* by its relatively uniform brown to olive-green dorsum (vs. a prominent series of five dark brown and four bluish-white stripes on the dorsum in *E. englei*). *Eutropis multicarinata* differs from *E. multifasciata* by its smaller size, less robust body (adult SVL 61–72 vs. 101–141 mm) and by more numerous (5–10 vs. 3) and moderate (vs. weak) keels on its dorsal scales (Fig. 8). *Eutropis multicarinata* can be distinguished from *E. islamaliit* by color pattern in having a gradual mottled light and dark color transition between the light venter and dark lateral band (vs. a crisply defined inferior lateral band border), by a smaller number of total toe lamellae (74–80 vs. 86–92), and slightly smaller adult body size (61–72 vs. 70–97). *Eutropis multicarinata* is very

morphologically similar to *E. caraga* despite the fact that they occur sympatrically and are highly distinctive genetically (Fig. 5), though *E. multicarinata* usually has a smaller number of subdigital toe lamellae than *E. caraga* (74–80 vs. 80–91; trait means are significantly different).

**Coloration in preservative.**—“Dorsum tannish olive green to olive brown, occasionally almost uniform but usually with a narrow, dark brown to blackish vertebral stripe from nape to region of fore limbs or slightly more posterior and often a series of dark brown to blackish spots along the dorsolateral margin at least anteriorly; upper lateral surfaces dark brown to blackish, frequently with a very narrow, faint, light line along the dorsal edge anteriorly; a somewhat wider light (bluish to grayish) solid or broken stripe from labials through ear to region of fore limbs and occasionally onto flank; venter bluish or grayish flesh to light slate, frequently with numerous or scattered small black spots on chin and throat” (Brown and Alcalá 1980:127–128).

**Coloration in life.**—Remains unrecorded, but in our experience, *Eutropis* coloration in preservative is usually quite similar to that in life, with only minor fading, reduction in brilliance and stark contrasts of light and dark adjacent color features, and loss of vibrant reds, blues, and yellows.

**Distribution.**—*Eutropis multicarinata* is known from localities in northeastern Mindanao Island (Agusan del Sur Province), as well as Dinagat, Samar, and Leyte islands.

**Habitat and natural history.**—*Eutropis multicarinata* inhabits primary and second-growth, midmontane forest throughout its range, and has also been found in the natural bonsai forest on Dinagat Island. It is a diurnally active species that has been collected on leaf litter on the forest floor, and rocks on stream banks, from sea level to 400 m. Specimens have also been collected beneath rotting logs and leaf litter, under bark or debris, and rarely low on tree trunks (Brown and Alcalá 1980). This species can be found sympatrically with four other species of *Eutropis*: *E. lapulapu*, *E. caraga*, *E. islamaliit*, and *E. multifasciata*.

**Remarks.**—Gray (1845) initially described *E. multicarinata* (the first species described from the endemic Philippine radiation) based on three specimens collected by H. Cuming, but the locality was only labeled as “Philippines.” Brown and Alcalá (1980) found that two of the specimens (which Gray mistakenly identified as juveniles, an assumption that was perpetuated by later researchers including Taylor) were mature adults that belonged to a new species they described as *E. cumingi*. They also suggested that the third specimen (BMNH 1946.8.15.13, which they assigned as the *E. multicarinata* holotype) was likely drawn from one of the southern populations in the archipelago (which they then described as the subspecies *E. m. multicarinata*) based on the fact that the interparietal is relatively long and narrow, and the presence of dark markings under the chin and throat. They designated Leyte (somewhat arbitrarily) as the type locality based on the fact that Cuming was known to have visited several islands in the southeastern portion of the archipelago (including Leyte, but also Samar, and Dinagat). Barley et al. (2013) determined that the southern Philippine populations of *E. multicarinata* were actually composed of two distinct species (*E. multicarinata* and Clade E, which we describe as *E. caraga* here) that occur syntopically on Mindanao, Samar, and Dinagat Island, and assumed that the Leyte populations were

representative of true *E. multica rinata*. Although these two species are extremely morphologically similar, they do usually differ based on lamellae count (74–80 for *E. multica rinata* and 80–91 for *E. caraga*), and each of the previous assumptions appears to be correct. Examination of the type specimen suggests it is morphologically similar to the Leyte populations and has 77 total subdigital toe lamellae. Thus, we consider the lineage containing the Leyte Island populations as representative of true *E. multica rinata* (Fig. 5).

*Eutropis borealis* comb. nov.

*Mabuya multica rinata*: Taylor 1917:371 [misidentification].

*Mabuya multica rinata borealis* Brown and Alcalá 1980:128.

Holotype male (CAS 15447) from “Subic Bay, Luzon Island, Philippines” [in part, examined].

*Eutropis multica rinata borealis*: Mausfeld and Schmitz 2003:169.

**Holotype.**—Male (CAS 15447), collected by J. Thomson, 7 June 1907, near Subic Bay, Luzon Island, Philippines.

**Paratypes.**—Eighty-one specimens, all from the Philippines (Brown and Alcalá 1980).

CAS 15446–15449, 15453, collected by J.C. Thomson, July 1907, vicinity of Subic Bay, Zambales Province, Luzon Island. CAS 61492–61498 collected by E.H. Taylor, April 1920, Balbalan, Mountain Province, Luzon Island. CAS 61320, collected by E.H. Taylor, May 1920, Majayjay, Laguna Province, Luzon Island. CAS 140047, 140048, collected by B. Gargar and G. Carilo, December 1974, Labnig, Albay Province, Luzon Island. BMNH 1895.1.11.2, 1892.10.24.7, 1894.10.24.6, FMNH 161652–161655, 161662, Luzon Island. CAS 62280–62284, collected by E.H. Taylor, August 1920, Quezon Province, Polillo Island. CAS 124107–124109, collected by L.C. Alcalá, May 1969, Buaya, Sicogon Island. CAS 144318, 144319, collected by L.C. Alcalá, June 1976, Mapuyo, Masbate Island. CAS 129292, 129325, 129329, collected by A.C. Alcalá, December 1961, Negros Oriental Province, Negros Island. CAS 131786, 131787, collected by D. Empeso, May 1964, Siaton, Negros Oriental Province, Negros Island. CAS 134314, 134316–134318, 134320, 134321 (collected by Q. Alcalá, December 1960), CAS 154956, 154957 (collected by A.C. Alcalá, February 1964), Palaypay, Negros Oriental Province, Negros Island. CAS 145948, 145950, 28781, 28782 (collected by Q. Alcalá, January 1964), CAS 145975 (collected 1964), Negros Oriental Province, Negros Island. CAS-SU 19852, collected by A.C. Alcalá, Q. Alcalá, F. Lusoc, April 1956, Cabagnaan, Negros Oriental Province, Negros Island. CAS-SU 21207, 21208, 21213, 21214, collected by A.C. Alcalá, Q. Alcalá, April 1957, Dungga, Negros Oriental Province, Negros Island. CAS-SU 26790, 26919, 26920, 28153, 28158 (collected by B. Gargar), 26791 (collected by S. Villamil, J. Empeso, B. Gargar), 26792, 28160, 28161 (collected by J. Empeso, M. Pineró), March–April 1962, Mount Canlaon, Negros Occidental Province, Negros Island. CAS-SU 28143, collected by A.C. Alcalá, April 1962, Kalapnagan, Negros Occidental Province, Negros Island. CAS 127862, 127867, 127868, collected by L.C. Alcalá, May 1970, Alegria Barrio, Antique Province, Caluya Island. CAS 124493, 124494, 124495, 124496, 124497, collected by L.C. Alcalá, June 1968, Langob, Iloilo Province, Gigantes North Island. CAS

125039, collected by L.C. Alcalá, June 1968, Gabi Barrio, Iloilo Province, Gigantes South Island. CAS 128445, collected by L.C. Alcalá, August 1970, Ubo Barrio, Cebu Province, Cebu Island. CAS 136794, 136795, 136796, collected by L.C. Alcalá, December 1971, Taptap Barrio, Cebu Province, Cebu Island. CAS 145664, collected by Q. Alcalá, November 1965, Camp 7 Barrio, Cebu Province, Cebu Island. CAS 124050, collected by L.C. Alcalá, May 1969, Mount Manaphag, Iloilo Province, Pan de Azúcar Island.

