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Systematics and phylogeny of *Philautus* Gistel, 1848 (Anura, Rhacophoridae) in the Western Ghats of India, with descriptions of 12 new species

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A taxonomic account of the genus *Philautus* from the Western Ghats of India is presented. All known species of this genus, their type specimens, current taxonomic status, and geographical distribution are revised, based on museum and field studies. In addition, 12 new species are described and compared with other members of the genus, especially with the name-bearing types of Indian *Philautus*. Diagnoses, detailed descriptions, illustrations, data on distribution, and natural history are provided for all species, and their relationships are estimated using molecular phylogenetic analyses of mitochondrial data sets. No reliable observations have been made for two species, *Philautus chalazodes* (Günther, 1876) and *Philautus flaviventris* (Boulenger, 1882), since the original descriptions in the 19th century. © 2009 The Linnean Society of London, *Zoological Journal of the Linnean Society*, 2009, **155**, 374–444.

ADDITIONAL KEYWORDS: biodiversity – biogeography – molecular phylogenetics – taxonomy.

INTRODUCTION

The genus *Philautus* Gistel, 1848 assembles a group of direct-developing rhacophorid frogs with a wide distribution in tropical Asia (Bossuyt & Dubois, 2001). These frogs can be found in a wide variety of microhabitats, ranging from the ground to the canopy level (Biju & Bossuyt, 2005a). The morphological differences between closely related *Philautus* species tend to be weak, and several authors (e.g. Dring, 1987; Bossuyt & Dubois, 2001) have therefore highlighted the importance of non-morphological methods, like bioacoustic analyses or molecular studies (Malkmus & Riede, 1996a; Bossuyt & Dubois, 2001). In a recent review, Bossuyt & Dubois (2001) recognized 84 valid species names of *Philautus*, but several species of *Philautus* from the Indian mainland are yet to be described (Biju, 2001).

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The Western Ghats, or Sahyadri Hills, is a chain of mountains that runs parallel with the west coast of India over 1600 km from 8°15′N to 21°00′N. This mountain range begins as low-lying hills in the northwestern state of Gujarat, and then passes southwards through Maharashtra, Goa, Karnataka, and Kerala, before ending abruptly in the Mahendragiri Hills in Tamil Nadu, at the southern tip of Peninsular India. The chain of hills is interrupted by the biogeographically important Palghat Gap at around 10°31′N, 76°31′E, which is an area of approximately 30 km in width with an elevation of less than 100 m a.s.l. (Fig. 1).

In the Western Ghats, the genus *Philautus* is currently represented by 20 endemic species (Bossuyt, 2002; Kuramoto & Joshy, 2003; Biju & Bossuyt, 2005a, b, c; Biju & Bossuyt 2006; Gururaja *et al.* 2007a, 2007b). Between 1994 and 2006, we have surveyed the entire Western Ghats, and sampled populations of *Philautus* from throughout this mountain range (Table 1). Here, we present a

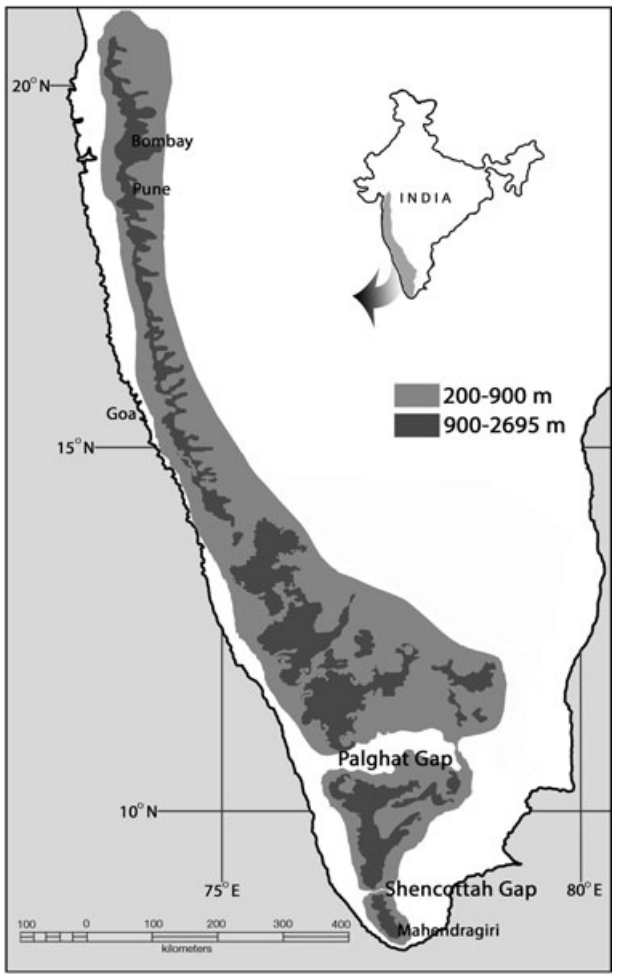

Figure 1. The Western Ghats: with an indication of the different altitudinal gradients, and showing the Palghat Gap.

comprehensive taxonomic revision of the genus *Philautus* from this region, and describe 12 new species. Our study is based on new collection material, and provides a molecular phylogeny, detailed descriptions, distribution maps, illustrations, and colour photographs.

MATERIAL AND METHODS

Field survey and specimen collection

Ecological surveys and the collection of specimens were performed during field trips in the Western Ghats between 1994 and 2006. Specimens were mostly collected at night by locating calling males. Colour patterns in life were recorded from individual animals within 1 h of collection. This was to avoid any confusion caused by subsequent colour changes in captivity. Photographs were taken in the wild (without handling), and a few were taken in captivity within 1 h of collection. Specimens were fixed in 5% formalin for 2 days, and were subsequently transferred to 70% ethanol. Samples for molecular analyses were taken from muscle tissue, and were preserved in 100% ethanol, before being stored at –20 °C.

Inference of phylogeny

Taxon sampling and DNA sequencing

We assembled a mitochondrial DNA matrix of 1488 bp for 39 taxa (34 *Philautus* and five outgroup taxa), covering part of the *16S rRNA*, part of the *ND1*, the complete $tRNA^{ILE}$ and $tRNA^{GLN}$, and part of the $tRNA^{MET}$ genes. The relevant sequences were compiled for all valid Western Ghats *Philautus* species, except *Philautus chalazodes* (Günther, 1876), *Philautus flaviventris* (Boulenger, 1882), and the recently described *Philautus ochlandrae* Gururaja *et al.*, 2007b.

DNA sequences were obtained by whole-genome extraction (Sambrook, Fritsch & Maniatis, 1989), PCR amplification (for primers, see Roelants *et al.*, 2007), and cycle sequencing along both strands. The new sequences are deposited in GenBank under accession numbers EU449994–EU450067. Alignments were created using the program ClustalX 1.81 (Thompson *et al.*, 1997), and minor corrections were made with MacClade 4.06 (Maddison & Maddison, 2000).

Phylogenetic analyses

Phylogenetic relationships were estimated using heuristic maximum parsimony (MP) and maximum likelihood (ML) searches, all executed with the program PAUP* 4.0b10 (Swofford, 2002). The MP analyses were performed with equal character weighting, 1000 replicates of random taxon addition, and tree-bisection-reconnection branch swapping. The MP clade stability was estimated by non-parametric bootstrapping (10 000 pseudoreplicates). Appropriate likelihood models were determined using the Akaike Information Criterion implemented in ModelTest 3.06 (Posada & Crandall, 1998). The ML search included ten replicates of random taxon addition, and was performed using a general time-reversible (GTR) model of DNA evolution, with gamma correction for among-site rate heterogeneity and an estimated proportion of invariable sites. Bayesian analyses were performed with MrBayes 3.0 (Ronquist & Huelsenbeck, 2003), with the same model and using default settings as priors. Four chains were run simultaneously for 2×10^6 generations, and trees were sampled every 1000 cycles. Bayesian posterior probabilities (PP) were estimated as the 50% majority rule consensus tree of the 1000 last sampled trees

Table 1. Collection localities that are discussed in the text. Localities are arranged by state

Locality	Altitude	Coordinates	Species recorded
		TAMIL NADU STATE	
Coimbatore District			
Anamalai Hills	600–1800 m a.s.l.	10°12′–10°50′N and 76°25′–77°23′E	*P. griet,* ***P. jayarami*** **sp. nov.**, *P. ponmudi,* ***P. sushili*** **sp. nov.**
Valparai	600 m a.s.l.	10°23′N, 76°59′E	*P. griet,* ***P. jayarami*** **sp. nov.**, *P. ponmudi,* ***P. sushili*** **sp. nov.**
Konalar, Grass Hills	1800 m a.s.l.	10°19′N, 77°04′E	*P. dubois*
Mettupalayam	300 m a.s.l.	11°21′N, 76°54′E	*P. wynaadensis*
Nilgiris District			
Nilgiri Hills ('Neelgherries')	1500–2335 m a.s.l.	11°11′–11°55′N and 76°13′–77°02′E	***P. coonoorensis*** **sp. nov.**, *P. signatus*, P. tinniens
Avalanche	2000 m a.s.l.	11°17′N, 76°35′E	*P. signatus, P. tinniens*
Coonoor	1850 m a.s.l.	11°22′N, 76°50′E	***P. coonoorensis*** **sp. nov.**, *P. signatus*, *P. tinniens*
Kothagiri	1780 m a.s.l.	11°28′N, 76°54′E	*P. signatus, P. tinniens*
Udagamandalam (Ooty)	1980 m a.s.l.	11°24′N, 76°40′E	*P. signatus, P. tinniens*
Parsons Valley	1900 m a.s.l.	11°26′N, 76°50′E	*P. signatus*
Naduvattam	1890 m a.s.l.	11°23′N, 76°34′E	*P. signatus, P. tinniens*
Dindigal District			
Kodaikanal	1780 m a.s.l.	10°15′N, 77°29′E	*P. dubois*
Teni District			
Bodinayakkanur ('Bodanaikanur, Travancore')	350 m a.s.l.	09°58′N, 77°29′E	*P. travancoricus*
Tirunelveli District			
Kakachi	1200 m a.s.l.	08°40′N, 77°38′E	*P. bobingeri*
Kannikatti	700 m a.s.l.	08°38′N, 77°18′E	***P. akroparallagi*** **sp. nov.**, *P. beddomii*
Mundanthurai	200 m a.s.l.	08°40′N, 77°30′E	***P. kani*** **sp. nov.**
Sengaltheri	1000 m a.s.l.	08°32′N, 77°26′E	*P. bobingeri*
Kanyakumari District			
Kiriparai	220 m a.s.l.	08°24′N, 77°24′E	***P. kani*** **sp. nov.**
		KERALA STATE	
Thiruvananthapuram District			
Ashambu Hills or Agasthyamala Hills	450–2000 m a.s.l.	08°27′–10°38′N and 77°06′–77°14′E	***P. akroparallagi*** **sp. nov.**, *P. bobingeri*, *P. beddomii*, ***P. chotta*** **sp. nov.**, *P. graminirupes*, ***P. kani*** **sp. nov.**, *P. ponmudi*
Athirimala ('Atray Mallay')	1425 m a.s.l.	08°36′N, 77°14′E	***P. akroparallagi*** **sp. nov.**, *P. beddomii*
Chathankod	180 m a.s.l.	08°39′N, 77°09′E	***P. akroparallagi*** **sp. nov.**, ***P. kani*** **sp. nov.**
Bonakkad	600 m a.s.l.	08°40′N, 77°11′E	***P. akroparallagi*** **sp. nov.**, ***P. kani*** **sp. nov.**
Palode	150 m a.s.l.	08°38′N, 77°09′E	***P. kani*** **sp. nov.**
Ponmudi	980 m a.s.l.	08°45′N, 77°08′E	***P. akroparallagi*** **sp. nov.**, *P. anili*, *P. bobingeri*, ***P. chotta*** **sp. nov.**, *P. graminirupes*, ***P. kani*** **sp. nov.**, *P. ponmudi*
Pathanamthitta District			
Gavi	1000 m a.s.l.	09°26′N, 77°09′E	*P. ponmudi*
Idukki District			
Periyar	900 m a.s.l.	09°26′N, 77°05′E	*P. wynaadensis*
Vandiperiyar	800 m a.s.l.	09°52′N, 77°10′E	*P. travancoricus*