**Referred specimens.**—Forty-one specimens, all from the Philippines. Luzon Island, Zambales Province, Subic Bay: CAS 15448. Camarines del Sur Province, Municipality of Baao, Barangay La Medalla: KU 306196. Camarines Norte Province, Municipality of Labo, Barangay Tulay Na Lapa: KU 313911. Nueva Vizcaya Province, Municipality of Quezon, Barangay Maddiangat, Sitio Upper Dayog: KU 325793–325794. Kalinga Province, Municipality of Tabuk City, Barangay Dupag, Situi Patiking: KU 327754. Aurora Province, Municipality of Maria Aurora, Barangay Villa Aurora, Sitio Dimani, Aurora Memorial National Park: KU 323199–323206. Municipality of Casiguran, Barangay Capsipan: KU 324812. Municipality of Baler, Barangay Zabali, Aurora State College of Technology: KU 323208, 323210, 323214, 323220. Municipality of San Luis, Barangay Real Sitio Minoli: KU 323222, 323223, 325050, 325051. Isabela Province, Municipality of Cabagan, Barangay Garita, Mitra Ranch: KU 327560. Municipality of San Mariano, Barangay Dibuluan, Sitio Apaya, Apaya Creek: KU 327366. Sitio Dunoy, Dunoy Lake: KU 327549. Dibante Ridge: KU 327562. Barangay Del Pilar: KU 327387, 327557. Barangay San Jose: KU 327567–327568. Cagayan Province, Municipality of Gattaran, Gattaran DENR Reforestation Project Reserve: KU 335107–335108. Municipality of Gonzaga, Barangay Magrafil, Mount Cagua: 330071–330072. Quezon Province, Municipality of Real, Barangay Maunlad, University of the Philippines Quezon Land Grant: KU 345421. Babuyan Claro Island, Cagayan Province, Municipality of Calayan, Barangay Babuyan Claro: KU 304837. Catanduanes Island, Catanduanes Province Municipality of Gigmoto, Barangay San Pedro: KU 308125. Polillo Island, Quezon Province: CAS 62280. Municipality of Burdeos, Barangay Aluyon, Sitio Malinao: KU 327369. Municipality of Polillo, Barangay Pinaglubayan: KU 302877, 307536.

**Diagnosis.**—A species of *Eutropis*, distinguished by the following combination of characters: (1) body medium-sized (SVL 64–83 mm in adults); (2) interparietal small, parietals in contact posteriorly; (3) paravertebrals 37–42; (4) sum of subdigital lamellae on all five toes of one foot 80–89; (5) ventral scales rows 25–30; (6) midbody scale rows 28–33; (7) keels on the dorsal and lateral body scales moderately defined, 6–11; (8) lower eyelid scaly; (9) supraciliaries five; (10) prefrontals separated; (11) primary temporal scales one; (12) dorsal and lateral body surfaces with relatively uniform bronze and dark brown coloration, respectively, without pronounced light stripes.

**Comparisons.**—Critical comparisons for *E. borealis* include other Philippine species of *Eutropis*, particularly those known from the northern islands of the archipelago. *Eutropis borealis* can be distinguished from members of the *E. indepressa* complex (including both *E. lapulapu* and *E. cumingi*, with which it occurs sympatrically) by its larger

(adult SVL 64–83 mm), more robust body (vs. 45–70 mm in *E. lapulapu* and 43–60 mm in *E. cumingi*) and fewer subdigital toe lamellae (80–89 in *E. borealis* vs. 70–80 in *E. lapulapu* or 59–70 in *E. cumingi*). *Eutropis borealis* can also be distinguished from *E. cumingi* by fewer vertebral scale rows (37–42 vs. 42–47). It can be distinguished from *E. multifasciata* by its smaller body size (64–83 mm vs. 101–141 mm adult SVL), and more numerous and pronounced (Fig. 8) keels on the trunk dorsals (6–9 vs. 3). *Eutropis borealis* can be readily distinguished from *E. bontocensis* by color pattern, which either lacks lateral stripes or has faint, lateral, light stripes on the anterior portion of the body (compared to two prominent, light stripes on the lateral surface that extend the length of the body). It can also be distinguished from *E. bontocensis* by more strongly keeled dorsal scales (vs. lightly keeled dorsal scales), by a larger number of subdigital toe lamellae (80–89 vs. 67–76), and fewer vertebral scale rows (37–42 vs. 44–50). A phenotypically very similar species (*E. gubataas*) appears to be patchily distributed across Northern Luzon Island and the Babuyan Island Group. It can readily be distinguished from *E. borealis* using genetic data (Fig. 5).

**Coloration in preservative.**—Based on 22 specimens, including holotype. Dorsal ground color dark greenish olive to brown. The dorsal coloration is generally uniform, though some specimens exhibit dark streaks of brown at the margins (KU 306196, 323199, 327366). Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Most specimens exhibit a light stripe extending down the body separating the dorsal surface and the dark brown bands on the lateral surface, though the extent and prominence of this stripe varies (being very distinct in KU 306196, extending down almost the entire length of the body in KU 323210, and nearly nonexistent in KU 304837, 313911). Below the dark bands on the lateral surface, a faint, light stripe extends from the upper labials down the lateral surface of the body, though the length of this stripe varies (extending down the entire length of the body in some cases: KU 306196, 327369; extending just past the axilla in KU 304837, 327366, 327562; and being discontinuous in KU 323223).

Venter grayish tan to bluish, with lighter chin and preloacal region. Some individuals exhibit small, dark flecks on the anterior portion of their lateral (flank) surfaces (KU 306196, 323223). The transition between the lateral and ventral body surfaces possesses a mottled pattern of grayish to bluish coloration interspersed with dark brown. Dorsal surfaces of limbs and digits greenish olive brown, mottled with dark brown spots. The mottling is particularly prominent on the proximal portion of the forelimb. Ventral surfaces of limbs mostly light grayish to blue, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Dorsal ground color continues onto head scales, which are usually uniform, but exhibit dark brown flecks or spots in some cases (KU 306196, 323199). Upper labials dusky brown, lower labials lighter in color, both usually exhibiting dark bars at margins of scales, though this is more common in upper labials (KU 323210).

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, usually with scattered dark brown flecks; head and neck brown. Lateral surfaces with a thick, dark brown band that extends from the eye, past

the hindlimb, becoming thinner and less distinct posteriorly. Chin creamy white with dark markings. Dorsal surfaces of forelimbs, hindlimbs, and digits dark with indistinct spots. Frequently there are traces of light lines above and below the lateral brown stripes.

**Distribution.**—*Eutropis borealis* is known from localities throughout Luzon Island (Brown and Alcala 1980; Brown et al. 2000, 2012, 2013b; Siler et al. 2011; Devan-Song and Brown 2012), as well as Babuyan Claro in the Babuyan Island Group (Oliveros et al. 2011), and Polillo and Catanduanes islands (Ross and Gonzales 1992). *Eutropis borealis* may occur on additional islands in the Babuyan and Batanes islands groups; however, additional survey work is necessary in these incompletely studied, isolated small islands. Populations have also been reported from Lanyu Island, Taiwan (Ota 1991). Closely related, but genetically divergent populations that may represent one or more distinct species are now also known from the biogeographically distinct central Philippine islands of Negros, Panay (Ferner et al. 2001), and Siquijor (Fig. 5). However, we refer them to this species pending further investigation. Presumably this species also occurs on other central Philippine islands within this range (e.g., Romblon Province islands [Sibuyan, Romblon, Tablas], Guimaras, Masbate, Ticao, and Burias islands).

**Habitat and natural history.**—*Eutropis borealis* can be considered a habitat generalist, as it has been collected in a wide variety of habitats across its distribution. It occurs in primary and second-growth, upper, and lowland rainforest from sea level to 1500-m elevation, where it is often one of the most common, diurnally active lizard species at any given locality where it has been recorded. It has also been found in limestone forest and dry, scrub forest on Luzon Island. This species can be found in many types of disturbed habitats including agricultural areas, coconut groves, bamboo forests, selectively logged forests, residential areas, and forest edge habitats. It is a diurnally active species that has been collected on leaf litter on the forest floor, tree trunks, and on branches of small shrubs, as well as on rocks on stream banks. It can also be found basking in disturbed, open areas, and on a variety of ground-cover objects such as coconut husks, fallen logs, or other debris. During the rainy season, this species has been reported to spend a significant amount of time in arboreal microhabitats (Lagat 2011). Several specimens have been collected sleeping under rocks and rotten logs in the forest, inside abaca and banana plant husks or axils, inside tree crevices, and even sleeping exposed on leaf fronds hanging over streams at night. *Eutropis borealis* is oviparous, laying 2–4 eggs, that are apparently sometimes eaten by the congeneric species *Eutropis longicaudata* in Taiwan, where they occur sympatrically (Huang 2006). The diet of this species appears to primarily consist of insects, and has been observed eating butterflies, grasshoppers, and beetles (Lagat 2011). This species can be found sympatrically with at least four other congeners in the Philippines: *E. gubataas*, *E. cumingi*, *E. lapulapu*, and *E. multifasciata*. Its range also encompasses that of *E. bontocensis*; however, the two species have not been collected syntopically, and their ranges may be elevationally segregated (with *E. borealis* generally occurring at lower elevations and *E. bontocensis* occurring at higher elevations).

**Remarks.**—Brown and Alcalá (1980) mistakenly designated CAS 15564 as a paratype of this species (which was originally described as a subspecies). They identified the locality (in error) as Luzon Island; however, the specimen was actually collected near Lake Lanao on Mindanao Island by J.C. Thomson in October 1907 (a locality substantially outside the distribution of *E. borealis*).

*Eutropis lapulapu* sp. nov.

*Mabuya multicarinata*: Taylor 1918:247 [in part, misidentification]

*Mabuya indepressa*: Brown and Alcalá 1980:122 [in part, misidentification].

*Eutropis indepressa*: Mausfeld and Schmitz 2003:164 [misidentification].

*Eutropis* Clade C Barley et al. 2013:3563.

**Holotype.**—Female (PNM 9848, formerly KU 310781), collected by C.D. Siler and C.W. Linkem, 13 October 2007, near Barangay San Rafael at 180 m, Municipality of Taft, Eastern Samar Province, Samar Island, Philippines (11.82924°N, 125.27663°E).

**Paratypes (paratopotypes).**—KU 310340 (collected by RMB 3 October 2007), 310781, 310783 (collected by CDS 13 October 2007), bearing the same locality as the holotype.

**Paratypes.**—Fifteen specimens, all from Philippines. KU 302876, collected by CDS and C.W. Linkem 24 November 2001 at 180 m, Barangay Duyong, Municipality of Pandan, Antique Province, Panay Island (11.76081°N, 122.03974°E). KU 306194, collected by C.W. Linkem and CDS, 24 June 2006, near Barangay Esperanza at 120 m, Municipality of Loreto, Dinagat Islands Province, Dinagat Island (10.3816°N, 125.6168°E). KU 306195, collected by C.W. Linkem, 26 June 2006 at 40 m, Barangay San Juan, Municipality of Loreto, Dinagat Islands Province, Dinagat Island (10.36517°N, 125.56873°E). KU 306200, 306201 (collected by CDS 16 June 2006), KU 306202, 306204, 306205 (collected by C.W. Linkem and CDS 16 June 2006) at 220 m, Taft Forest, Barangay San Rafael, Municipality of Taft, Eastern Samar Province, Samar Island (11.83163°N, 125.28317°E). KU 337443, collected by RMB, 14 June 2014 at 75 m, Kadakan River, Barangay San Rafael, Municipality of Taft, Eastern Samar Province, Samar Island (11.81207°N, 125.2916°E). KU 344246, collected by RMB and J.B. Fernandez, 4 April 2016 at 130 m, Kaantulan River Drainage, Sitio Bangon, Barangay Guinmaayohan, Municipality of Balangiga, Eastern Samar Province, Samar Island (11.2074°N, 125.3672°E). KU 331836, collected by J.B. Fernandez, 11 December 2011 at 400 m, Mt. Lantoy, Municipality of Argao, Cebu Province, Cebu Island (9.901°N, 123.530°E). KU 306197, 306199, collected by C.W. Linkem and CDS, 7 July 2006 at 30 m, Barangay Maangas, Municipality of Presentacion, Camarines del Sur Province, Luzon Island (13.71972°N, 123.66666°E). CAS 27478, collected by L. Alcalá, 9 March 1967, Buhisan Barrio, Cebu City Province, Cebu Island. CAS 24673 collected by D.S. Rabor 31 May 1964, Municipality of Mahaplag, Leyte del Sur Province, Leyte Island.

**Referred specimens.**—Sixteen specimens, all from Philippines. Panay Island, Antique Province, Municipality of Pandan, Barangay Duyong: KU 302874–302875, 305174–305177. Mindanao Island, Agusan del Sur Province,

Municipality of San Francisco, Barangay Kaimpugan, Agusan Marsh: KU 314104. Zamboanga City Province, Municipality of Pasonanca, Pasonanca Natural Park, Barangay Baluno: KU 315006. Barangay Tulosa, Sitio Santa Clara, Cabo Negro Outpost: 321832. Cebu Island, Cebu Province, Municipality of Argao, Mount Lantoy: KU 331836–331838. Samar Island, Samar Province, Municipality of Taft, Barangay San Rafael: KU 306203, 310341, 310782. Luzon Island, Camarines del Sur Province, Municipality of Baao, Barangay La Medalla: KU 306198.

**Diagnosis.**—A species of *Eutropis*, distinguished by the following combination of characters: (1) adult body small to medium-sized (SVL 45–70 mm); (2) interparietal relatively large, separating parietals; (3) paravertebrals 39–45; (4) sum of subdigital lamellae on all five toes of one foot 70–80; (5) ventral scales rows 25–30; (6) midbody scale rows 27–33; (7) keels on the dorsal and lateral body scales moderately defined, 5–9; (8) lower eyelid scaly (9) supraciliaries five or six; (10) prefrontals separated or in contact; (11) primary temporal scales one or two; (12) dorsolateral surface with two faint to moderate light stripes that fade or become broken towards the posterior portion of the body, adult males frequently exhibiting a bright orange coloration on the anterior portion of the body under the chin or suffusing the lateral band (Fig. 6).

**Comparisons.**—Critical comparisons for *Eutropis lapulapu* include other Philippine species of *Eutropis*, particularly those known from the southern islands of the archipelago. *Eutropis lapulapu* can be distinguished from *E. rudis* and *E. multifasciata* by its small (adult SVL 45–70 mm) body size (vs. a larger, more robust body; adult SVL 85–92 mm in *E. rudis* and 101–141 mm in *E. multifasciata*). *Eutropis lapulapu* also has more numerous keels (5–9) on dorsal body scales (vs. only 3 in *E. multifasciata* and *E. rudis*) and the new species can readily be distinguished from *E. rugifera* by having less strongly defined keels of dorsal body scales (vs. more raised and sharply defined in *E. rugifera*) and a broad, dark dorsolateral band (vs. absent in *E. rugifera*). *Eutropis lapulapu* also has a smaller interparietal and parietals not in contact (vs. in contact posteriorly in *E. rugifera*). As a member of the *E. indepressa* complex, *E. lapulapu* can be distinguished from species in the *E. multicarinata* complex (including *E. multicarinata*, *E. cuprea*, *E. borealis*, and *E. caraga*) by its smaller maximum body size, and its tendency to have more prominent, light, dorsolateral striping on the anterior portion of the body and a more mottled dark lateral band, as well as males frequently having a bright orange coloration on the anterior portion of the body (vs. less prominent light striping, a more prominent dark band and no orange coloration; Tables 1 and 2; Figs. 6 and 7). It can also be distinguished from *E. borealis* by having a large interparietal that separates the parietals (vs. a small interparietal with parietals in contact). *Eutropis lapulapu* can be distinguished from *E. cumingi* by usually having more numerous subdigital toe lamellae (70–80 under Toes I–V vs. 59–70 in *E. cumingi*) and generally having more well-developed hindlimbs (0.25–0.30% of SVL vs. 0.18–0.25%).