Table 1. *Continued*

Locality	Altitude	Coordinates	Species recorded
Vagaman	900 m a.s.l.	09°34′N, 77°05′E	*P. griet*, *P. ponmudi*, *P. travancoricus*
Devikulam	1400 m a.s.l.	10°05′N, 77°06′E	*P. griet*, ***P. munnarensis* sp. nov.**
Eravikulam	2200 m a.s.l.	10°14′N, 77°05′E	*P. dubois*
Munnar	1410 m a.s.l.	10°05′N, 77°08′E	*P. beddomii*, ***P. chlorosommai* sp. nov.**, *P. griet*, ***P. munnarensis* sp. nov.**
Thrissur District			
Thrissur	050 m a.s.l.	10°28′N, 76°20′E	*P. wynaadensis*
Meladoor	150 m a.s.l.	10°19′N, 76°21′E	*P. wynaadensis*
Kozhikode District			
Kakkayam	745 m a.s.l.	11°33′N, 75°55′E	*P. ochlandrae*
Palakkad District			
Kaikatti–Nelliyampathi	1000 m a.s.l.	10°35′N, 76°44′E	***P. kaikatti* sp. nov.**, ***P. marki* sp. nov.**
Palakkad	200 m a.s.l.	10°45′N, 76°36′E	*P. wynaadensis*
Parambikulam–Puliyarapadam	1100 m a.s.l.	10°24′N, 76°45′E	*P. wynaadensis*
Wayanad District			
Wayanad Plateau	800–1500 m a.s.l.	11°26′–11°48′N and 75°46′–76°26′E	***P. akroparallagi* sp. nov.**, *P. anili*, *P. chromasynchysi*, *P. glandulosus*, *P. nerostagona*, *P. ponmudi*, *P. tuberohumerus*, P. wynaadensis
Kalpetta	950 m a.s.l.	11°36′N, 76°05′E	***P. akroparallagi* sp. nov.**, *P. anili*, *P. nerostagona*, *P. ponmudi*, *P. wynaadensis*
Sulthanbathery (‘Sultan’s Battery’, ‘Ganapathivattam’)	1000 m a.s.l.	11°40′N, 76°15′E	***P. akroparallagi* sp. nov.**, *P. anili*, *P. glandulosus*, *P. nerostagona*, *P. ponmudi*, *P. wynaadensis*
Kurichiyarmala	1200 m a.s.l.	11°35′N, 75°58′E	*P. chromasynchysi*
Mananthavady (‘Manantoddy’, ‘Manantavadi’)	1100 m a.s.l.	11°50′N, 76°05′E	***P. akroparallagi* sp. nov.**, *P. anili*, *P. glandulosus*, *P.nerostagona*, *P. ponmudi*, *P. wynaadensis*
Muthanga	830 m a.s.l.	11°40′N, 76°22′E	*P. tuberohumerus*
	KARNATAKA STATE		
Belgaum District			
Londa	550 m a.s.l.	15°26′N, 74°31′E	***P. amboli* sp. nov.**, *P. bombayensis*
Shimoga District			
Jog Falls–Mavingundi	600 m a.s.l.	14°12′N, 74°48′E	***P. amboli* sp. nov.**, *P. luteolus*
Uttara Kannada District			
Castle Rock	620 m a.s.l.	15°23′N, 74°20′E	***P. amboli* sp. nov.**, *P. bombayensis*
Kodagu District			
Mercara (Medikeri)	1100 m a.s.l.	12°25′N, 75°43′E	*P. charius*, *P. glandulosus*, *P. luteolus*, *P. tuberohumerus*
Kirundadu	980 m a.s.l.	12°29′N, 75°47′E	*P. luteolus*
Madenadu	920 m a.s.l.	12°27′N, 75°38′E	*P. luteolus*
Chikmagalur District			
Chikmagalur (‘Chikmalagr’)	1030 m a.s.l.	13°20′N, 75°46′E	*P. charius*, *P. tuberohumerus*
Someshwar–Agumbae	700 m a.s.l.	13°31′N, 75°06′E	*P. tuberohumerus*
Kudremukh–Malleshwaram	940 m a.s.l.	13°12′N, 75°16′E	***P. amboli* sp. nov.**, *P. luteolus*, *P. tuberohumerus*
Muthodi	1100 m a.s.l.	13°39′N, 75°42′E	*P. charius*, *P. luteolus*
Hassan District			
Sakleshpur	840 m a.s.l.	12°56′N, 75°42′E	*P. luteolus*, *P. tuberohumerus*
Kempholay	880 m a.s.l.	13°03′N, 75°53′E	*P. luteolus*, *P. tuberohumerus*
Kottigehara (‘Kottigehar’)	850 m a.s.l.	13°07′N, 75°37′E	*P. charius*

Table 1. *Continued*

Locality	Altitude	Coordinates	Species recorded
		MAHARASHTRA STATE	
Sawantwadi District			
Amboli	720 m a.s.l.	15°56′N, 74°00′E	***P. amboli* sp. nov.**, *P. bombayensis*
Kolhapur District			
Amba	590 m a.s.l.	16°55′N, 73°47′E	***P. amboli* sp. nov.**
		Precise locality unknown	
'Travancore'			*P. chalazodes*
Approximately the Western Ghats, south of Palghat (08°15′–09°15′N and 76°32′–77°03′′E), Kerala, India			
'Malabar'			*P. flaviventris*

Approximately the entire Western Ghats (including coastal area) from river Tapti to Cape Kumarin (i.e. Kanyakumari), Peninsular India (Hooker & Thomson, 1855).

(stationarity was evaluated graphically, and 1000 samples were discarded as burn-in).

MORPHOLOGY

The new species were compared with all types, with special attention payed to those from Sri Lanka and India. Drawings of the types were made using a stereomicroscope with a drawing tube. Measurements and terminology follow that of Bossuyt & Dubois (2001). For convenience of discussion, *Philautus* species were grouped as small (15–23-mm long), medium (24–34-mm long), and large (35–45-mm long). The term shank is used here to refer to the part of the leg that contains the tibia, and thigh is used for the part of the leg that contains the femur. The following measurements were taken to the nearest 0.1 mm using a digital slide caliper, or using a binocular microscope with a micrometer ocular: snout–vent length (SVL); head width, measured at the angle of the jaws (HW); head length, measured from the rear of the mandible to the tip of the snout (HL); distance from the rear of the mandible to the nostril (MN); distance from the rear of the mandible to the anterior orbital border of the eye (MFE); distance from the rear of the mandible to the posterior orbital border of the eye (MBE); snout length, measured from the tip of the snout to the anterior orbital border of the eye (SL); eye length, i.e. the horizontal distance between the bony orbital borders of the eye (EL); inter upper eyelid width, i.e. the shortest distance between the upper eyelids (IUE); maximum upper eyelid width (UEW); internal front of eyes, i.e. the shortest distance between the anterior orbital borders of the eyes (IFE); internal back of eyes, i.e. the shortest distance between the posterior orbital borders of the eyes (IBE); largest tympanum diameter (TYD); forelimb length, measured from the elbow to the base of the outer palmar tubercle (FLL); hand length, measured from the base of the outer palmar tubercle to the tip of the third finger (HAL); third finger length, measured from the base of the first subarticular tubercle to the tip of the finger (TFL); disc width on finger III (FD_{III}); width of finger III, measured at the base of the disc (FW_{III}); shank length (ShL); thigh length (TL); foot length, measured from the base of the inner metatarsal tubercle to the tip of the fourth toe (FOL); distance from the heel to the tip of the fourth toe (TFOL). Measurements (only of type series) of *P. ochlandrae* were adopted from Gururaja *et al.* (2007b).

Sex and maturity were determined by examining secondary sexual characters, or, when absent, by examining the gonads through a small lateral incision in the specimen. The abbreviations used for museums are as follows: BNHS, Bombay Natural History Society, Bombay, India; CCB, Central College, Bangalore, Karnataka, India; DU, University of Delhi, Delhi, India; FMNH, Field Museum of Natural History, Chicago, USA; IRSNB, Institut Royal des Sciences Naturelles de Belgique, Bruxelles, Begium; KBIN, Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussel; MNHN, Muséum National d'Histoire Naturelle, Paris, France; BMNH, British Museum of Natural History, London, UK; NMW, Naturhistorisches Museum, Wien, Austria; VUB, Vrije Universiteit Brussel, Belgium; WHT, Wildlife Heritage Trust of Sri Lanka, Colombo, Sri Lanka; ZMB, Zoologisches Museum, Berlin, Germany; ZSIC, Zoological Survey of India, Calcutta, India; ZSIM, Zoological Survey of India, Southern Regional

Station, Madras, India. The abbreviations of frequently used terms are as follows: FB, Franky Bossuyt; NPG, north of Palghat Gap; SDB, S.D. Biju; SPG, south of Palghat Gap.

The genus *Philautus* contains many species that are polymorphic in dorsal coloration. For that reason, some taxonomists have considered it to be a particularly difficult group (Inger *et al.*, 1984; Bossuyt & Dubois, 2001). Here, we discuss the colour variation that is observed in the wild, as well as colour changes during captivity, wherever appropriate. Importantly, many *Philautus* species of the Western Ghats can be identified by their colour pattern on the groin and thigh, which is a characteristic that usually remains visible in preserved specimens. We therefore paid special attention to this trait, and tried to describe this pattern whenever appropriate.

In the following section, a diagnosis for all species, detailed description, illustrations, and natural history are arranged alphabetically. The following characters are common to all species of *Philautus* in the Western Ghats, and are consequently not repeated in the description: nostril rounded or oval; pupil oval, horizontal; tympanum rounded; vomerine teeth absent; tongue emarginated; arms short; tips of fingers with discs, and with distinct circummarginal grooves; thigh and shank slender; tips of toes with discs, and with distinct circummarginal grooves; belly granular. Males have a large vocal sac when calling, and have a pair of gular slits at the base of the lower jaw. The female has a relatively low (22–62) number of large unpigmented eggs, and all species for which information is available undergo direct development.

Coordinates for the distribution are given in Table 1, and for each species, the localities are plotted on a map. A detailed explanation of the localities, 'Travancore' and 'Malabar' is given elsewhere (Biju, 2001).

RESULTS

PHYLOGENETIC RELATIONSHIPS

Alignment resulted in a data matrix of 1488 bp, of which 1378 bp could be reliably aligned: 650 were variable, and 541 were parsimony informative. The maximum parsimony analyses produced three equally parsimonious trees of 3189 steps. The ML analyses (GTR + G + I, selected by Modeltest) produced a single ML tree (–Ln L = 1 4763.97), and Bayesian analyses produced very similar results (Fig. 2).

A group of species shares an amino acid deletion at the end of the *NDH* gene (Fig. 2). The ML tree does not show them as monophyletic (because of the position of *Philautus chotta* sp. nov.), but one of the three MP trees does support the monophyly of these species. Additional sampling will be necessary to resolve these relationships.

Although basal relationships receive moderate or conflicting support, depending on the criterion used, several smaller clades received strong support (bootstrap > 70, Bayesian posterior probability > 95) under all criteria.

1. A clade combining several green *Philautus* species (*Philautus akroparallagi* sp. nov., *Philautus bobingeri* Biju & Bossuyt, 2005, *Philautus glandulosus* (Jerdon, 1853), and *Philautus jayarami* sp. nov.) with *Philautus graminirupes* Biju & Bossuyt, 2005.
2. A sister relationship between *Philautus travancoricus* (Boulenger, 1891) and *Philautus luteolus*Kuramoto & Joshy, 2003.
3. A clade clustering *Philautus anili*Biju & Bossuyt, 2006, *Philautus kaikatti* sp. nov., and *Philautus sushili* sp. nov.
4. A clade clustering *Philautus dubois* Biju & Bossuyt, 2005 with *Philautus beddomii* (Günther, 1876) and *Philautus munnarensis* sp. nov.
5. A sister relationship of *Philautus signatus* (BOULENGER, 1882) and *Philautus tinniens* (Jerdon, 1853).
6. A clade clustering *Philautus charius* Rao, 1937 with *Philautus griet* Bossuyt, 2002 and *Philautus coonoorensis* sp. nov.
7. A sister relationship of *Philautus bombayensis* (Annandale, 1919) and *Philautus tuberohumerus* Kuramoto & Joshy, 2003.

These relationships are used in the subsequent species descriptions as a base for the comparison of species with their closest relatives.

SPECIES ACCOUNTS

PHILAUTUS AKROPARALLAGI SP. NOV.

(FIGS 2, 3A–D, 4A–D, 5, 6A, 19; TABLE 2)

Type material: Holotype, BNHS 4387, an adult male, SVL 20.5 mm, collected by SDB on 21 July 1999 from Ponmudi, Thiruvananthapuram District, Kerala, India; paratypes, BNHS 4388–4389 and BNHS 4391–4392, four adult males, and BNHS 4536, an adult female, collected along with the holotype.

Other material studied: FMNH 218117, an adult male, from Ponmudi; BNHS 4394, an adult male, from Athirimala; BNHS 4395, an adult male, from Kannikatti; BNHS 4396, an adult male, from Chathankod; BNHS 4397, an adult male, from Bonakkad; BNHS 4561–4566, six adult males, and BNHS 4567, an adult female, all from Kalpetta (Table 2).

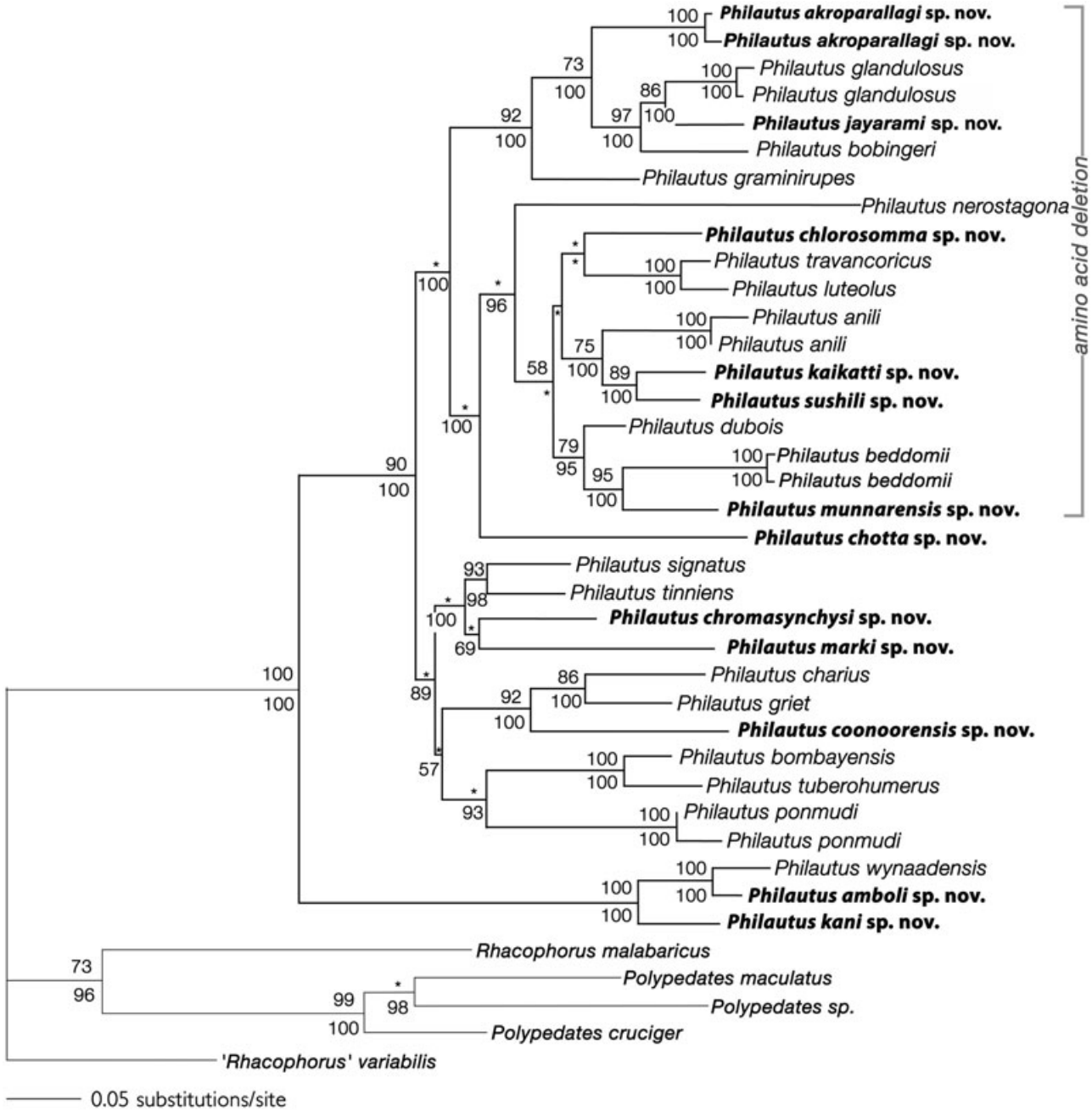

Figure 2. Maximum-likelihood phylogram (GTR + G + I; –Ln *L* = 14 763.97) for the mitochondrial DNA data set of 1488 bp of 34 taxa of Western Ghats *Philautus* and five outgroup species. Numbers above branches indicate non-parametric bootstrap values under maximum parsimony (MP). Numbers below branches indicate Bayesian posterior probabilities. *Values of less than 50.