**Description of holotype.**—A large, gravid female (SVL 58.0 mm); body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.2; forelimb length/SVL = 0.2); tail regenerated; head robust (head

length/SVL = 0.2), longer than wide (head width/head length = 0.7); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supraciliary; frontonasal wider than long, in contact with supranasal, prefrontals, rostral, and anterior loreal; prefrontals in contact, also in contact with anterior and posterior loreals, first and second supraoculars, frontal, frontonasal and first supraciliary; two loreal scales, anterior loreal contacting first and second supralabials; frontal longer than wide, in broad contact with second supraocular; supraoculars four, second largest; supraciliaries five, third supraciliary distinctly elongate; frontoparietals not fused, in contact with second, third, and fourth supraoculars; interparietal large, separating parietals; head scales embossed; one pair of enlarged nuchals; eye relatively large, diameter 25.0% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; supralabials six, fifth elongate (from anterior to posterior), beneath center of eye; primary temporals two; enlarged pretemporals six, primary and upper secondary in contact with parietal; six infralabials; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 29.0% of eye diameter; body elongate, with 42 paravertebrals, midbody scale rows 31; dorsal and lateral scales with 8–9 keels, ventral scale rows 29, smooth; tail elongate, but regenerating, 0.8× body length; all limbs pentadactyl, forelimbs smaller than hindlimbs; forelimb scales smaller than body scales, keeled; relative finger length with subdigital lamellae in parentheses (L/R): IV(19/16) = III(16/16) > II(12/13) > V(11/11) > I(8/7); hindlimbs moderate (hindlimb length/axilla–groin distance = 0.5), scales smaller than body scales, keeled; relative toe length with lamellae (L/R) in parentheses: IV(24/24) > III(19/19) > V(15/15) > II(11/13) > I(8/9).

**Measurements of holotype (in mm).**—SVL 58.0; tail length 44.7; axilla–groin distance 26.1; hindlimb length 14.1; forelimb length 12.1; snout–forelimb length 12.0; head length 12.4; head width 9.0; interorbital distance 6.2; internarial distance 2.7; eye diameter 3.1; auricular opening diameter 0.9.

**Coloration in preservative.**—The following color description was written in 2013, following 6 yr of storage in 70% ethanol. Dorsal ground color nearly solid dark greenish olive to brown, though some dark streaks of brown mark the margins of some scales. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin. Two light stripes extending from behind the head, down the body halfway between the axilla and groin separate the dorsal surface and the dark brown bands on the lateral surface. Venter grayish tan to bluish, with lighter chin and preloacals. Margins of ventral scales dark, gray, with central portions light tan. On lower lateral surfaces of body, ventral coloration becomes mottled with streaks of dark brown; a prominent, light stripe from the upper labials

extends down the lateral surface of the body, below the ear, to the groin.

Dorsal surfaces of limbs and digits greenish olive brown, mottled with dark brown spots. Ventral surfaces of limbs mostly light grayish to blue, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Head scales uniformly greenish olive brown, as in the dorsal ground color. Upper labials mostly tan to ivory, though the upper edge of some scales exhibits a dark brown color. Lower labials also tan to ivory, with dark bars on the posterior labials.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, with scattered dark brown flecks or lines; head and neck brown. Lateral surfaces contain a thick, dark brown band that extends from the eye to the hindlimb, sometimes suffused with orange in adult males. Venter a light creamish to green, with few dark markings. Chin creamy white with dark flecks. Dorsal surfaces of forelimbs, hindlimbs, and digits dark with indistinct spots. A faint, light line occurs above the lateral brown stripes, being most distinct above the forelimb. A more distinct light line extends from the labial scales to the hindlimb below the dark lateral stripe and above a series of scales that have a mottled brown-white coloration.

**Variation.**—*Eutropis lapulapu* varies in numbers of subdigital toe lamellae (Toe I 8–9 [8 ± 1], Toe II 13–14 [13 ± 1], Toe III 17–19 [18 ± 1], Toe IV 20–24 [22 ± 2], and Toe V 14–15 [14 ± 1]). Both the supralabials and infralabials vary slightly (6 or 7), as do supraciliaries (5 or 6), ventrals (25–30 [27 ± 1]), paravertebrals (39–45 [41 ± 2]), midbody scale rows (27–33 [31 ± 2]), and the number of scales that line the lower eyelid (16–19 [17 ± 1]). Numbers of keels per dorsal body scale ranges both within and among individuals (5–9). Prefrontals are usually separated (KU 302875, 302876, 306204, 331836), but occasionally in contact (KU 306201), enlarged/differentiated primary temporals vary between one (KU 310340) or two (KU 306194, 306200, 306201, 310783) and pretemporals vary between six (KU 306194, 310781) and seven (KU 306204). The anterior loreal scale either contacts the first two (KU 305177, 310781) or three supralabials (KU 310340). Dorsal color pattern varies in the amount of dark streaking and blotches present (more extensive in KU 202875, 331836 vs. reduced in KU 306200, 306204). The ventral surface of most individuals is relatively uniform, though some individuals have several small dark flecks dispersed randomly (KU 306200, 331836, 331837). The thick dark stripe on the lateral surface of the body varies in color from nearly solid brown (KU 310340) to extensively mottled throughout (KU 302876, 306200). The light stripe above the dorsolateral band varies from faint and short (KU 310340, 310783) to bright and long (KU 306200, 306202). The stripe below the dorsolateral band also varies from short (KU 302876) to long (KU 306201). Some individuals exhibit dark spots on the head scales (KU 306200, 306205).

**Distribution.**—*Eutropis lapulapu* appears to be distributed throughout the islands of the central and southern Philippines, and is known from the Bicol Peninsula on Luzon island, localities throughout Mindanao island, as well as Samar, Dinagat, Panay, and Cebu islands.



**Habitat and natural history.**—*Eutropis lapulapu* can be found in primary and second-growth forest throughout its range, and in peat swamp forest on Mindanao Island. It appears to tolerate disturbance well, as it has been found in agricultural and residential areas, as well as coconut palm plantations. It is a diurnally active species that can be found under logs, on stream banks, and on the forest floor, as well as in open areas near forest from sea level to 800 m. This species can potentially be found sympatrically with seven other species of *Eutropis*, but only one (*E. multifasciata*) is sympatric throughout its range. *Eutropis lapulapu* occurs sympatrically with *E. multicarinata* in northeastern Mindanao and on Dinagat, Siargao, Samar, and Leyte, with *E. caraga* throughout Mindanao, Dinagat, Siargao, Samar, and Bohol, with *E. borealis* in the West Visayan Islands and the Bicol Peninsula (Luzon), and with *E. rugifera* on the western tip of Zamboanga Peninsula (Mindanao). It also likely occurs sympatrically with *E. englei* and *E. cuprea* in southwestern Mindanao. A morphologically similar species (*E. sibalom*, described here) also occurs in western Panay; however, the ranges of these two distinct genetic lineages are not well understood on Panay Island, as only a single population of each has been sequenced to confirm its genetic identity. *Eutropis lapulapu* is known from a population in the Municipality of Pandan in the extreme northwest portion of the island, whereas *E. sibalom* is known only from southern Panay (Municipality of San Remigio and Municipality of Sibalom).

**Etymology.**—We are pleased to name this species in honor of the Philippine National Hero, Lapu-Lapu, who is considered to be the first Filipino native to have resisted Spanish colonization. Lapu-Lapu was a ruler on the island of Mactan in the Visayas, where this species is known to occur. Suggested common name: Lapu-lapu's Sun Skinks.

*Eutropis sahulinghanganan* sp. nov.

*Mabuya multicarinata*: Taylor 1922:156 [in part, misidentification].

*Mabuya indepressa*: Brown and Alcalá 1980:122 [in part, misidentification].

*Eutropis indepressa*: Mausfeld and Schmitz 2003:164 [by implication].

*Eutropis* Clade D Barley et al. 2013:3563.

**Holotype.**—Female (PNM 9867, formerly KU 311407), collected by E.L. Rico, J.B. Fernandez, and R.M. Brown, 13 July 2007 on Mount Bintangor at 1070 m, Municipality of Rizal, Palawan Province, Palawan Island, Philippines (8.81306°N, 117.64305°E).

**Paratypes.**—Eleven specimens, all from Palawan Province, Palawan Island, Philippines. KU 311449, collected by RMB, 31 March 2007, at the boundary between Barangay Samarinana and Saubg on Mount Mantalingahan at 800 m (area “Pitang”), Municipality of Brooke's Point (8.7503°N, 117.6896°E). KU 311406, collected by E.L. Rico, J.B. Fernandez, and RMB, 24 June 2007, on Mount Mantalingahan at 1490 m (Peak 2), Municipality of Rizal (8.81250°N, 117.66083°E). CAS-SUR 28729, collected by M. Pinero, 29 March 1961 at 100 ft, Site 437: 5 km SE camp Malatgaw on bank of Malatgaw River, Municipality of Puerto Princesa. CAS-SUR 28731, collected by A.C. Alcalá, 13 April 1961 at 300 ft, Site 483: 1 km SE Camp 2, Malakdaw, Municipality of

Puerto Princesa. CAS-SUR 28732 (collected by M. Pinero and S. Magusara, 6 April 1961), 28733 (collected by E. Dujon, 9 April 1961), 28734 (collected by S. Magusara, 9 April 1961), Site 465 near Camp 2 at 300 ft, Municipality of Puerto Princesa. CAS-SUR 28735, collected by L.C. Alcalá, 13 April 1961 at 400 ft, Site 484, 1 km NW Camp 2 Malatgaw, Municipality of Puerto Princesa. CAS 157302, collected by A. Alcalá and J. Vindum, 16 June 1984, Tagnipa, Tinitian Barrio, Municipality of Roxas. CAS-SUR 28678, collected by Q. Alcalá, 29 March 1961, 1.5 km south of Camp 1, southern slope of Thumb Peak, Malatgaw River, Municipality of Puerto Princesa. CAS-SUR 28637, collected by Q. Alcalá at 400 ft, Site 480, 2 km northwest of camp Malatgaw No. 2, Municipality of Puerto Princesa. CAS 157417, collected by A. Alcalá and J. Vindum at sea level, near Puerto Princesa Airport, Municipality of Puerto Princesa.

**Referred specimens.**—Six specimens, all from Philippines. Palawan Island, Palawan Province, Municipality of Puerto Princesa: CAS-SUR 28633–28635, 28639, 28730, 28736.

**Diagnosis.**—A species of *Eutropis* distinguished by the following combination of characters: (1) adult body size small (SVL 40–63 mm); (2) interparietal large, separating parietals; (3) paravertebrals 38–42; (4) sum of subdigital lamellae on all five toes of one foot 63–77; (5) ventral scale rows 26–30; (6) midbody scale rows 28–33; (7) keels on dorsal and lateral body scales moderately defined, 5–10; (8) lower eyelid scaly; (9) supraciliaries five or six; (10) prefrontals separated; (11) primary temporal scales two; (12) dorsolateral surface with two faint to moderate light stripes that fade or become broken towards the posterior portion of the body, adult males frequently with a bright orange coloration on the ventral portion of the head and/or suffusing the lateral band (Fig. 6).

**Comparisons.**—Critical comparisons for *Eutropis sahulinghanganan* include other Philippine species of *Eutropis*, particularly those known from the western portion of the archipelago. *Eutropis sahulinghanganan* can be distinguished from *E. multifasciata* by its small body size and more numerous keels on the trunk dorsals (adult SVL 40–63 mm with 5–10 keels on dorsal scales in *E. sahulinghanganan* vs. adult SVL 101–141 mm with 3 keels on dorsal scales in *E. multifasciata*). The new species can be distinguished from *E. islamaliit* by its smaller adult body size and fewer total subdigital toe lamellae (adult SVL 40–63 mm with 63–77 total subdigital lamellae in *E. sahulinghanganan* vs. adult SVL 70–97 with 86–92 lamellae in *E. islamaliit*). As originally noted by Brown and Alcalá (1980:123), *E. sahulinghanganan* (at the time referred to as the Palawan populations of *E. indepressa*) exhibits a “somewhat lower number of vertebral scale rows between the parietals and base of the tail” than *E. indepressa*. This trait is not diagnostic, as the range of values for this scalation character in each species overlap, though the trait means are significantly different.

**Description of holotype.**—A large female (SVL 62.9 mm); body robust (axilla–groin distance/SVL = 0.5); limbs well developed (hindlimb length/SVL = 0.2; forelimb length/SVL = 0.2); tail recently broken, not regenerated; head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.9); snout tapered, rounded at tip;

rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated, contacting anterior and posterior loreals, first and second supraoculars, frontal, frontonasal, and first supraciliary; two loreal scales, the anterior loreal in contact with the first three supralabials; frontal longer than wide, in broad contact with second supraocular; supraoculars four, second largest; supraciliaries six, third supraciliary distinctly elongate; frontoparietals not fused, in contact with second, third, and fourth supraoculars; scales on posterior of head missing due to damage; head scales embossed; eye relatively large, diameter 28.4% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; supralabials six, fifth elongate (from anterior to posterior), beneath center of eye; infralabials six; primary temporals two; enlarged pretemporals seven, primary and upper secondary in contact with parietal; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 37.3% of eye diameter; body elongate, paravertebrals 43, midbody scale rows 33, ventral scale rows 28; dorsal and lateral scales with 7–8 keels, ventral scales smooth; tail elongate, recently severed; limbs pentadactyl, forelimbs smaller than hindlimbs; limb scales smaller than body scales, keeled; relative finger lengths with subdigital lamellae in parentheses (L/R): IV(19/19) = III(17/17) > II(12/13) > V(12/11) > I (7/8); hindlimbs moderate (hindlimb-length/axilla–groin distance = 0.6); relative toe length with lamellae (L/R) in parentheses: IV(23/23) > III(19/18) > V(15/15) > II(13/13) > I(8/8).

**Measurements of holotype (in mm).**—SVL 62.9; axilla–groin distance 29.3; hindlimb length 14.4; forelimb length 13.0; snout–forelimb length 22.2; head length 11.8; head width 10.5; interorbital distance 6.2; internarial distance 3.5; eye diameter 3.4; auricular opening diameter 1.3.

**Coloration in preservative.**—The following color description was written in 2018 following 11 yr of storage in 70% ethanol. Dorsal ground color dark greenish olive to brown, with several dark brown streaks on the anterior and posterior portion of the dorsum at the edges of several scale rows. Additionally, the anterolateral edges of the dorsum have a light stripe that progressively fades posteriorly. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin, with the anterior portion being darkest, gradually becoming lighter on the posterior portion of the body. Venter grayish tan to bluish, with regions near the chin, anterior limbs, and precloacals lighter. Margins of ventral scales dark, gray, with central portions light tan. Several dark flecks randomly dispersed on the chin.

On lateral surfaces of body, ventral coloration intergrades into dark brown rather abruptly on the anterior portion of the body and more gradually on the posterior portion, with a

broken dark brown streak on the axilla–groin region. Dorsal surfaces of limbs and digits greenish olive brown with dark brown streaks. Ventral surfaces of limbs tan to ivory, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown, palmar surface of manus and plantar surface of pes tan to ivory. Head scales greenish olive brown, as in the dorsal ground color, with several dark brown flecks. Upper portion of supralabials dark brown, fading to light gray to bluish on lower portion, lower labials also gray to bluish with edges of several labial scales highlighted by dark brown coloration. Lower eyelid scales and supraciliaries are tan to light gray in color; upper eyelid scales are dark brown, as are the upper portions of the lower preoculars and fifth supralabial, which extend the coloration of the dark lateral band to the nasal scale, with the coloration fading as it approaches the snout.

**Coloration in life.**—Dorsal ground coloration and tail an iridescent bronze to olive coloration, with extensive dark brown flecks throughout; head and neck brown, with fewer dark flecks. The lateral surfaces contain a dark brown band that is randomly broken with light spots and extends from the eye to the hindlimb. The lateral band is sometimes suffused with orange anteriorly in adult males. Chin is creamy white with few dark markings, or bright orange in some adult males (Fig. 6). Dorsal surfaces of forelimbs, hindlimbs, and digits dark with indistinct spots. Frequently there are traces of light lines above and below the lateral brown stripes.