Diagnosis: Philautus akroparallagi sp. nov. can be distinguished from known congeners by the following combination of characters: (1) small male adult size (19.2–22.5-mm long), medium female adult size (26.0–27.3-mm long); (2) loreal and tympanic regions mostly light brown; (3) dorsal surface of forearm and lateral side of snout, light brown to dark brown in life, turns light brownish grey in preservation.

Philautus akroparallagi sp. nov. can be easily differentiated from all of the green species of *Philautus* from the Western Ghats by its unique light-brown to dark-brown forearm, and loreal and tympanic regions, in nearly all colour morphs (Figs 4A–D, 19).

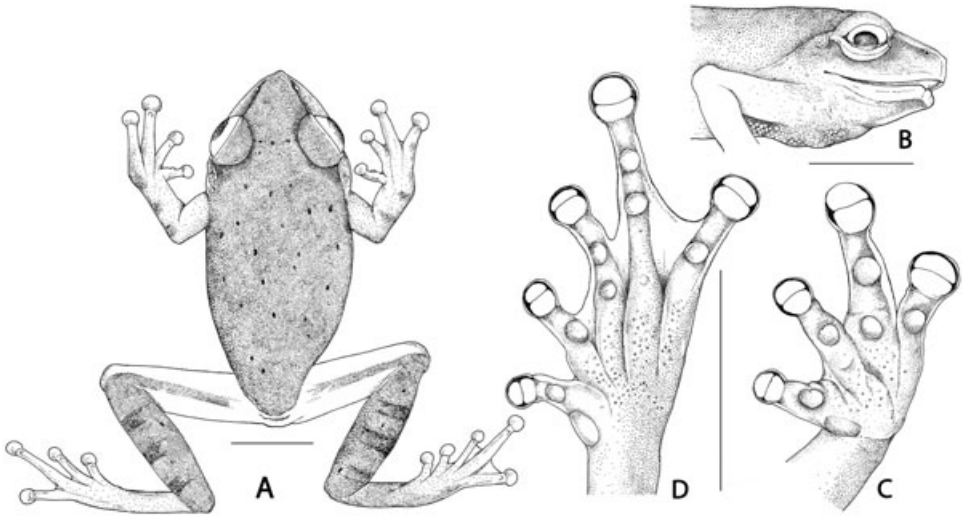

Figure 3. Holotype of ***Philautus akroparallagi* sp. nov.** (BNHS 4387). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

Figure 4. ***Philautus akroparallagi* sp. nov.** A, specimen SDB 3021; B, paratype, (BNHS 4388); C, paratype, (BNHS 4536); D, paratype, (BNHS 4392). All photographs are from the type locality, Ponmudi, and were collected from within a range of about 100 m^2.

However, because of the overall green coloration (excepting the variation), *P. akroparallagi* sp. nov. could be confused with four other green species from the Western Ghats (*P. beddomii*, *P. bobingeri*, *P. glandulosus*, and *P. jayarami* sp. nov.) and with one species, *Philautus femoralis* (Günther, 1864), from Sri Lanka.

Apart from the unique light-brown loreal and tympanic region coloration, *P. akroparallagi* sp. nov. is distinct from *P. bobingeri*, *P. glandulosus*, and *P. jayarami* sp. nov. by its smaller male snout–vent length (Fig. 5), SVL 20.7 ± 1.0 mm, $N = 16$ (vs. SVL 22.5 ± 2.0 mm, $N = 7$, in *P. bobingeri*; SVL 25.2 ± 2.0 mm, $N = 4$, in *P. glandulosus*; SVL 26.3 ± 2.0 mm, $N = 6$, in *P. jayarami* sp. nov.), and light-yellowish groin and thigh margins (vs. dark flesh red in *P. bobingeri*, Fig. 13; light white to greyish white groin and thigh margins without marking, Fig. 40A, or with bluish black spots, Fig. 40B, in *P. jayarami* sp. nov.).

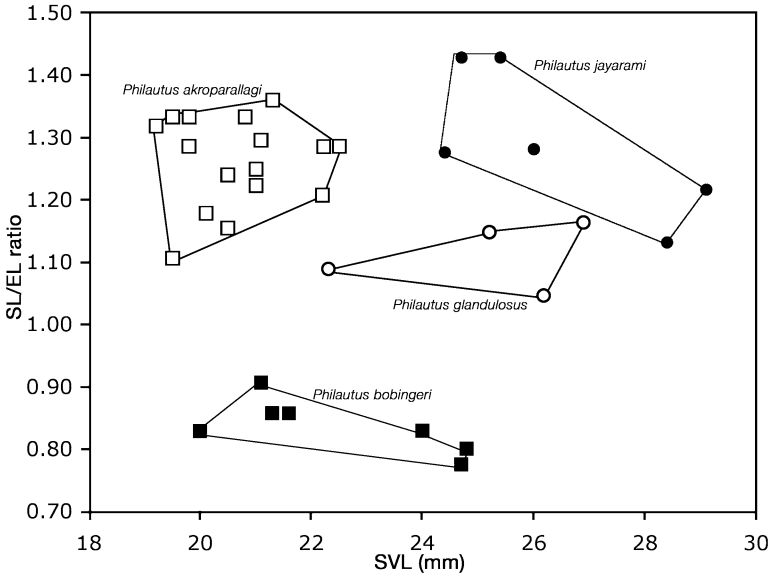

Figure 5. Morphometric distinction between males of four green *Philautus* species: □, ***Philautus akroparallagi* sp. nov.**; ■, *Philautus bobingeri*; ○, *Philautus glandulosus*; and ●, ***Philautus jayarami* sp. nov.** The ratio of the snout length (SL)/eye length (EL) is plotted against the snout–vent length SVL (see Table 2).

Although *P. beddomii* is not allied with the new species, we also made a comparison so as to avoid further confusion caused by the overall green colour and comparable snout–vent length. *Philautus akroparallagi* sp. nov. differs from *P. beddomii* by a number of distinct morphological traits and coloration: snout length longer than horizontal diameter of eye, SL 3.3 ± 0.2 mm vs. EL 2.6 ± 0.2 mm, $N = 16$ (vs. snout length equal to horizontal diameter of eye, i.e. SL 2.8 ± 0.2 mm and EL 2.8 ± 0.2 mm, $N = 11$), lateral side of snout, forearm, and loreal and tympanic regions light brown to dark brown (vs. dorsal green coloration completely extended to snout, limbs, and loreal and tympanic regions). *Philautus femoralis* is a member of the Sri Lankan radiation, and is not closely related to the green species of the Western Ghats (Bossuyt *et al.*, 2004). A more detailed comparison of green coloured *Philautus* species of the Western Ghats is shown in Figure 19A–D.

Description of the holotype (with all measurements in mm): Small frog (SVL 20.5) with a slender body (Fig. 3A); head length (HL 7.7; Fig. 3B) slightly larger than width (HW 7.5; MN 5.9; MFE 4.5; MBE 1.6); outline of snout in dorsal and ventral views pointed, snout length (SL 3.1) longer than horizontal diameter of eye (EL 2.5); canthus rostralis rounded, loreal region acutely concave; distance between posterior margins of eyes (IBE 7.4) about 1.7 times the distance between anterior margins of eyes (IFE 4.3); tympanum (TYD 0.9) rather indistinct; supratympanic fold rather indistinct; tongue without lingual papilla.

Forelimb (FLL 4.2) shorter than hand (HAL 5.4; TFL 2.9); fingers without lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single, IV2 absent (Fig. 3C); prepollex rather indistinct; palmar tubercle absent; supernumerary tubercles rather indistinct; nuptial pads present (Fig. 3C), smooth, and creamy white.

Hindlimbs moderately long, shank (ShL 10.3) almost equal to thigh (TL 10.2), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 8.4); distance from heel to tip of toe IV (TFOL 13.6); webbing reduced (Fig. 3D), reaching up to second subarticular tubercle on the inside of toe IV, and just above the second subarticular tubercle on the outside of toe IV; dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple, IV3 weakly developed, V2 absent (Fig. 3D); supernumerary tubercles weakly present.

Skin of snout, between eyes, upper eyelids, side of head, and back, shagreened; flanks shagreened to sparsely granular; dorsal part of limbs shagreened; throat shagreened to granular; chest, belly, and posterior surface of thighs granular.

Colour of holotype: In life: dorsum uniformly light green with a few scattered grey spots, loreal and tympanic regions light brown; iris light brown, encircled by light bluish white outer ring, lateral region light yellowish, groin light yellowish, forelimbs brownish, thigh with a green line extending from near vent to knee, anterior and posterior margins of thigh light yellow, without markings; shank

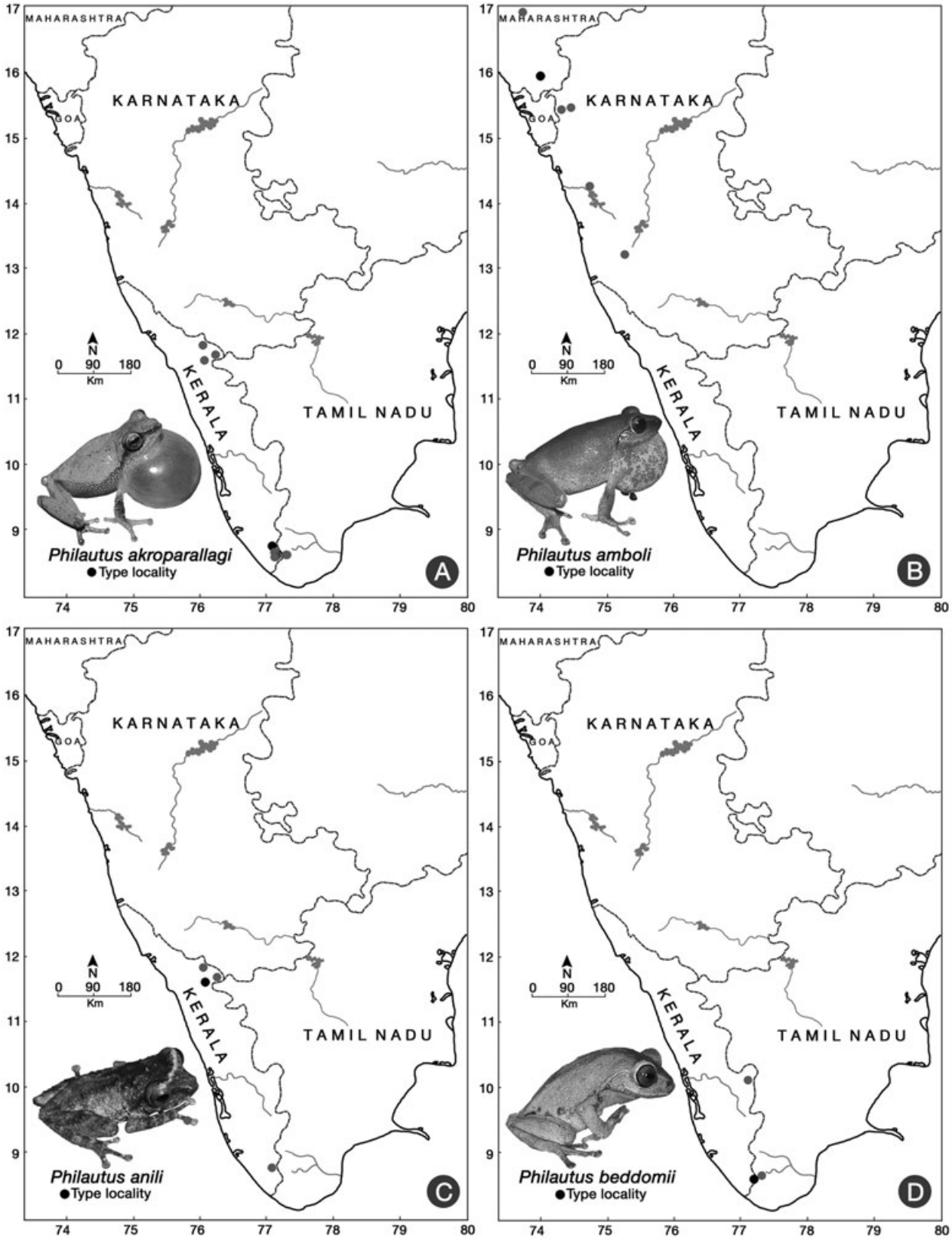

Figure 6. Distribution map. A, ***Philautus akroparallagi* sp. nov.**; B, ***Philautus amboli* sp. nov.**; C, *Philautus anili*; D, *Philautus beddomii*.