**Variation.**—*Eutropis sahulinghanganan* varies in the number of subdigital lamellae beneath the toes (Toe I 7–9 [8 ± 1], Toe II 10–13 [11 ± 1], Toe III 15–19 [17 ± 1], Toe IV 20–23 [21 ± 2], and Toe V 10–15 [13 ± 1]) and Finger III subdigital lamellae (13–17 [15 ± 1]). The infralabials vary (6 or 7), as do the supraciliaries (5 or 6), the number of ventrals (26–30 [28 ± 1]), paravertebrals (38–42 [40 ± 1]), midbody scale rows (28–33 [30 ± 1]), and the number of scales lining the lower eyelid (17–22 [20 ± 2]). The number of keels on the dorsal scales is also highly variable, both within and among individuals (5–10). The number of enlarged pretemporals varies between five (CAS-SUR 28635), six (CAS-SUR 28639, 28733, CAS 157417), and seven (KU 311407). In most specimens, the nasal scale contacts the first and second supralabial (CAS-SUR 28735, CAS 157302), unlike in the holotype where it only contacts the first supralabial. The anterior loreal scale contacts the first and second supralabial in some individuals (CAS 157147, CAS-SUR 28733), the first three supralabials in others (KU 311407), or sometimes only the second supralabial (CAS-SUR 28735, KU 311449). Additionally, dorsal color pattern varies slightly in the degree of dark brown streaking/flecking present, being extensive throughout the dorsum and having a continuous middorsal line (CAS-SUR 28735) or nearly absent (KU 311407, 311449). The amount of dark flecking on the labial scales varies, being prominent in some individuals (KU 311407) and nearly absent in others (CAS-SUR 28733, 28735).

**Distribution.**—*Eutropis sahulinghanganan* is only known from Palawan Island of the western Philippines.

**Habitat and natural history.**—*Eutropis sahulinghanganan* is known from primary and second-growth forests from sea level to 1500 m. This species is also reported to be associated with mangrove forests near Puerto Princesa (Dangan-Galon et al. 2015) and can be found sympatrically

with at least one other species of *Eutropis* (*E. multifasciata*). It seems likely that an *E. multicarinata* complex species eventually will be discovered on Palawan (such as *E. islamaliit* or *E. borealis*); however, to date, no specimens appear to have ever been collected, despite extensive surveys. An adult individual with a bifurcated (presumably regenerated) tail is reported from near Barangay Villa Libertad, Palawan (Sy and Dalabajan 2018).

**Etymology.**—The specific epithet is in reference to the fact that Palawan is often referred to as “the last ecological frontier” of the Philippines. The name is an adjectival derivation from the Tagalog adjective *huling* (meaning last) and noun *hanguanan* (meaning frontier), and thus directly translates to “*Eutropis* from the last frontier.” Suggested common name: Palawan Sun Skinks.

*Eutropis sibalom* sp. nov.

*Eutropis* Clade B Barley et al. 2013:3563.

**Holotype.**—Juvenile (PNM 9869, formerly KU 306811), collected by R.M. Brown, 11 October 2006 at 340 m, near Barangay Aningalan, Municipality of San Remigio, Antique Province, Panay Island, Philippines (10.8088°N, 122.1013°E).

**Paratypes (paratopotypes).**—KU 306810 collected by RMB, 8 October 2006, bearing the same locality data as the holotype.

**Diagnosis.**—A species of *Eutropis* distinguished by the following combination of characters: (1) subadult body size small (SVL 40–48 mm); (2) paravertebrals 39–44; (3) sum of subdigital lamellae on all five toes of one foot 71–72; (4) ventral scale rows 28; (5) midbody scale rows 34; (6) keels on dorsal and lateral body scales moderately defined, 3–5; (7) lower eyelid scaly; (8) supraciliaries five; (9) prefrontals separated; (10) primary temporals two; (11) dorsolateral surface with two faint to moderate light stripes that fade or become broken towards the posterior portion of the body.

**Comparisons.**—Critical comparisons for *E. sibalom* include other Philippine species of *Eutropis*, particularly those known from western portions of the archipelago. Unfortunately, because this species is only known from two subadult specimens, we are unable to assess variation for comparisons to other species confidently. Genetic data clearly show it is part of the *E. indeprensa* complex, which suggests that adults likely have smaller, less robust body sizes than *E. borealis* and *E. multifasciata* (and is consistent with the small body sizes of these two subadult specimens). It also appears to have a smaller number of total toe lamellae than *E. borealis*. Both specimens have low numbers of keels on dorsal scales (3 and 3–5) compared to other *E. indeprensa* complex species (which would distinguish it from *E. lapulapu*); however, this is presumably just a function of their small size. Juvenile specimens of other species frequently have lower numbers of keels on dorsals than do adults of the same species (AJB, personal observation). There are no other obvious morphological characteristics of these specimens that clearly distinguish *E. sibalom* from other species of *Eutropis* in the *E. indeprensa* complex despite the fact that it is highly genetically divergent from all the other species; future systematic research with additional specimens would be valuable for characterizing the morphology of this species.

**Description of holotype.**—A relatively small specimen (SVL 40.86 mm); body robust (axilla–groin distance/SVL = 0.4); limbs well developed (hindlimb length/SVL = 0.3; forelimb length/SVL = 0.2); tail long (SVL/tail length = 0.6); head robust (head length/SVL = 0.2), longer than wide (head width/head length = 0.8); snout tapered, rounded at tip; rostral broader than high, in contact with frontonasal, nasals, and first supralabial; frontonasal wider than long, in contact with supranasals, frontal, prefrontals, rostral, and anterior loreal; prefrontals separated, contacting anterior and posterior loreals, first and second supraocular, frontal, frontonasal and first supraciliary; frontal longer than wide, in broad contact with second supraocular; supraoculars four, second largest; supraciliaries five, third supraciliary distinctly elongate; frontoparietals not fused, in contact with second, third, and fourth supraoculars; scales on posterior of head missing because of damage; head scales embossed; eye relatively large, diameter 28.3% of head length; nasal pierced in center by narial opening, surrounded anteriorly by rostral, posteriorly by anterior loreal, dorsally by supranasal, and ventrally by first supralabial; supranasals long and narrow, not in contact at midline; supralabials six, fifth elongate (from anterior to posterior), beneath center of eye; infralabials six; primary temporals two; enlarged pretemporals seven; mental wider than long; postmental wider than long, in contact with first infralabial and partially contacting second infralabial; enlarged chin shields in three pairs, first pair in contact medially, second pair separated by a single median scale, and third pair separated by three scales medially; third pair of chin shields separated from infralabial row by a single scale row; lower eyelid scaly; tympanum moderately sunk, without lobules on margins of auricular opening; auricular opening 49.8% of eye diameter; body elongate, paravertebrals 39, midbody scale rows 34, ventral scale rows 28; dorsal and lateral scales with three keels, ventral scales smooth; tail elongate, 1.7 × body length; limbs pentadactyl, forelimbs smaller than hindlimbs; limb scales smaller than body scales, keeled; relative finger lengths with subdigital lamellae in parentheses (L/R): IV(15/16) = III(14/14) > II(11/–) > V(9/10) > I (7/7); hindlimbs moderate (hindlimb length/axilla–groin distance = 0.6); relative toe length with lamellae (L/R) in parentheses: IV(21/20) > III(17/17) > V(15/15) > II(9/11) > I(9/8).

**Measurements of holotype (in mm).**—SVL 40.9; tail length 68.2; axilla–groin distance 17.8; hindlimb length 11.7; forelimb length 8.8; snout–forelimb length 15.8; head length 9.6; head width 7.4; interorbital distance 5.4; internarial distance 2.7; eye diameter 2.7; auricular opening diameter 1.4.

**Coloration in preservative.**—The following color description was written in 2018 following 12 yr of storage in 70% ethanol. Dorsal ground color relatively uniform, dark greenish olive to brown. Thick, dark brown, longitudinal bands extend down lateral surfaces of body from posterior of eye to groin, with the anterior portion being darkest, and gradually becoming lighter and thinner on the posterior portion of the body. Two light stripes extending from behind the head down the body, just past the insertion of the forelimbs, separate the dorsal surface and the dark brown bands on the lateral surfaces. Venter grayish tan to bluish, with lighter chin and preloacals. Margins of ventral scales dark gray, with central portions light tan. On the anterior

portion of the lower lateral surfaces of body, ventral coloration becomes mottled with streaks of dark brown, until a prominent, light stripe from the upper labials extends down the lateral surface of the body to the insertion of the forelimb. On the posterior portion of the lower lateral surface, the transition from the ventral coloration to the dark brown coloration is more gradual.

Dorsal surfaces of limbs and digits greenish olive brown with several dark brown spots. Ventral surfaces of limbs grayish tan to blue proximally and brownish tan distally, intergrading with dark brown coloration on lateral surfaces. Ventral surfaces of digits dark brown to dark gray, palmar surface of manus and plantar surface of pes tan to ivory. Head scales greenish olive brown, slightly lighter than the dorsal ground color. Upper portion of supralabials dark brown, tan to ivory on lower portion, lower labials ivory with dark brown flecks becoming common on posterior labial scales. Lower eyelid scales are tan to light gray in color; upper eyelid scales are tan to dark brown, as are the upper portions of the lower preoculars and fifth supralabial.

**Coloration in life.**—Remains unrecorded, but in our experience, *Eutropis* coloration in preservative is usually quite similar to that in life, with only minor fading, reduction in brilliance and stark contrasts of light and dark adjacent color features, and loss of vibrant reds, blues, and yellows.

**Distribution.**—This species is only known from southwestern Panay Island in the Philippines. In addition to the specimens collected from near San Remigio, this species has been collected nearby in Sibalom (see Barley et al. 2013); however, corresponding specimens (originally deposited at PNM) may have been subsequently lost.

**Habitat and natural history.**—The few specimens that exist for this species were found on the forest floor in second-growth forest. Several other species of *Eutropis* are known to occur sympatrically, including *E. multifasciata* and *E. borealis*. *Eutropis lapulapu* also occurs on Panay Island, and future studies characterizing the ranges of the two species, and any potential contact zones, on the island would be valuable.

**Etymology.**—We derive the new species' specific epithet (used as a noun in apposition) from Sibalom Natural Park (from where this species is known) of southwestern Panay, which is one of the last lowland rainforest habitats left on Panay. The name is feminine in gender. Suggested common name: Sibalom Sun Skinks.

#### DISCUSSION

Philippine *Eutropis* are a taxonomically challenging group, representing the more complex and difficult end of the species-delimitation spectrum (Barley et al. 2013), primarily because morphological differentiation does not always appear to accompany speciation. This phenomenon has been increasingly observed as molecular data have become available for additional taxonomic groups across the tree of life (e.g., Highton 2000; Jörger and Schrödl 2013). Although there are extensive opportunities for geographic isolation in island archipelagos like the Philippines, the extensive sympatry among Philippine *Eutropis* is striking (see Czekanski-Moir and Rundell 2019 for a more extensive discussion of this in other systems). Many of the divergent evolutionary lineages we have identified exhibit intraspecific

variation in scalation trait ranges that closely abut or overlap, rendering the identification of diagnostic character differences problematic. This might be the result of a combination of factors. First, Philippine *Eutropis* have not diversified ecologically, and thus, these lineages may not have been subjected to selection for divergence in phenotypic trait values. Rather, selection could be maintaining similar trait values across species due to their ecological similarity. Second, the Philippine species appear to have arisen relatively recently, particularly in comparison to other Asian species of *Eutropis* (Barley et al. 2015). Given that most species are relatively common and abundant, they also likely have large population sizes, and thus, trait values among species may not have had sufficient time to diverge via drift.

Variation in the degree to which morphological and molecular divergence co-occur renders sole reliance on morphological data to delimit species problematic, which has previously been recognized in other groups of scincid lizards (Austin 1995; Bruna et al. 1996). This challenge highlights the necessity of identifying whether phylogenetically diagnosed clades are truly genetically isolated, given that this is the primary criterion for identifying independently evolving metapopulation lineages in such circumstances. Although coalescent approaches to species delimitation have been promoted as a means to fill this gap, the extent to which they accurately identify species is still poorly understood (and previous work suggests one of the most commonly used models exhibits poor fit to the *Eutropis* data set used here; Barley et al. 2018). However, increased attention directed towards identifying processes responsible for genetic differentiation in cryptic species complexes may provide additional insights into the evolutionary status of these lineages, and the manner by which taxonomic hypotheses should be evaluated in these systems. For example, scincid lizards are known to have well-developed chemosensory systems, and pheromones are known to be important to mate choice in some species (Cooper and Vitt 1986). The extent to which divergence in chemosensory reception may contribute to sexual selection and speciation in *Eutropis* is unknown but represents an intriguing subject for future research.

Several taxonomic ambiguities persist in Philippine *Eutropis* and these represent challenges for future studies. Additional research should focus on addressing the following in order to clarify the taxonomic status of several populations. Genetic data have yet to be obtained for the enigmatic Mindanao endemic, *E. englei*, although several lines of evidence suggest it likely represents a distinct species. It possesses a highly distinctive phenotype unlike other species in the southern Philippines (notably, a contrasting series of stripes down the dorsum; Fig. 3). *Eutropis englei* also exhibits a unique habitat preference, apparently restricted to coastal habitats and open areas along river mouths (Taylor 1925). Determining the phylogenetic affinities of *E. englei* remains an intriguing question (Taylor 1922 related and compared the species to *E. rugifera*, whereas Brown and Alcalá 1980 considered it related to *E. multicaerinata*). Future field-based surveys targeting *E. islamaliit*, *E. cuprea*, and *E. sibalom* would be useful so that the morphology and geographic distributions of these species can be better characterized.

Future taxonomic investigation should also focus on obtaining additional geographic and genetic sampling to

determine if several of the morphologically cryptic, divergent genetic groups identified by Barley et al. (2013) are likely on separate evolutionary trajectories or reproductively isolated (e.g., lacking gene flow with congeners). *Eutropis borealis* populations in West Visayan islands may warrant taxonomic recognition; individuals from Negros, Panay, and Siquijor are somewhat genetically distinct from each other, and from northern Philippines populations (at both mitochondrial and nuclear loci). However, our sampling also contains substantial geographic gaps in the intervening regions; surveys targeting these islands (e.g., Mindoro, Sibuyan, Masbate, Cebu) will be particularly valuable for characterizing the ranges of any potentially distinct lineages. Populations of *E. caraga* from Mindanao, Bohol, and Samar are somewhat genetically divergent from populations on Dinagat and Siargao (Barley et al. 2013; although this result appears to be driven primarily by the mitochondrial data; Fig. 5), and thus warrant further study. Finally, populations of *E. cumingi* from the Cordillera Mountains on Luzon might represent an intriguing case of recent or ongoing intrasland speciation. Genetic data indicate some divergence between populations in the Cordillera Mountains and those from the rest of northern Luzon. In fact, our mtDNA gene tree suggests that the Mindoro populations of *E. indeprensa* are more closely related to type locality *E. cumingi* (Zambales Province, Luzon Island) than the Cordillera Mountain populations are (Barley et al. 2013:Fig. 2). However, the nuclear data suggest the Cordillera Mountain populations are sister to type locality *E. cumingi*, and coalescent species delimitation analyses found weak support for the distinctiveness of these populations (Barley et al. 2013). Intervening geographic sampling would allow a test of whether any of these observed genetic divergences are geography based (isolation by distance), or due to one or more speciation events. Collection of genomic data to obtain gene flow and/or divergence time estimates will be important to determining the extent of genetic isolation among these less divergent, population groups. Though of course, even with robust estimates of evolutionary and demographic history, species boundaries can still be challenging to identify because of the (largely) continuous nature of the speciation process, particularly when species divergences are shallow (Petren et al. 2005; Shaffer and Thomson 2007). Additional collecting efforts combined with novel statistical approaches (e.g., Ezard et al. 2010; Zapata and Jiménez 2012) may be effective in helping to better characterize phenotypic distributions of quantitative traits in cryptic species; however, field identification of individual specimens will likely remain challenging where trait distributions overlap.

#### CONCLUSIONS

Although taxonomy and species identification within Philippine *Eutropis* (and the genus in general) will continue to present challenges, this work takes a major step towards the development of a biologically meaningful framework for understanding species diversity in this unique evolutionary radiation. Additional systematic work on this system will continue to improve our overall understanding of vertebrate diversification and biogeography of terrestrial communities in the Philippines (Brown et al. 2013a), but also has important conservation implications. Understanding species

diversity in this commonly encountered group of conspicuous, highly abundant, and near-ubiquitous lizards (found in the majority of the archipelago's habitats) will allow for the incorporation of this information into evolutionarily informed and biologically appropriate conservation and management efforts. This goal has been virtually impossible until now.

In some cases (as in many radiations of cryptic/taxonomically challenging species), field identification will remain problematic due to highly conserved external morphology, however, the use of a species' geographic ranges, in combination with what is known of their morphological variation, will allow for reliable species identification in many scenarios (e.g., Sanguila et al. 2011). Novel information on the ecology and fine-scale geographic distributions of these new species relies entirely on continued faunistic biodiversity survey work, and the collection of voucher specimens and corresponding genetic samples. Future ecological studies (that integrate genetic information) could potentially provide additional data for distinguishing sympatric species (e.g., microhabitat preferences, elevational zonation, behavioral differences, etc.), and are grounds for future inquiry.