Table 2. Morphometric measurements (in mm) of the specimens used in this study

Species	Sex	Locality	Museum number	SVL	HW	HL	IUE	UEW	SL	EL	FLL	HAL	TL	ShL	FOL	HeTo
***Philautus akroparallagi* sp. nov.**	**M**	**Ponmudi**	**BNHS 4387 (HT)**	**20.5**	**7.5**	**7.7**	**2.9**	**1.7**	**3.1**	**2.5**	**4.2**	**5.4**	**10.2**	**10.3**	**8.4**	**2**
	M	Ponmudi	BNHS 4388 (PT)	22.3	8.5	8.7	3.8	2.0	3.6	2.8	4.7	5.2	10.4	10.4	8.6	2
	M	Ponmudi	BNHS 4389 (PT)	21.0	7.7	7.6	2.8	1.8	3.0	2.4	4.3	5.2	10.5	10.4	8.3	2
	M	Ponmudi	BNHS 4391 (PT)	22.2	8.2	8.2	3.0	2.0	3.5	2.9	4.6	5.8	11.0	10.8	8.5	2
	M	Ponmudi	BNHS 4392 (PT)	20.5	7.6	7.5	3.1	1.6	3.0	2.6	4.0	5.3	10.5	10.2	7.8	1
	M	Ponmudi	FMNH 218117	19.8	7.3	7.3	2.9	1.7	3.6	2.8	3.8	5.0	10.0	10.0	7.1	2
	M	Athirimala	BNHS 4394	19.5	7.8	7.8	3.1	1.8	3.2	2.4	3.9	5.4	10.4	10.1	8.1	2
	M	Kannikatti	BNHS 4395	19.2	7.5	7.6	3.3	1.6	2.9	2.2	4.0	5.0	10.4	9.8	7.4	2
	M	Chathankod	BNHS 4396	22.5	8.4	8.6	3.1	2.1	3.6	2.8	4.5	6.2	11.9	11.0	8.6	2
	M	Bonakkad	BNHS 4397	19.8	7.1	7.3	3.0	1.8	3.2	2.4	4.1	5.3	10.1	9.9	7.6	2
			Average	**20.7**	**7.8**	**7.8**	**3.1**	**1.8**	**3.3**	**2.6**	**4.2**	**5.4**	**10.5**	**10.3**	**8.0**	
			Standard deviation	**1.2**	**0.4**	**0.5**	**0.3**	**0.2**	**0.3**	**0.2**	**0.3**	**0.3**	**0.5**	**0.4**	**0.5**	
	M	Kalpetta	BNHS 4561	21.1	7.8	8.0	2.8	1.4	3.5	2.7	4.3	5.1	9.5	9.8	7.2	2
	M	Kalpetta	BNHS 4562	20.8	7.2	7.5	2.3	1.5	3.2	2.4	3.7	5.6	9.8	10.1	7.7	2
	M	Kalpetta	BNHS 4563	19.5	7.1	7.3	2.4	1.5	3.1	2.8	3.8	5.4	9.5	9.8	7.3	1
	M	Kalpetta	BNHS 4564	21.3	7.3	7.5	2.6	1.5	3.4	2.5	4.6	5.4	10.3	10.6	7.8	2
	M	Kalpetta	BNHS 4565	21.0	7.2	7.4	2.4	1.4	3.3	2.7	4.1	5.3	10.3	10.1	7.8	2
	M	Kalpetta	BNHS 4566	20.1	7.1	7.3	2.6	1.4	3.3	2.8	4.2	5.1	10.4	10.2	8.5	1
			Average	**20.6**	**7.3**	**7.5**	**2.5**	**1.5**	**3.3**	**2.7**	**4.1**	**5.3**	**10.0**	**10.1**	**7.7**	
			Standard deviation	**0.7**	**0.3**	**0.3**	**0.2**	**0.0**	**0.1**	**0.2**	**0.3**	**0.2**	**0.4**	**0.3**	**0.5**	
	F	Ponmudi	BNHS 4536 (PT)	27.3	10.9	10.8	4.2	1.8	4.6	3.9	5.0	7.6	14.1	13.3	11.1	2
	F	Kalpetta	BNHS 4567	26.0	10.0	10.2	3.5	2.3	4.4	3.4	5.3	7.1	12.5	12.3	10.1	2
***Philautus amboli* sp. nov.**	M	Amboli	BNHS 4398 (HT)	33.4	12.0	12.0	3.5	2.5	4.8	4.5	6.5	9.7	15.9	15.8	12.9	2
	M	Amboli	BNHS 4399 (PT)	34.1	12.0	12.1	3.4	2.6	5.0	4.0	6.7	9.8	16.5	16.4	12.9	2
	M	Amboli	BNHS 4400 (PT)	32.2	12.0	12.0	3.4	2.7	5.1	3.7	6.2	9.6	15.4	15.3	12.5	2
	M	Amboli	BNHS 4401 (PT)	32.4	12.6	12.7	3.8	2.7	5.2	4.2	6.1	9.2	15.3	15.2	13.0	2
	M	Amboli	BNHS 4402 (PT)	31.7	12.0	12.1	3.7	2.4	4.8	4.2	6.1	9.4	15.1	15.1	12.6	2
	M	Amboli	BNHS 4403 (PT)	31.3	11.2	11.4	3.2	2.5	5.0	3.7	6.3	9.3	15.1	15.0	13.5	2
	M	Castle Rock	BNHS 4542	29.4	11.5	11.5	3.4	2.5	4.8	4.1	6.1	9.3	15.1	15.0	12.2	2
	M	Londa	BNHS 4475	27.6	9.9	10.0	3.0	2.5	4.4	3.4	5.9	8.0	14.4	14.3	12.6	2
	M	Jog Falls	BNHS 4534	28.1	11.3	11.5	3.2	2.4	4.7	3.7	6.1	8.2	14.1	14.2	13.1	2
			Average	**31.1**	**11.6**	**11.7**	**3.4**	**2.5**	**4.9**	**3.9**	**6.2**	**9.2**	**15.2**	**15.1**	**12.8**	
			Standard deviation	**2.3**	**0.8**	**0.8**	**0.3**	**0.1**	**0.2**	**0.3**	**0.2**	**0.6**	**0.7**	**0.7**	**0.4**	
	F	Amboli	BNHS 4535 (PT)	37.5	13.7	14.2	4.9	3.1	6.2	4.1	8.1	11.0	18.4	18.2	15.0	2
Philautus anili	M	Kalpetta	BNHS 4276 (HT)	23.8	9.0	9.2	2.5	2.4	3.6	3.2	5.5	6.3	10.8	11.6	8.9	2
	M	Kalpetta	BNHS 4277 (PT)	25.2	9.3	9.4	3.0	2.6	4.3	3.6	5.8	6.8	11.6	12.5	9.6	2
	M	Sulthanbathery	BNHS 4278 (PT)	23.9	9.1	9.3	2.7	2.3	4.1	3.0	5.6	6.6	11.9	12.3	9.4	2
	M	Sulthanbathery	BNHS 4279 (PT)	24.5	9.3	9.4	3.4	2.7	3.9	3.9	5.7	6.6	12.0	12.1	9.6	2
	M	Sulthanbathery	BNHS 4585 (PT)	23.2	9.0	9.1	3.1	2.0	3.5	3.6	5.6	6.1	10.2	11.8	9.0	2
	M	Kalpetta	BNHS 4404	24.5	8.9	8.9	2.7	2.1	3.7	3.3	5.1	7.0	12.0	13.0	9.8	2

M	Kalpetta	BNHS 4405	23.8	9.0	8.9	3.0	2.4	3.4	3.1	5.0	6.7	10.4	11.8	9.0	2	
		Average	**24.1**	**9.1**	**9.2**	**2.9**	**2.4**	**3.8**	**3.4**	**5.5**	**6.6**	**11.3**	**12.2**	**9.3**		
		Standard deviation	**0.7**	**0.2**	**0.2**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.8**	**0.5**	**0.4**		
M	Ponmudi	BNHS 4568	27.0	10.0	10.3	2.7	2.6	3.9	4.0	5.6	7.3	12.8	12.7	9.8	2	
M	Ponmudi	BNHS 4569	25.1	9.6	9.8	2.7	2.2	4.0	3.6	5.4	6.6	12.6	12.4	9.2	2	
M	Ponmudi	BNHS 4570	27.7	9.8	10.0	3.0	2.6	4.3	3.2	5.6	6.3	13.0	13.1	9.5	2	
M	Ponmudi	BNHS 4571	23.0	9.1	9.0	2.8	2.3	3.6	3.4	5.0	6.0	11.2	11.3	8.0	2	
M	Ponmudi	BNHS 4572	22.0	9.4	9.3	3.4	2.0	3.7	3.6	4.6	5.2	10.8	11.6	8.1	2	
M	Ponmudi	BNHS 4573	25.7	10.0	9.9	2.9	2.3	3.4	3.2	5.6	6.4	12.3	12.9	8.2	2	
		Average	**25.1**	**9.7**	**9.7**	**2.9**	**2.3**	**3.8**	**3.5**	**5.3**	**6.3**	**12.1**	**12.3**	**8.8**		
		Standard deviation	**2.2**	**0.4**	**0.5**	**0.3**	**0.2**	**0.3**	**0.3**	**0.4**	**0.7**	**0.9**	**0.7**	**0.8**		
F	Kalpetta	BNHS 4280 (PT)	39.3	11.8	12.0	3.7	3.0	5.1	4.1	6.7	9.6	14.7	15.8	12.7	2	
M	'Atray Mallay'	NMW 22884-2 (LT)	16.8	6.7	6.7	2.7	1.3	2.7	2.8	4.0	4.3	7.5	7.7	6.6	2	
M	'Atray Mallay'	BMNH1947.2.26.76	16.4	6.7	6.6	1.9	1.6	2.5	2.6	4.0	4.4	7.0	7.7	6.0	2	
M	'Atray Mallay'	BMNH1947.2.26.77	16.1	6.2	6.1	2.1	1.4	2.3	2.4	3.9	4.9	7.0	7.9	5.9	2	
M	'Atray Mallay'	BMNH 1947.2.26.67	17.4	6.5	6.4	2.1	1.6	2.7	2.7	3.5	4.7	7.1	8.0	6.0	2	
M	Athirimala	BNHS 4407	18.3	7.3	7.2	2.6	1.2	2.8	2.8	4.1	5.5	8.8	9.7	7.8	2	
M	Athirimala	BNHS 4408	15.6	6.3	6.1	2.0	1.4	2.5	2.5	3.9	4.5	7.4	8.0	6.2	2	
M	Athirimala	BNHS 4409	20.6	7.4	7.5	2.8	1.6	2.8	2.8	4.1	5.5	10.1	10.2	8.2	2	
M	Kannikatti	BNHS 4410	19.9	7.7	7.6	2.5	1.9	2.7	2.7	4.6	5.4	9.4	9.8	7.9	2	
		Average	**17.6**	**6.9**	**6.8**	**2.3**	**1.5**	**2.6**	**2.7**	**4.0**	**4.9**	**8.0**	**8.6**	**6.8**		
		Standard deviation	**1.8**	**0.6**	**0.6**	**0.4**	**0.2**	**0.2**	**0.2**	**0.3**	**0.5**	**1.2**	**1.1**	**1.0**		
M	Munnar	BNHS 4411	21.3	8.1	8.1	2.8	1.7	3.0	2.9	5.3	6.3	9.5	10.1	8.6	2	
M	Munnar	BNHS 4412	23.0	8.5	8.4	2.8	1.5	3.2	3.1	4.7	6.2	10.7	10.4	8.7	2	
M	Munnar	BNHS 4413	23.3	8.3	8.2	2.9	2.1	3.1	3.0	4.9	6.9	9.9	10.8	9.5	2	
		Average	**22.5**	**8.3**	**8.2**	**2.8**	**1.8**	**3.1**	**3.0**	**5.0**	**6.5**	**10.0**	**10.4**	**8.9**		
		Standard deviation	**1.1**	**0.2**	**0.2**	**0.1**	**0.3**	**0.1**	**0.1**	**0.3**	**0.4**	**0.6**	**0.4**	**0.5**		
F	'Atray Mallay'	BMNH1947.2.26.60	22.9	8.8	9.0	2.9	1.8	3.7	3.5	4.6	4.7	10.2	10.7	7.9	2	
F	'Atray Mallay'	BMNH1947.2.26.61	23.8	8.8	8.9	3.1	2.0	3.5	3.2	5.6	5.3	10.1	10.5	7.8	2	
F	Athirimala	BNHS 4414	24.6	9.1	9.0	2.7	1.7	3.3	3.4	5.2	6.5	11.3	11.3	9.2	2	
F	Munnar	BNHS 4415	29.9	10.8	10.6	3.3	2.3	3.6	3.8	6.0	8.4	13.6	13.6	11.9	2	
F	Munnar	BNHS 4416	27.9	10.2	9.8	3.4	2.2	4.0	3.9	6.1	8.2	12.9	12.8	10.9	2	
		Average	**25.8**	**9.5**	**9.5**	**3.1**	**2.0**	**3.6**	**3.6**	**5.5**	**6.6**	**11.6**	**11.8**	**9.5**		
		Standard deviation	**3.0**	**3.1**	**3.2**	**1.0**	**0.7**	**1.3**	**1.1**	**1.7**	**2.4**	**4.1**	**4.1**	**3.4**		
M	Ponmudi	BNHS 4272 (HT)	21.3	9.3	8.2	4.0	1.6	3.0	3.5	4.9	5.5	12.0	11.2	9.2	2	
M	Ponmudi	BNHS 4273 (PT)	24.8	9.4	8.9	3.6	2.3	3.2	4.0	5.9	6.6	12.7	11.6	10.0	2	
M	Ponmudi	BNHS 4274 (PT)	24.7	9.3	8.5	3.2	2.1	3.1	4.0	5.3	6.8	12.4	11.9	10.0	2	
M	Ponmudi	BNHS 4443 (PT)	24.0	9.2	8.4	3.4	2.0	3.4	4.1	5.6	6.4	12.2	11.0	10.0	2	
M	Ponmudi	FMNH 218111	20.0	8.1	7.8	3.2	1.8	2.9	3.5	4.1	5.8	10.6	9.8	7.9	2	
M	Ponmudi	FMNH 218112	21.1	8.9	8.1	3.2	1.8	2.9	3.2	4.8	6.0	11.2	10.2	8.0	2	
M	Ponmudi	FMNH 218113	21.6	8.5	7.8	2.8	1.7	3.0	3.5	4.1	6.0	11.4	10.9	8.1	2	
		Average	**22.5**	**9.0**	**8.2**	**3.3**	**1.9**	**3.1**	**3.7**	**5.0**	**6.2**	**11.8**	**10.9**	**9.0**		
		Standard deviation	**2.0**	**0.5**	**0.4**	**0.4**	**0.2**	**0.2**	**0.3**	**0.7**	**0.5**	**0.7**	**0.7**	**1.0**		

Philautus beddomii

Philautus bobingeri

Table 2. *Continued*

Species	Sex	Locality	Museum number	SVL	HW	HL	IUE	UEW	SL	EL	FLL	HAL	TL	ShL	FOL	HeTo
	F	Ponmudi	BNHS 4275 (PT)	26.0	10.9	10.1	3.4	2.2	3.9	4.2	5.2	7.5	13.2	12.5	10.0	2
	F	Ponmudi	FMNH 218114 (PT)	23.5	9.7	8.7	3.2	1.8	3.4	4.0	5.5	6.7	12.3	11.8	9.6	2
			Average	**24.8**	**10.3**	**9.4**	**3.3**	**2.0**	**3.7**	**4.1**	**5.4**	**7.1**	**12.8**	**12.2**	**9.8**	
			Standard deviation	**1.8**	**0.8**	**1.0**	**0.1**	**0.3**	**0.4**	**0.1**	**0.2**	**0.6**	**0.6**	**0.5**	**0.3**	
Philautus bombayensis	M	Castle Rock	ZSIC 18287 (HT)	23.3	8.1	7.3	3.1	1.7	3.2	2.6	4.8	6.0	10.3	10.2	8.2	1
	M	Castle Rock	SDB 40205	21.0	7.8	7.2	2.3	1.7	3.2	2.5	4.4	6.3	9.5	9.8	8.5	1
	M	Castle Rock	BNHS 4418	20.2	7.9	7.1	2.9	1.4	3.3	2.4	4.1	6.7	9.0	9.4	8.4	1
	M	Amboli	BNHS 4589	22.5	8.1	7.5	2.7	1.7	3.5	2.6	4.3	6.9	9.6	9.8	8.5	1
	M	Amboli	SDB 2006B	24.3	9.2	8.8	2.6	1.8	4.0	3.0	5.1	7.1	10.0	10.3	9.0	1
	M	Londa	SDB 40196	20.7	7.6	7.0	2.0	1.2	3.0	2.4	4.6	6.0	9.6	9.7	8.6	1
			Average	**22.0**	**8.1**	**7.5**	**2.6**	**1.6**	**3.4**	**2.6**	**4.6**	**6.5**	**9.7**	**9.9**	**8.5**	
			Standard deviation	**1.6**	**0.6**	**0.7**	**0.4**	**0.2**	**0.4**	**0.2**	**0.4**	**0.5**	**0.4**	**0.3**	**0.3**	
	F	Castle Rock	BNHS 4419	24.9	9.6	9.2	3.4	2.0	3.5	3.0	4.8	7.5	9.8	9.3	8.4	1
Philautus chalazodes	F	'Travancore'	BMNH 1947.2.6.35 (HT)	27.9	10.8	10.2	3.2	1.8	4.1	4.2	6.6	7.7	13.2	13.3	13.1	–
Philautus charius	M	'Chikmalagur'	MNHN 1999.5597 (NT)	29.0	10.7	10.0	3.5	2.7	3.6	3.7	7.0	8.7	13.3	12.7	12.3	2
	M	Chikmagalur	BNHS 4420	28.3	9.8	8.8	3.7	2.7	4.2	4.2	6.1	8.2	13.2	12.2	11.4	2
	M	Chikmagalur	BNHS 4421	27.9	9.9	9.0	3.4	1.7	3.9	3.8	6.2	7.7	12.8	12.5	11.4	2
	M	Mercara	BNHS 4422	31.4	10.4	9.7	3.6	2.2	4.3	4.4	7.3	9.1	14.0	14.0	12.6	1
	M	Mercara	BNHS 4423	29.0	9.6	9.0	3.7	1.9	4.1	4.0	7.6	8.8	14.2	13.7	11.0	2
	M	Kottigehara	BNHS 4424	29.0	10.2	9.6	3.3	1.9	3.5	3.5	7.5	7.9	14.1	13.8	12.6	2
	M	Muthodi	SDB 40213	27.2	9.6	8.6	3.4	2.0	3.5	3.5	6.0	7.9	12.1	12.3	11.8	2
			Average	**28.8**	**10.0**	**9.2**	**3.5**	**2.2**	**3.9**	**3.9**	**6.8**	**8.3**	**13.4**	**13.0**	**11.9**	
			Standard deviation	**1.3**	**0.4**	**0.5**	**0.2**	**0.4**	**0.3**	**0.3**	**0.7**	**0.5**	**0.8**	**0.8**	**0.6**	
***Philautus chlorosomma* sp. nov.**	M	Munnar	BNHS 4425 (HT)	27.5	10.8	10.6	3.3	2.9	4.4	4.6	6.5	8.1	13.6	14.6	11.6	3
	M	Munnar	BNHS 4426 (PT)	26.9	10.4	10.3	3.0	2.8	4.4	4.3	5.7	7.9	12.4	14.3	10.7	3
	M	Munnar	SDB 1061B	25.9	10.6	10.4	2.9	2.7	4.3	4.2	5.6	7.3	12.3	13.6	10.5	3
			Average	**26.8**	**10.6**	**10.4**	**3.1**	**2.8**	**4.4**	**4.4**	**5.9**	**7.8**	**12.8**	**14.2**	**10.9**	
			Standard deviation	**0.8**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.2**	**0.5**	**0.4**	**0.7**	**0.5**	**0.6**	
***Philautus chotta* sp. nov.**	M	Ponmudi	BNHS 4427 (HT)	16.0	6.0	5.8	2.0	1.5	2.6	2.7	4.0	4.6	8.3	8.7	6.6	3
	M	Ponmudi	BNHS 4428 (PT)	16.5	6.9	6.7	2.1	1.6	2.9	2.4	4.2	4.3	8.7	8.9	6.4	3
	M	Ponmudi	BNHS 4429 (PT)	16.7	6.7	6.6	2.2	1.4	2.8	2.3	4.0	4.5	9.3	9.3	7.6	3
	M	Ponmudi	BNHS 4430 (PT)	16.5	6.8	6.7	2.2	1.5	3.0	2.4	4.0	4.8	9.1	9.4	6.9	3
	M	Ponmudi	BNHS 4431 (PT)	16.7	6.4	6.2	2.4	1.4	2.8	2.4	4.1	4.4	8.8	9.2	6.5	3
	M	Ponmudi	BNHS 4432 (PT)	17.0	6.5	6.4	2.3	1.5	2.7	2.5	4.0	4.2	8.9	9.0	6.3	3
	M	Ponmudi	FMNH 218107	17.2	6.1	6.4	2.4	1.5	2.7	2.4	4.0	4.2	8.7	8.9	6.0	3
			Average	**16.7**	**6.5**	**6.4**	**2.2**	**1.5**	**2.8**	**2.4**	**4.0**	**4.4**	**8.8**	**9.1**	**6.6**	
			Standard deviation	**0.4**	**0.3**	**0.3**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**	**0.5**	
	F	Ponmudi	FMNH 218101 (PT)	20.5	7.9	7.5	2.4	1.7	3.8	2.4	4.5	4.8	10.7	10.9	7.1	3

***Philautus chromasynchysi* sp. nov.**	M	Kurichiyarmala	BNHS 4433 (HT)	23.3	8.9	9.0	2.9	2.0	3.3	3.5	5.1	6.6	12.4	12.7	9.7	2
	M	Kurichiyarmala	BNHS 4434 (PT)	18.0	7.2	7.3	2.7	1.8	2.7	2.9	4.2	4.5	9.8	10.5	7.3	2
	M	Kurichiyarmala	BNHS 4436 (PT)	21.8	8.4	8.8	2.6	2.0	3.3	3.1	4.3	6.5	10.7	11.8	8.6	2
	M	Kurichiyarmala	BNHS 4435 (PT)	20.2	7.8	8.0	3.2	1.7	3.0	2.9	4.6	5.4	10.5	11.2	8.5	2
	M	Kurichiyarmala	BNHS 4437 (PT)	25.0	9.6	9.3	3.0	2.2	3.6	3.8	5.3	7.6	12.2	13.4	9.9	2
	M	Kurichiyarmala	BNHS 4438 (PT)	23.5	8.5	8.6	2.7	1.8	3.4	3.6	5.0	6.6	12.1	12.1	9.6	2
	M	Kurichiyarmala	BNHS 4439 (PT)	23.4	8.6	9.1	3.4	1.9	3.5	3.8	5.9	6.9	11.9	12.4	10.3	2
	M	Kurichiyarmala	BNHS 4440 (PT)	27.6	10.6	10.5	3.4	2.2	4.1	3.9	6.2	8.3	14.3	14.0	11.7	2
			Average	**22.9**	**8.7**	**8.8**	**3.0**	**2.0**	**3.4**	**3.4**	**5.1**	**6.6**	**11.7**	**12.3**	**9.5**	
			Standard deviation	**2.9**	**1.0**	**0.9**	**0.3**	**0.2**	**0.4**	**0.4**	**0.7**	**1.2**	**1.4**	**1.1**	**1.3**	
	F	Kurichiyarmala	BNHS 4441 (PT)	29.7	11.0	11.4	3.6	2.1	4.4	3.8	6.7	8.1	13.7	15.2	11.5	2
	F	Kurichiyarmala	BNHS 4442 (PT)	27.7	10.3	10.3	3.4	2.3	3.8	4.0	5.8	7.2	12.8	14.7	11.0	2
			Average	**28.7**	**10.7**	**10.9**	**3.5**	**2.2**	**4.1**	**3.9**	**6.3**	**7.7**	**13.3**	**15.0**	**11.3**	
			Standard deviation	**1.4**	**0.5**	**0.8**	**0.1**	**0.1**	**0.4**	**0.1**	**0.6**	**0.6**	**0.6**	**0.4**	**0.4**	
***Philautus coonoorensis* sp. nov.**	M	Coonoor	BNHS 4444 (HT)	22.4	8.0	7.9	3.0	1.4	3.5	2.8	4.9	6.5	11.6	11.9	9.4	3
	M	Coonoor	BNHS 4445 (PT)	23.6	8.7	8.6	3.0	1.8	3.8	2.9	5.2	6.6	12.5	12.7	10.3	3
	M	Coonoor	BNHS 4446 (PT)	23.8	8.7	8.7	3.3	2.1	3.4	2.5	5.4	7.0	12.6	12.4	9.6	3
	M	Coonoor	BNHS 4447 (PT)	20.8	8.0	7.9	2.9	2.1	3.7	2.3	4.6	5.7	9.2	10.5	8.5	3
	M	Coonoor	SDB 0003	20.7	7.5	7.5	3.0	1.6	3.4	2.1	4.4	5.6	9.3	10.5	7.6	3
			Average	**22.3**	**8.2**	**8.1**	**3.0**	**1.8**	**3.6**	**2.5**	**4.9**	**6.3**	**11.0**	**11.6**	**9.1**	
			Standard deviation	**1.5**	**0.5**	**0.5**	**0.2**	**0.3**	**0.2**	**0.3**	**0.4**	**0.6**	**1.7**	**1.0**	**1.0**	
Philautus dubois	M	Kodaikanal	BNHS 4281 (HT)	20.5	8.6	8.5	2.7	1.8	3.1	2.8	4.4	6.3	9.5	8.9	8.0	2
	M	Kodaikanal	BNHS 4282 (PT)	19.2	8.3	7.6	2.7	2.1	3.0	2.8	4.2	5.4	9.3	8.9	7.7	2
	M	Kodaikanal	BNHS 4283 (PT)	20.6	8.2	7.8	3.0	2.0	3.2	2.7	4.9	5.1	10.1	9.2	8.3	2
	M	Kodaikanal	BNHS 4284 (PT)	20.8	8.2	8.5	2.8	1.7	3.1	2.6	4.1	5.8	10.0	9.3	7.1	2
	M	Kodaikanal	BNHS 4285 (PT)	20.1	7.8	7.4	2.6	1.5	3.1	2.4	4.3	5.5	9.8	9.0	7.5	2
	M	Eravikulam	BNHS 4448	21.6	9.4	8.4	2.6	1.7	3.2	2.7	4.4	5.8	10.1	9.4	7.4	2
	M	Konalar	BNHS 4449	22.1	7.7	7.6	2.5	1.8	3.1	2.6	4.3	5.8	9.6	9.0	7.6	2
			Average	**20.7**	**8.3**	**8.0**	**2.7**	**1.8**	**3.1**	**2.7**	**4.4**	**5.7**	**9.8**	**9.1**	**7.7**	
			Standard deviation	**1.0**	**0.6**	**0.5**	**0.2**	**0.2**	**0.1**	**0.1**	**0.3**	**0.4**	**0.3**	**0.2**	**0.4**	
	F	Kodaikanal	BNHS 4286 (PT)	25.1	9.3	9.0	3.5	1.9	3.6	2.7	5.2	7.2	10.9	11.8	9.5	2
	F	Kodaikanal	BNHS 4287 (PT)	25.3	10.1	9.6	3.6	2.1	3.9	3.1	5.8	7.3	11.8	12.4	10.3	2
			Average	**25.2**	**9.7**	**9.3**	**3.6**	**2.0**	**3.8**	**2.9**	**5.5**	**7.3**	**11.4**	**12.1**	**9.9**	
			Standard deviation	**0.1**	**0.6**	**0.4**	**0.1**	**0.1**	**0.2**	**0.3**	**0.4**	**0.1**	**0.6**	**0.4**	**0.6**	
Philautus flaviventris	M	'Malabar'	BMNH 1947.2.26.98 (LT)	29.8	11.3	10.6	3.9	2.7	3.9	3.7	7.1	8.5	13.6	13.7	11.6	2
Philautus glandulosus	M	'Manantoddy'	BMNH1947.2.27.22 (NT)	22.3	9.1	8.0	3.2	2.0	3.5	3.2	4.6	5.3	11.3	11.0	8.5	2
	M	Mercara	BNHS 4453	25.2	10.1	9.1	3.8	2.0	3.8	3.3	6.2	6.9	13.2	12.5	9.6	2
	M	Mananthavady	SDB 40239	26.2	10.4	9.9	3.5	2.0	4.1	3.9	5.7	7.2	14.4	13.4	9.7	1
	M	Sulthanbathery	BNHS 4454	26.9	10.3	9.8	3.9	2.1	4.2	3.6	5.4	6.6	14.5	12.7	10.3	2
			Average	**25.2**	**10.0**	**9.2**	**3.6**	**2.0**	**3.9**	**3.5**	**5.5**	**6.5**	**13.4**	**12.4**	**9.5**	
			Standard deviation	**2.0**	**0.6**	**0.9**	**0.3**	**0.1**	**0.3**	**0.3**	**0.7**	**0.8**	**1.5**	**1.0**	**0.8**	