#### KEY TO PHILIPPINE *EUTROPIS*

- 1a. Dorsal keels on trunk scales 3, adult body size large (76–141 mm) ..... 2
- 1b. Dorsal keels on trunk scales > 3, adult body size small to medium (40–89 mm) ..... 3
- 2a. Head scales smooth, keels on the trunk dorsals weak, prefrontals in contact ..... *E. multifasciata*
- 2b. Head scales embossed posteriorly, keels on the trunk dorsals strong, prefrontals separate, southwestern Philippines ..... *E. rudis*
- 3a. Broad, dark lateral bands absent, sharply defined keels on the trunk dorsals, southwestern Philippines ..... *E. rugifera*
- 3b. Broad, dark lateral bands present, dorsal keels moderately defined ..... 4
- 4a. Highly distinct dorsal or lateral stripes extending the length of the body present ..... 5
- 4b. Distinct dorsal or lateral stripes not present or faint ... 6
- 5a. Five dark brownish to black dorsal stripes, Mindanao Island ..... *E. englei*
- 5b. Two prominent, light stripes on lateral surface, Luzon, Babuyan, or Batanes Islands ..... *E. bontocensis*
- 6a. Adult body size medium (60–89 mm), robust, dorso-lateral striping usually limited and faint to absent, adult males without bright orange coloration on chin or anterior lateral surface ..... 7
- 6b. Adult body size small (43–69 mm), slender, dorso-lateral striping usually faint, but more extensive, adult males frequently with bright orange coloration on the anterior portion of the body ..... 12
- 7a. Interparietal large, parietals separate, southern Philippines ..... 8
- 7b. Interparietal small, parietals in contact, northern/central Philippines/Borneo ..... 10
- 8a. Single primary temporal scale, southwestern Mindanao ..... *E. cuprea*

- 8b. Two primary temporal scales, Mindanao, Samar, Leyte, Bohol, Dinagat, Siargao ..... 9
- 9a. Total number of toe lamellae 74–80, Mindanao, Samar, Leyte, Dinagat.....*E. multicarinata*
- 9b. Total number of toe lamellae 80–91, Siargao, Dinagat, Mindanao, Bohol, Samar ..... *E. caraga*
- 10a. Lateral band sharply defined below, lacking dark, mottled coloration, and highlighted by a striking, crisp transition to light, ventral coloration. Lubang, Semirara, Borneo, Samar..... *E. islamaliit*
- 10b. Mottled coloration present below dark lateral band, causing a more gradual transition to the light ventral coloration, northern/central Philippines ..... 11
- 11a. One or two primary temporal scales, Northern Luzon, Babuyan Islands .....*E. gubataas*
- 11b. One primary temporal scale, Luzon, Babuyan Islands, Polillo, Catanduanes, Negros, Panay, Siquijor ..... *E. borealis*
- 12a. Northern Luzon or Lubang, total number of toe lamellae generally smaller (59–70), hindlimb length/SVL ratio generally smaller (<0.45) .....*E. cumingi*
- 12b. Central or southern Philippines (including Bicol Peninsula), total number of toe lamellae generally larger (>63), hindlimb length/SVL ratio generally larger (>0.45) ..... 13
- 13a. Palawan Island, vertebral scale rows (38–42) and total number of toe lamellae (63–77) generally lower .....*E. sahulinghanganan*
- 13b. Central or southern Philippines, vertebral scale rows (39–47) and total number of toe lamellae (70–83) generally higher ..... 14
- 14a. Mindoro island or Borneo, vertebral scale rows (41–47), ventral scale rows (28–31), and midbody scale rows (30–33) generally higher..... *E. indepressa*
- 14b. Central or southern Philippines, vertebral scale rows (39–45), ventral scale rows (25–30), and midbody scale rows (27–33) generally lower..... 15
- 15a. SW Panay island, number of keels on the trunk dorsals in subadults low (3–5) .....*E. sibalom*
- 15b. Central or southern Philippines (including NW Panay), number of keels on the trunk dorsals in adults generally high (5–9) .....*E. lapulapu*

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## APPENDIX

### Specimens Examined

All specimens from the Philippines.

***Eutropis bontocensis***.—BATAN ISLAND: BATANES PROVINCE: Municipality of Basco, Barangay San Antonia, Sitio Chadpidan (KU 314025); CALAYAN ISLAND: CAGAYAN PROVINCE: Municipality of Calayan: Barangay Magsidel (KU 304873–74, 304878, 304881–304883, 304886–304890–92); SABTANG ISLAND: BATANES PROVINCE: Municipality of Sabtang: Barangay Chavayan (KU 314026–314030–32); LUZON ISLAND: MOUNTAIN PROVINCE: Municipality of Bontoc (KU 335111–13, 335121–23); Municipality of Sabangan (CAS 61344 [paratype]); BENGUET PROVINCE: Municipality of Baguio (CAS 61327 [paratype]).

***Eutropis borealis***.—See referred specimens section.

***Eutropis caraga***.—See holotype and paratypes sections.

***Eutropis cumingi***.—BATAN ISLAND: BATANES PROVINCE: Municipality of Ivana: Barangay Salagao, Sitio Imnadyed (KU 314022, 314023); CAMIGUIN NORTE ISLAND: CAGAYAN PROVINCE: Municipality of Calayan: Barangay Balatubat (KU 304745, 304746); LUBANG ISLAND: OCCIDENTAL MINDORO PROVINCE: Municipality of Lubang: Barangay Vigo (KU 304009, 320489); LUZON ISLAND: AURORA PROVINCE: Municipality of Casiguran: Barangay Casapsipan (KU 325106); CAGAYAN PROVINCE: Municipality of Gonzaga: Barangay Magrafil: Mt. Cagua (KU 330070); Municipality of Pamplona: Barangay Nagattatan (KU 306216); ISABELA PROVINCE: Municipality of San Mariano: Barangay Dibuluan, Sitio Apaya, Apaya Creek area (KU 327378, 327382); Sitio Dumoy, Dumoy Lake area (KU 327383); Dibanti Ridge, Dibanti River area (KU 327385); KALINGA PROVINCE: Municipality of Balbalan: Barangay Balbalasang (FMNH 258984, 259453); LA UNION PROVINCE: Municipality of Baloan (KU 335132–33); MOUNTAIN PROVINCE: Municipality of Bontoc (KU 335134); LAGUNA PROVINCE: Municipality of Paete: Barangay Saray (KU 345441); NUEVA VIZCAYA PROVINCE: Municipality of Quezon: Barangay Maddiangat, Sitio Dayog (KU 308933); ZAMBALES PROVINCE: Municipality of Botolan: Barangay Porac, Ramon Magsaysay Technological University Campus (KU 335135, 335139); Municipality of San Felipe (CAS 15473 [holotype]); SABTANG ISLAND: BATANES PROVINCE: Municipality of Sabtang: Barangay Chavayan (KU 314025).

***Eutropis cuprea***.—See holotype and paratypes sections.

***Eutropis englei***.—MINDANAO ISLAND: COTABATO PROVINCE: Cotabato Coast, Tatayan and Saub (MCZ 26289 [holotype], MCZ 26290 [paratype]). DAVAO DEL SUR PROVINCE: Municipality of Digos City (CAS 124842, 124843, 124844).

***Eutropis gubataas***.—See holotype and paratypes sections.

***Eutropis indeprensa***.—MINDORO ISLAND: OCCIDENTAL MINDORO PROVINCE: Municipality of Calintaan: Barangay Malpalon (KU 306992–93); Municipality of Sablayan: Barangay Batong Buhay, Butalai, Mount Siburan (KU 304027–28, 304032, 304035); Municipality of San Jose: 500 yards south of Bugsanga River (CAS 86663 [paratype]); Municipality of Victoria: Barangay Loyal (KU 302883).

***Eutropis islamaliit***.—See holotype and paratypes sections.

***Eutropis lapulapu***.—See holotype and paratypes sections.

***Eutropis multicarinata***.—See referred specimens section.

***Eutropis palauensis***.—See holotype and paratypes sections.

***Eutropis sahulinhanggan***.—See holotype and paratypes sections.

***Eutropis sibalom***.—See holotype and paratypes sections.