Table 2. *Continued*

Species	Sex	Locality	Museum number	SVL	HW	HL	IUE	UEW	SL	EL	FLL	HAL	TL	ShL	FOL	HeTo
Philautus graminirupes	M	Ponmudi	BNHS 4264 (HT)	22.6	9.4	9.4	2.8	2.7	3.1	4.0	5.0	7.0	12.8	11.6	9.3	2
	M	Ponmudi	BNHS 4265 (PT)	21.4	8.6	8.3	2.6	2.1	3.0	3.9	5.1	5.7	11.0	10.5	8.2	2
	M	Ponmudi	BNHS 4266 (PT)	21.6	9.8	9.1	2.9	2.5	3.0	3.8	5.2	6.5	12.2	11.7	9.0	2
	M	Ponmudi	BNHS 4587 (PT)	22.4	9.1	9.0	2.6	2.4	3.2	4.2	5.3	6.8	12.2	11.6	8.9	2
			Average	**22.0**	**9.2**	**9.0**	**2.7**	**2.4**	**3.1**	**4.0**	**5.2**	**6.5**	**12.1**	**11.4**	**8.9**	
			Standard deviation	**0.6**	**0.5**	**0.5**	**0.2**	**0.3**	**0.1**	**0.2**	**0.1**	**0.6**	**0.8**	**0.6**	**0.5**	
	F	Ponmudi	BNHS 4267 (PT)	29.4	12.0	12.0	3.5	2.9	4.0	4.8	6.5	6.4	15.6	15.0	11.9	2
	F	Ponmudi	FMNH 218118 (PT)	27.3	11.6	11.4	3.7	2.6	4.0	4.5	6.5	6.2	15.0	14.8	11.0	2
			Average	**28.4**	**11.8**	**11.7**	**3.6**	**2.8**	**4.0**	**4.7**	**6.5**	**6.3**	**15.3**	**14.9**	**11.5**	
			Standard deviation	**1.5**	**0.3**	**0.4**	**0.1**	**0.2**	**0.0**	**0.2**	**0.0**	**0.1**	**0.4**	**0.1**	**0.6**	
Philautus griet	M	Munnar	KBIN 1919 (HT)	21.3	7.5	7.0	2.5	2.0	2.7	2.6	5.6	6.3	9.2	9.3	8.9	2
	M	Munnar	BNHS 4455	20.6	7.5	7.4	2.3	1.6	2.5	2.7	5.0	6.7	9.5	9.0	8.7	2
	M	Munnar	BNHS 4456	19.7	6.4	6.5	2.2	1.3	2.6	2.8	4.7	5.6	8.0	9.0	8.6	2
	M	Munnar	BNHS 4457	21.6	6.5	6.6	2.1	1.6	2.5	2.4	4.6	5.2	8.3	8.7	8.5	2
	M	Valparai	BNHS 4458	22.4	7.0	7.0	2.5	1.2	2.4	2.5	5.3	6.7	9.5	9.4	8.5	1
			Average	**21.1**	**7.0**	**6.9**	**2.3**	**1.5**	**2.5**	**2.6**	**5.0**	**6.1**	**8.9**	**9.1**	**8.6**	
			Standard deviation	**1.0**	**0.5**	**0.4**	**0.2**	**0.3**	**0.1**	**0.2**	**0.4**	**0.7**	**0.7**	**0.3**	**0.2**	
	F	Munnar	BNHS 4464	22.0	7.5	7.6	3.3	1.4	2.6	2.7	4.8	5.4	10.0	9.4	8.6	1
***Philautus jayarami* sp. nov.**	M	Valparai	BNHS 4459 (HT)	26.0	11.0	10.0	4.5	2.0	4.1	3.2	5.7	8.0	13.0	13.3	11.2	2
	M	Valparai	BNHS 4460 (PT)	28.4	11.5	10.8	3.4	2.3	4.3	3.8	5.5	8.4	14.7	14.8	11.6	2
	M	Valparai	BNHS 4461 (PT)	29.1	11.7	10.7	4.0	2.2	4.5	3.7	6.1	8.1	14.5	14.5	11.6	2
	M	Valparai	BNHS 4462 (PT)	24.4	9.1	8.9	3.6	1.7	3.7	2.9	4.9	6.5	12.1	12.0	9.4	2
	M	Valparai	BNHS 4543 (PT)	25.4	9.8	9.3	3.6	1.6	4.0	2.8	5.7	7.4	12.4	12.3	10.5	2
	M	Valparai	SDB 40273	24.7	9.3	8.6	3.6	2.0	4.0	2.8	5.0	6.8	11.9	12.0	9.4	2
			Average	**26.3**	**10.4**	**9.7**	**3.8**	**2.0**	**4.1**	**3.2**	**5.5**	**7.5**	**13.1**	**13.2**	**10.6**	
			Standard deviation	**2.0**	**1.1**	**0.9**	**0.4**	**0.3**	**0.3**	**0.5**	**0.5**	**0.8**	**1.2**	**1.3**	**1.0**	
***Philautus kaikatti* sp. nov.**	M	Kaikatti	BNHS 4557 (HT)	24.2	9.5	9.5	2.8	1.9	3.6	3.7	5.4	7.3	12.5	12.7	10.0	2
	M	Kaikatti	BNHS 4465 (PT)	26.3	9.7	9.7	3.2	2.6	3.6	4.1	5.8	8.1	13.8	13.6	10.8	2
	M	Kaikatti	BNHS 4417 (PT)	25.4	9.8	9.7	3.3	2.4	3.6	3.8	4.9	7.3	12.7	11.9	10.1	2
	M	Kaikatti	BNHS 4466 (PT)	25.8	10.1	9.9	3.1	2.8	3.9	3.7	5.5	8.4	11.5	11.6	10.4	2
	M	Kaikatti	SDB 541	22.8	8.9	8.9	2.8	1.9	3.6	3.8	5.2	6.9	12.0	11.8	9.5	2
			Average	**24.9**	**9.6**	**9.5**	**3.0**	**2.3**	**3.7**	**3.8**	**5.4**	**7.6**	**12.5**	**12.3**	**10.2**	
			Standard deviation	**1.4**	**0.4**	**0.4**	**0.2**	**0.4**	**0.1**	**0.2**	**0.3**	**0.6**	**0.9**	**0.8**	**0.5**	
***Philautus kani* sp. nov.**	M	Chathankod	BNHS 4467 (HT)	20.0	7.6	8.1	2.4	2.0	4.0	3.0	4.7	5.8	10.6	10.6	8.0	2
	M	Chathankod	BNHS 4468 (PT)	21.4	7.2	7.9	2.6	2.1	3.6	3.0	4.3	6.4	10.2	10.2	8.5	2
	M	Chathankod	BNHS 4469 (PT)	18.1	6.6	7.2	2.4	1.9	2.9	2.3	3.7	5.3	9.8	9.9	7.6	2
	M	Chathankod	BNHS 4470 (PT)	21.4	7.0	8.0	2.4	2.0	3.0	3.1	4.7	5.6	10.2	10.3	8.1	2
	M	Chathankod	BNHS 4471 (PT)	19.7	7.2	8.1	2.3	1.7	3.6	2.4	4.7	5.2	9.6	9.7	7.5	2
	M	Chathankod	BNHS 4472 (PT)	22.9	7.7	8.8	2.3	2.2	3.8	3.2	5.1	6.0	11.1	11.0	9.4	2
	M	Palode	BNHS 4473 (PT)	21.0	7.0	7.9	2.7	1.7	2.9	2.4	4.4	5.8	10.6	11.5	8.1	2

			Average	**20.6**	**7.2**	**8.0**	**2.4**	**1.9**	**3.4**	**2.8**	**4.5**	**5.7**	**10.3**	**10.5**	**8.2**	
			Standard deviation	**1.5**	**0.4**	**0.5**	**0.2**	**0.2**	**0.5**	**0.4**	**0.4**	**0.4**	**0.5**	**0.6**	**0.6**	
	F	Chathankod	BNHS 4474 (PT)	24.4	8.7	10.2	2.2	2.1	3.6	3.0	5.1	6.4	12.5	12.4	10.1	2
Philautus	M	Kirundadu	BNHS 4191 (HT)	27.9	10.0	10.6	3.5	2.5	3.6	3.7	6.1	7.5	13.2	13.5	10.0	2
luteolus	M	Kudremukh	BNHS 4476	25.6	9.4	9.7	3.5	2.2	3.8	3.7	5.6	7.4	12.3	12.2	10.0	2
	M	Kudremukh	BNHS 4477	26.4	9.8	9.7	3.2	2.0	4.1	3.5	5.8	7.4	12.6	12.7	9.8	2
	M	Mercara	BNHS 4478	27.3	9.6	10.1	3.2	2.1	4.2	3.7	5.7	7.3	12.8	12.9	10.2	2
	M	Muthodi	BNHS 4479	23.8	8.6	8.6	2.8	2.0	3.6	2.9	5.1	6.7	11.3	11.4	9.3	2
	M	Sakleshpur	BNHS 4480	27.9	9.8	10.0	3.7	2.4	4.2	4.0	5.4	7.0	12.8	12.8	10.1	2
	M	Jog falls	BNHS 4532	28.6	9.8	10.4	3.1	2.4	4.3	3.3	6.0	8.0	13.2	13.3	10.4	2
			Average	**26.8**	**9.6**	**9.9**	**3.3**	**2.2**	**4.0**	**3.5**	**5.7**	**7.3**	**12.6**	**12.7**	**10.0**	
			Standard deviation	**1.7**	**0.5**	**0.7**	**0.3**	**0.2**	**0.3**	**0.4**	**0.3**	**0.4**	**0.7**	**0.7**	**0.3**	
Philautus	M	Kaikatti	BNHS 4537 (HT)	22.8	7.2	7.4	2.9	1.6	3.4	2.9	4.5	6.3	9.4	10.6	9.0	2
***marki* sp.**	M	Kaikatti	BNHS 4538 (PT)	21.2	7.2	7.4	2.4	1.4	3.2	2.8	4.8	6.8	9.3	10.5	9.7	2
nov.	M	Kaikatti	BNHS 4539 (PT)	22.4	7.7	7.8	2.8	1.6	3.2	2.4	5.6	6.8	9.4	10.9	8.4	2
	M	Kaikatti	SDB 028C	22.2	7.3	7.4	2.4	1.7	3.3	2.6	5.0	6.7	10.0	11.2	9.3	2
			Average	**22.2**	**7.4**	**7.5**	**2.6**	**1.6**	**3.3**	**2.7**	**5.0**	**6.7**	**9.5**	**10.8**	**9.1**	
			Standard deviation	**0.7**	**0.2**	**0.2**	**0.3**	**0.1**	**0.1**	**0.2**	**0.5**	**0.2**	**0.3**	**0.3**	**0.5**	
	F	Kaikatti	BNHS 4540 (PT)	30.0	10.5	10.6	3.8	2.2	4.0	3.2	6.4	8.5	13.0	14.4	11.3	2
	F	Kaikatti	BNHS 4541 (PT)	27.6	10.3	10.4	4.0	1.9	4.5	3.6	6.5	8.2	11.5	12.6	11.0	2
			Average	**28.8**	**10.4**	**10.5**	**3.9**	**2.1**	**4.3**	**3.4**	**6.5**	**8.4**	**12.3**	**13.5**	**11.2**	
			Standard deviation	**1.7**	**0.1**	**0.1**	**0.1**	**0.2**	**0.4**	**0.3**	**0.1**	**0.2**	**1.1**	**1.3**	**0.2**	
Philautus	M	Munnar	BNHS 4481 (HT)	28.8	11.2	10.0	3.4	3.0	4.1	3.9	7.3	9.4	15.2	14.6	12.2	2
munnarensis	M	Munnar	BNHS 4482 (PT)	32.4	13.2	11.5	3.6	3.0	5.2	5.0	7.4	9.4	16.1	15.2	13.4	2
sp. nov.	M	Munnar	BNHS 4533 (PT)	27.8	10.6	11.0	3.4	2.7	4.5	4.3	6.7	9.3	14.4	13.6	12.2	2
	M	Munnar	SDB 029	31.4	12.0	11.9	2.9	2.7	4.3	4.0	6.4	9.5	16.3	14.0	12.7	2
	M	Devikulam	BMNH 97.10.13.2-a	32.6	13.2	11.9	3.6	2.6	5.1	4.8	6.7	9.2	16.2	15.2	13.3	2
	M	Devikulam	BMNH 97.10.13.2-b	29.5	12.4	11.4	3.5	2.9	4.3	4.0	7.0	9.4	16.1	15.0	12.4	2
			Average	**30.4**	**12.1**	**11.3**	**3.4**	**2.8**	**4.6**	**4.3**	**6.9**	**9.4**	**15.7**	**14.6**	**12.7**	
			Standard deviation	**2.0**	**1.1**	**0.7**	**0.3**	**0.2**	**0.5**	**0.5**	**0.4**	**0.1**	**0.8**	**0.7**	**0.5**	
Philautus	M	Kalpetta	BNHS 4244 (HT)	34.0	13.7	12.6	3.2	3.2	5.3	4.4	7.4	10.6	16.6	17.1	14.3	2
nerostagona	M	Kalpetta	BNHS 4245 (PT)	30.1	12.4	11.6	3.5	2.9	5.0	3.8	6.5	9.1	14.5	16.0	12.6	2
	M	Kalpetta	BNHS 4246 (PT)	32.4	13.1	11.9	3.3	3.0	5.8	3.8	7.1	9.4	15.3	17.2	14.0	2
			Average	**32.2**	**13.1**	**12.0**	**3.3**	**3.0**	**5.4**	**4.0**	**7.0**	**9.7**	**15.5**	**16.8**	**13.6**	
			Standard deviation	**2.0**	**0.7**	**0.5**	**0.2**	**0.2**	**0.4**	**0.3**	**0.5**	**0.8**	**1.1**	**0.7**	**0.9**	
Philautus	M	Kakkayam	ZSI/WGFRS/V/A 632 (HT)	25.6	8.6	6.4	2.8	1.9	2.9	2.9	4.4	7.0	10.4	10.1	9.5	–
ochlandrae	M	Kakkayam	ZSI/WGFRS/V/A 633 (PT)	22.1	8.2	6.0	2.8	1.6	2.6	2.8	4.9	6.0	9.5	10.1	8.8	–
	M	Kakkayam	ZSI/WGFRS/V/A 637 (PT)	24.5	8.0	6.3	2.6	1.9	3.0	3.3	5.3	6.1	9.9	11.3	9.4	–
	M	Kakkayam	SDB 6076	23.3	8.1	7.1	2.7	1.4	2.7	2.5	4.3	6.4	9.0	9.7	9.4	1
	M	Kakkayam	BNHS 4559	24.0	8.6	7.5	2.9	1.9	3.0	2.7	4.3	7.4	10.2	10.0	9.9	1
			Average	**23.9**	**8.3**	**6.6**	**2.7**	**1.7**	**2.8**	**2.8**	**4.6**	**6.6**	**9.8**	**10.2**	**9.4**	
			Standard deviation	**1.3**	**0.3**	**0.6**	**0.1**	**0.2**	**0.2**	**0.3**	**0.4**	**0.6**	**0.6**	**0.6**	**0.4**	
	F	Kakkayam	ZSI/WGFRS/V/A636 (PT)	23.3	8.3	6.1	2.9	1.7	3.1	3.1	5.4	7.4	10.4	11.4	9.9	–

Table 2. *Continued*

Species	Sex	Locality	Museum number	SVL	HW	HL	IUE	UEW	SL	EL	FLL	HAL	TL	ShL	FOL	HeTo
Philautus ponmudi	M	Ponmudi	BNHS 4257 (HT)	35.9	14.7	13.1	4.0	3.1	4.9	4.4	8.6	10.0	18.0	17.4	14.6	1
	M	Ponmudi	BNHS 4258 (PT)	36.3	14.9	13.6	4.9	3.3	5.0	5.2	8.5	10.1	17.3	17.3	14.4	1
	M	Ponmudi	BNHS 4259 (PT)	38.9	14.7	13.6	4.8	3.4	5.4	5.3	8.4	10.3	18.0	17.8	14.7	1
	M	Ponmudi	BNHS 4588 (PT)	38.6	15.0	13.5	4.5	3.6	5.5	5.2	8.8	10.6	17.3	17.7	14.8	1
	M	Vagaman	BNHS 4483	32.2	12.7	11.6	3.7	2.8	4.5	4.5	7.0	9.3	15.4	14.7	12.7	1
	M	Gavi	BNHS 4484	38.7	14.5	13.8	4.3	3.4	5.7	5.2	8.2	11.7	18.7	17.4	14.3	1
			Average	36.8	14.4	13.2	4.4	3.3	5.2	5.0	8.3	10.3	17.5	17.1	14.3	
			Standard deviation	2.6	0.9	0.8	0.5	0.3	0.4	0.4	0.6	0.8	1.1	1.2	0.8	
	M	Kalpetta	BNHS 4574	37.5	14.7	13.7	4.6	3.1	5.7	4.6	7.5	11.8	17.9	18.9	16.3	2
	M	Kalpetta	BNHS 4575	36.1	13.7	12.8	3.8	3.0	5.0	4.2	7.5	10.7	17.2	16.8	16.1	1
	M	Kalpetta	BNHS 4576	36.1	13.6	12.6	3.9	3.5	4.6	5.0	8.1	10.8	17.3	16.5	14.9	2
	M	Kalpetta	BNHS 4577	36.8	14.6	13.4	3.9	3.2	4.5	5.0	7.9	10.3	17.9	17.1	15.1	2
	M	Kalpetta	BNHS 4578	34.0	13.0	12.1	3.7	2.7	4.4	4.1	7.2	10.2	16.9	16.8	14.4	1
	M	Kalpetta	BNHS 4579	35.4	13.3	12.3	4.2	2.7	4.8	4.3	7.5	11.2	16.2	16.5	14.9	1
			Average	**36.0**	**13.8**	**12.8**	**4.0**	**3.0**	**4.8**	**4.5**	**7.6**	**10.8**	**17.2**	**17.1**	**15.3**	
			Standard deviation	**1.2**	**0.7**	**0.6**	**0.3**	**0.3**	**0.5**	**0.4**	**0.3**	**0.6**	**0.6**	**0.9**	**0.7**	
	F	Kalpetta	BNHS 4580	43.1	16.7	16.0	5.2	3.3	5.9	4.5	8.7	13.6	21.6	22.3	19.6	1
Philautus signatus	M	'Neelgherries'	BMNH 1947.2.27.36 (LT)	31.5	12	11.9	4	2.9	4.6	4.1	7.6	8.8	14.2	15	13.1	3
	M	Nilgiri Hills	BMNH 1947.2.27.37	28.7	11.0	11.0	3.9	2.8	4.7	4.1	5.9	8.4	13.7	14.5	11.8	2
	M	Coonoor	BNHS 4486	27.2	9.5	9.8	3.6	2.3	4.8	3.5	5.5	7.5	13.0	13.9	11.0	2
	M	Parsons Valley	BNHS 4487	29.1	9.7	9.3	3.1	2.3	4.1	3.3	5.9	7.1	11.9	12.7	10.1	2
	M	Naduvattam	BNHS 4488	35.1	12.5	12.5	4.5	3.1	5.0	4.3	6.8	10.3	15.0	15.9	13.5	2
	M	Avalanche	BNHS 4489	26.1	9.7	9.4	3.1	2.3	4.1	3.3	5.9	7.1	12.2	12.9	10.1	2
	M	Udhagamandalam	BNHS 4558	29.0	10.9	10.6	3.4	2.9	5.0	4.1	6.1	9.0	14.0	14.9	12.7	2
	M	Udhagamandalam	BNHS 4491	29.8	10.9	10.6	3.2	2.5	4.5	3.9	5.7	7.9	13.0	14.9	11.3	2
			Average	**29.6**	**10.8**	**10.6**	**3.6**	**2.6**	**4.6**	**3.8**	**6.2**	**8.3**	**13.4**	**14.3**	**11.7**	
			Standard deviation	**2.8**	**1.1**	**1.1**	**0.5**	**0.3**	**0.4**	**0.4**	**0.7**	**1.1**	**1.0**	**1.1**	**1.3**	
	F	Avalanche	BNHS 4492	40.5	14.9	13.4	5.2	2.9	6.4	5.0	9.1	11.4	18.9	18.9	16.1	2
***Philautus sushili* sp. nov.**	M	Valparai	BNHS 4544 (HT)	25.0	10.3	9.5	3.2	2.2	4.0	3.7	5.1	7.3	13.4	14.0	10.1	2
	M	Valparai	BNHS 4452 (PT)	25.2	10.3	9.4	3.2	2.5	3.7	4.0	5.0	7.1	12.8	13.5	10.5	2
	M	Valparai	BNHS 4450 (PT)	21.0	8.2	7.4	2.7	2.0	3.2	2.8	4.9	5.3	9.8	10.8	7.6	2
	M	Valparai	BNHS 4451 (PT)	26.6	10.7	9.7	3.1	2.6	4.1	3.9	6.1	7.8	12.9	13.8	9.9	2
	M	Valparai	SDB 016B	26.5	10.4	9.6	3.4	2.4	4.2	3.8	6.2	7.6	12.8	13.4	10.0	2
			Average	**24.9**	**10.0**	**9.1**	**3.1**	**2.3**	**3.8**	**3.6**	**5.5**	**7.0**	**12.3**	**13.1**	**9.6**	
			Standard deviation	**2.3**	**1.0**	**1.0**	**0.3**	**0.2**	**0.4**	**0.5**	**0.6**	**1.0**	**1.4**	**1.3**	**1.2**	

Philautus tinniens	F	'Neelgherries'	MNHN 1985.0527 (NT)	25.0	9.3	8.6	3.0	2.0	2.8	2.8	5.8	6.9	10.2	9.9	10.2	2
	F	Avalanche	BNHS 4497	27.4	10.0	9.0	2.8	1.8	3.4	3.1	4.9	6.6	10.3	10.6	10.5	2
	F	Udhagamandalam	BNHS 4548	28.0	10.1	9.1	3.0	1.8	3.3	2.8	5.7	6.5	10.5	10.4	10.3	2
			Average	**26.8**	**9.8**	**8.9**	**2.9**	**1.9**	**3.2**	**2.9**	**5.5**	**6.7**	**10.3**	**10.3**	**10.3**	
			Standard deviation	**1.6**	**0.4**	**0.3**	**0.1**	**0.1**	**0.3**	**0.2**	**0.5**	**0.2**	**0.2**	**0.4**	**0.2**	
	M	Coonoor	BNHS 4494	21.5	7.9	7.6	2.4	1.1	2.7	2.4	4.1	5.9	9.4	9.0	8.9	2
	M	Udhagamandalam	BNHS 4495	18.4	6.6	6.9	2.4	1.4	2.6	2.4	3.5	5.0	8.3	7.7	7.7	2
	M	Naduvattam	BNHS 4496	21.6	7.2	8.0	2.5	1.6	3.1	2.9	4.1	5.6	9.4	8.8	8.6	2
			Average	**20.5**	**7.2**	**7.5**	**2.4**	**1.4**	**2.8**	**2.6**	**3.9**	**5.5**	**9.0**	**8.5**	**8.4**	
			Standard deviation	**1.8**	**0.7**	**0.6**	**0.1**	**0.3**	**0.3**	**0.3**	**0.3**	**0.5**	**0.6**	**0.7**	**0.6**	
Philautus travancoricus	F	'Bodanaikanur'	BMNH 1947.2.6.20 (HT)	29.8	10.3	12.3	3.6	1.5	4.1	3.3	6.8	7.3	13.6	13.7	11	2
	M	Vandiperiyar	BNHS 4546	21.5	7.7	7.0	2.3	1.2	3.3	2.4	4.8	6.1	9.5	9.5	8.6	2
	M	Vagaman	BNHS 4547	24.7	7.8	8.2	3.0	1.4	3.2	2.6	5.2	6.9	10.9	10.8	9.8	2
	M	Vagaman	SDB 4592	24.2	7.3	8.2	2.8	1.6	3.7	2.5	5.1	7.0	10.0	10.0	9.4	2
			Average	**23.5**	**7.6**	**7.8**	**2.7**	**1.4**	**3.4**	**2.5**	**5.0**	**6.7**	**10.1**	**10.1**	**9.3**	
			Standard deviation	**1.7**	**0.3**	**0.7**	**0.4**	**0.2**	**0.3**	**0.1**	**0.2**	**0.5**	**0.7**	**0.7**	**0.6**	
Philautus tuberohumerus	M	Kudremukh	BNHS 4193 (HT)	18.2	6.6	6.9	2.4	1.7	2.6	2.5	4.0	4.4	9.3	9.0	7.0	2
	M	Kudremukh	BNHS 4498	18.8	6.4	6.8	2.4	1.4	2.2	2.2	4.0	4.6	8.7	7.8	7.0	2
	M	Kudremukh	BNHS 4499	19.0	6.3	6.8	2.3	1.5	2.4	2.5	4.5	5.0	9.7	8.5	7.9	2
	M	Mercara	BNHS 4590	18.4	6.7	7.0	2.0	1.5	2.5	2.5	4.2	4.7	9.6	8.1	6.8	2
	M	Sakleshpur	VUB 002	18.0	6.2	7.2	2.0	1.3	2.2	2.0	4.3	5.0	9.3	8.8	7.8	2
	M	Muthanga	SDB 4512	17.7	6.1	6.3	2.0	1.3	2.4	2.3	3.9	5.1	8.4	8.1	7.2	2
			Average	**18.4**	**6.4**	**6.8**	**2.2**	**1.5**	**2.4**	**2.3**	**4.2**	**4.8**	**9.2**	**8.4**	**7.3**	
			Standard deviation	**0.5**	**0.2**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.3**	**0.5**	**0.5**	**0.5**	
Philautus wynaadensis	M	Ganapathivattam	MNHN 1999.5596 (NT)	28.3	9.6	10.1	3.3	2.5	4.1	3.6	6.5	7.3	12.9	13.4	11.8	2
	M	Mettupalayam	BNHS 4550	24.1	8.2	9.1	2.6	2.1	3.8	3.5	5.8	6.6	12.1	12.9	10.0	2
	M	Kalpetta	BNHS 4551	26.3	9.0	10.2	3.2	2.3	4.2	3.4	5.3	7.5	13.1	13.7	11.2	2
	M	Kalpetta	BNHS 4552	23.9	7.7	9.2	2.8	2.0	3.7	3.5	5.7	6.8	11.3	12.0	9.3	2
	M	Sulthanbathery	BNHS 4553	26.1	8.3	9.2	2.7	1.2	3.9	3.6	6.1	7.8	13.0	13.9	10.3	2
	M	Sulthanbathery	BNHS 4554	25.7	9.1	9.6	3.1	2.3	3.8	3.5	6.1	7.6	13.1	13.9	11.3	2
	M	Mananthavady	BNHS 4555	25.8	9.2	10.4	3.4	1.9	4.0	3.7	5.7	7.8	13.0	13.9	11.4	2
			Average	**25.7**	**8.7**	**9.7**	**3.0**	**2.0**	**3.9**	**3.5**	**5.9**	**7.3**	**12.6**	**13.4**	**10.8**	
			Standard deviation	**1.5**	**0.7**	**0.5**	**0.3**	**0.4**	**0.2**	**0.1**	**0.4**	**0.5**	**0.7**	**0.7**	**0.9**	
	F	Kalpetta	BNHS 4556	27.2	9.4	10.8	3.4	2.6	4.0	3.8	5.3	7.5	13.3	14.0	10.8	2

The status of specimens is given after the museum number: HT, holotype; PT, paratypes; LT, lectotype; NT, neotype. HeTo: heels, with hindlimbs folded at right angle to the body, (1) do not touch, (2) barely touch (3) overlap; All other abbreviations are defined in the text.

completely green; throat light yellowish white, belly yellowish, hands and feet light brown.

In preservation: dorsally uniform light-violet–grey, with a few scattered light-grey spots, loreal and tympanic regions light brown, lateral region light grey; forelimbs with minute blackish brown spots, giving a light-brown appearance, hindlimbs with faint brownish grey cross bands; ventral side greyish white.

Variation: Measurements of 18 specimens, including six from the type series, are given in Table 2. There is a high variation in dorsal colour patterns, ranging from a predominantly uniform green through a variety of colours and markings (Fig. 4A–D): (1) greyish white in life (SDB 3021, Fig. 4A), turns light purplish in preservation; (2) typical yellowish green, without markings in life (paratype, BNHS 4388, Fig. 4B), turns to light-bluish violet in preservation, and has a slightly more granular dorsum when compared wth the holotype; (3) golden yellow with brownish black large irregular spots, and faint light-brown cross bands on limbs in life (paratype, BNHS 4536, Fig. 4C), turns to yellowish grey dorsum with dark spots; (4) dark-green with a golden yellowish streak from snout, along the side of head to near the vent in life (BNHS 4395), turns to light-violet dorsum and light-yellowish white streak in preservation; (5) dark-brown dorsum with a light-yellow streak in life (paratype, BNHS 4392, Fig. 4D), turns to light-greyish violet dorsum and light-grey streak in preservation; (6) dark-green dorsum with dark spots throughout in life, turns purplish violet with dark spots in preservation (BNHS 4390). These striking differences in colour pattern are also reflected in the preserved animals. When animals are held in captivity, the colour shifts from green to brownish green; however, the degree of variation in other colour morphs is rather limited. The tip of the snout in females is rather sharply pointed with a knob-like structure, and is lighter in coloration compared with the dorsum colour.

Etymology: Derived from two Greek words – *akro*, meaning 'extreme' and *parallagi*, meaning 'variation' – referring to the extreme variation in the dorsum colour of this species.

Distribution and natural history: Athirimala, Bonakkad, Chathankod, Ponmudi, Kalpetta, Mananthavady, and Sulthanbathery (Kerala), and Kannikatti (Tamil Nadu) (Fig. 6A, Table 1). *Philautus akroparallagi* sp. nov. has a wide range of habitat choice, from evergreen forest to plantations near secondary forest fringes. All individuals were found between 1 and 2 m off the ground, on leaves of undergrowth. The reproductive mode of this species was discussed (as *P. glandulosus*) by Biju (2003).

Remarks: This species was identified as *P. femoralis* by Inger *et al.* (1984).

PHILAUTUS AMBOLI SP. NOV.

(FIGS 2, 6B, 7A–D, 8, 9; TABLE 2)

Type material: Holotype, BNHS 4398, an adult male, SVL 33.4 mm, collected by SDB on 24 August 2001 from Amboli, Sawantwadi District, Maharashtra, India; paratypes, BNHS 4399–4403, five adult males, collected along with holotype, and BNHS 4535, an

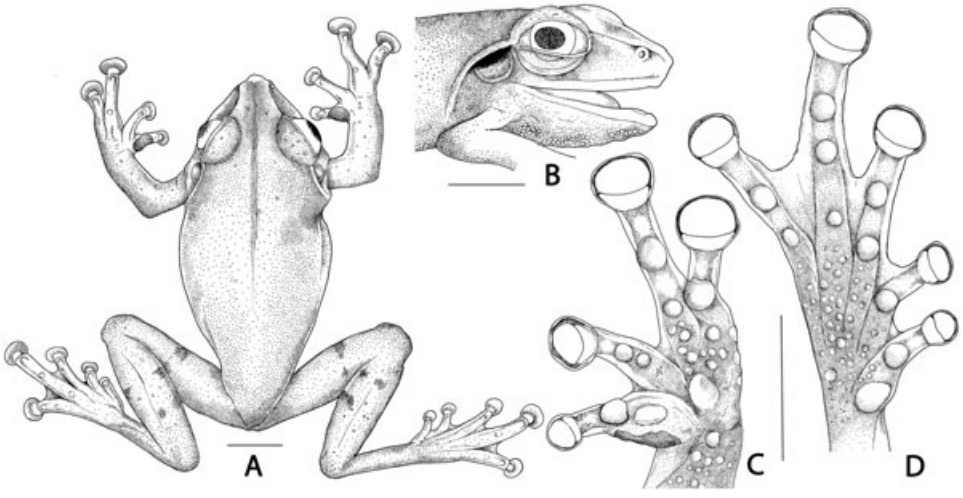

Figure 7. Holotype of ***Philautus amboli* sp. nov.** (BNHS 4398). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

adult female collected by SDB on 15 August 2004 from the same locality as the holotype.

Other material studied: BNHS 4542, an adult male, from Castle Rock; BNHS 4475, an adult male, from Londa, and BNHS 4534, an adult male from Jog Falls (Table 2).

Diagnosis: Philautus amboli sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (27.6–34.1-mm long), large female adult size (37.5-mm long); (2) body rather robust; (3) discs of fingertips much enlarged (FD_{III} = 2.6 ± 0.1 mm vs. FW_{III} = 1.0 ± 0.1 mm, N = 5); (4) upper 2/3 of tympanum dark brown; (5) throat lemon yellowish with minute black spots.

Figure 8. Holotype of ***Philautus amboli* sp. nov.** (BNHS 4398) from Amboli.

Philautus amboli sp. nov. can be easily differentiated from all of the known species of *Philautus* from the Western Ghats by its dark-brown tympanum (both in life and in preservation), in combination with a relatively larger snout–vent length (Figs 8, 9). However, because of the tympanum coloration, *P. amboli* sp. nov. could be confused with two other species that have dark-brownish black tympanums from this region, *Philautus kani* sp. nov. and *Philautus wynaadensis* Jerdon, 1853, and three species from Sri Lanka, *Philautus leucorhinus* (Lichtenstein & Martens, 1856), *Philautus nasutus* (Günther, 1869), and *Philautus temporalis* (Günther, 1864). *Philautus amboli* sp. nov. differs from *P. kani* sp. nov. and *P. wynaadensis* by the relatively larger snout–vent length of the adult male (Fig. 9), SVL 31.1 ± 2.3 mm, N = 9 (vs. the small adult male SVL 20.6 ± 1.5 mm, N = 7, in *P. kani* sp. nov.; medium adult SVL 25.7 ± 1.5 mm, N = 7, in *P. wynaadensis*), rather robust body (vs. slender in both species), throat lemon yellowish with black spots (vs. fleshy white or grey in *P. kani* sp. nov.; light-greyish yellow with minute spots in *P. wynaadensis*), restricted distribution in Maharashtra and Karnataka states (vs. both species endemic to Kerala and Tamil Nadu). More specifically, *P. amboli* sp. nov. is distinct from *P. kani* sp. nov. by its head width, which is almost equal to its length (Fig. 9): HW 11.6 ± 0.8 mm vs. HL 11.7 ± 0.8 mm,

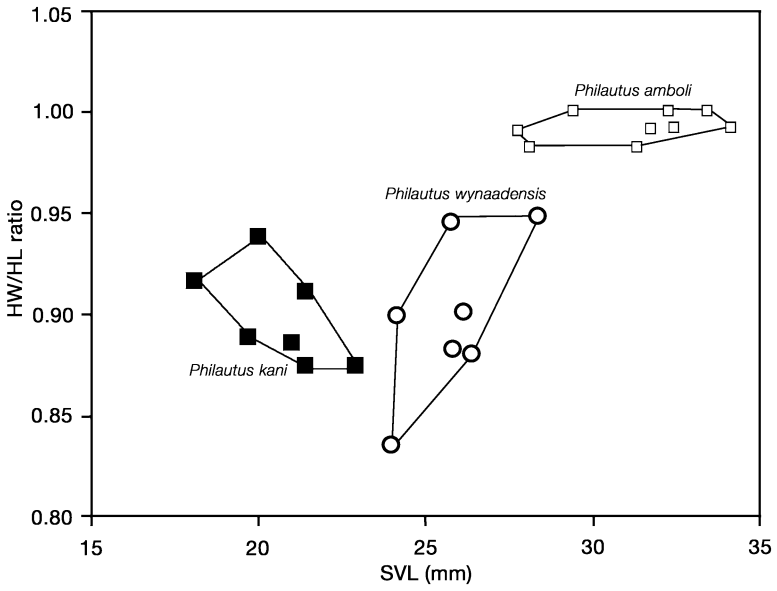

Figure 9. Morphometric distinction between males of three *Philautus* species: ■, ***Philautus kani* sp. nov.**; ○, *Philautus wynaadensis*; □, ***Philautus amboli* sp. nov.** The ratio of head width (HW)/head length (HL) is plotted against snout–vent length SVL (see Table 2).

$N = 9$ (vs. head shorter than its length, HW 7.2 ± 0.4 mm vs. HL 8.0 ± 0.5 mm, $N = 7$), canthus rostralis indistinct (vs. rounded), third finger disc 2.6 times wider than finger, $FD_{III} = 2.6 \pm 0.1$ mm, vs. $FW_{III} = 1.0 \pm 0.1$ mm, $N = 5$, Figure 7A and C (vs. third finger disc 1.7 times wider than finger, $FD_{III} = 1.0 \pm 0.1$ mm, vs. $FW_{III} = 0.6 \pm 0.1$ mm, $N = 5$, Fig. 43A and C), uniformly shagreened dorsum, Fig. 8 (vs. scattered spinular granulation throughout, Fig. 44A); and differs from *P. wynaadensis* by its head width being almost equal to its length (Fig. 9), HW 11.6 ± 0.8 mm vs. HL 11.7 ± 0.8 mm, $N = 9$ (vs. head shorter than length, HW 8.7 ± 0.7 mm vs. HL 9.7 ± 0.5 mm, $N = 7$), snout pointed in ventral view (vs. snout subelliptical), third finger disc 2.6 times wider than finger, $FD_{III} = 2.6 \pm 0.1$ mm vs. $FW_{III} = 1.0 \pm 0.1$ mm, $N = 5$ (vs. third finger disc 1.8 times wider than finger, $FD_{III} = 1.3 \pm 0.1$ mm vs. $FW_{III} = 0.7 \pm 0.1$ mm, $N = 5$), shank almost equal to thigh (ShL 15.1 ± 0.7 mm vs. TL 15.2 ± 0.7 mm, $N = 9$ (vs. shank longer than thigh, ShL 13.4 ± 0.7 mm vs. TL 12.6 ± 0.7 mm, $N = 7$), uniformly shagreened dorsum (vs. scattered spinular granulation throughout, Fig. 64A). *Philautus amboli* sp. nov. differs from *P. leucorhinus*, *P. nasutus*, and *P. temporalis* by its relatively larger SVL 31.1 ± 2.3 mm, $N = 9$, male, and SVL 37.5 mm, $N = 1$, female (vs. SVL 20.0 mm, subadult female, holotype ZMB 3057, in *P. leucorhinus*, Fig. 65A; SVL 17.3 mm, male, holotype BMNH 1947.2.6.21, in *P. nasutus*, Fig. 65B; SVL 31.0 mm, female, lectotype BMNH 1947.2.6.9, in *P. temporalis*; rather robust body (vs. slender in all the three species), the absence of vomerine teeth (vs. presence in *P. temporalis*), and absence of calcar on the tibiotarsal articulation (vs. present in *P. nasutus*).

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 33.4) with a rather robust body (Fig. 7A); head length (HL 12.0) equal to width (HW 12.0; MN 10.2; MFE 8.1; MBE 4.3); outline of snout in dorsal and ventral views pointed, snout length (SL 4.8) slightly longer than horizontal diameter of eye (EL 4.5) (Fig. 7B); canthus rostralis indistinct, loreal region acute to obtuse; distance between posterior margins of eyes (IBE 10.5) 1.8 times that of distance between anterior margins of eyes (IFE 5.7); tympanum (TYD 2.1) distinct; supratympanic fold distinct, from posterior corner of upper eyelid to near the shoulder (Fig. 7B); tongue without lingual papilla.

Forelimb (FLL 6.5), shorter than hand (HAL 9.7; TFL 5.4); fingers without lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, double in II, single in I, III, and IV, III2 and IV2 relatively smaller (Fig. 7C); prepollex rather distinct, oval; palmar tubercle single, oval, distinct; supernumerary tubercles present on fingers III and IV (Fig. 7C); nuptial pad present, prominent, slightly spinular (Fig. 7C).

Hindlimbs moderately long, shank (ShL 15.8) almost as long as thigh (TL 15.9), longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 12.9); distance from heel to tip of toe IV (TFOL 21.3); webbing moderate (Fig. 7D); reaching below the second subarticular tubercle on the inside, and up to the second subarticular tubercle on the outside of toe IV; dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple, IV3 and V2 smaller; supernumerary tubercle present on all toes.

Skin of snout and between eyes shagreened, upper eyelids shagreened with a few granular projections (Fig. 7A), side of head shagreened to slightly granular, anterior and posterior parts of back shagreened, upper and lower parts of flank shagreened, horny ridge from snout to vent (Fig. 8); dorsal part of forelimb, thigh, leg, and tarsus shagreened; throat and chest shagreened to granular, belly and thigh granular.

Colour of holotype: In life: dorsum uniform blackish brown (Fig. 8), snout much darker, loreal and tympanic region blackish, upper two-thirds of tympanum dark-blackish brown, lateral side light brownish with numerous dark black spots; iris upper half light-golden brownish, lower half dark-golden brownish; limbs dorsally brown, forelimbs and hindlimbs with obscure brownish black cross bands; ventral side light greyish with variable size of brownish grey specks, especially on the side of limbs; throat distinctly lemon yellow with blackish specks, foot and hand greyish, webbing greyish.

In preservation: dorsally uniform blackish brown, tympanic region dark brownish, abdominal region light grey with dark spots; ventral side uniform greyish with dark-brownish irregular spots united in patches.

Variation: Measurements of ten specimens, including the type series, are given in Table 2.

Etymology: Named after Amboli, where the type series was collected. Amboli is treated as an invariable noun in apposition to the generic name.

Distribution and natural history: Amboli and Amba in Maharashtra; Castle Rock, Londa, Jog Falls-Mavingundi, and Kudremukh-Malleshwaram in Karnataka, (Fig. 6B, Table 1). Five out of seven specimens from the type series were collected from the ground near disturbed evergreen forest patches. The remaining two were collected in amplexus from vegetation about 1-m high. The vocal sac is large and

transparent when calling. All were collected during a rainy evening after 19:00 h.

PHILAUTUS ANILI BIJU & BOSSUYT, 2006
(FIGS 2, 6C, 10; TABLE 2)

Type material: Holotype, BNHS 4276, an adult male, SVL 23.8 mm, collected by SDB on 28 July 1997 from Kalpetta, Wayanad District, Kerala, India; paratypes, BNHS 4277, an adult male, and BNHS 4280, an adult female, collected along with the holotype; BNHS 4278, BNHS 4279, and BNHS 4585 (ex TBGRI 2002.0057), three adult males collected from Sulthanbathery, Wayanad District, Kerala (Biju & Bossuyt, 2006).

Other material studied: BNHS 4404 and BNHS 4405, two adult males, from Kalpetta; BNHS 4568–4573, six adult males, from Ponmudi (Table 2).

Diagnosis: Philautus anili can be distinguished from known congeners by the following combination of characters: (1) small to medium male adult size (SVL 24.6 ± 1.6 mm, $N = 13$), large female adult size (SVL 39.3 mm); (2) canthus rostralis sharp; (3) flanks and groins deep brown with light-grey blotches; (4) anterior surface of thighs and inner side of shanks with light chocolate-brown blotches, alternated with variable sized grey patches.

Philautus anili could be confused with *P. sushili* sp. nov. and *P. kaikatti* sp. nov. However, *P. anili* differs from *P. sushili* sp. nov. by its pointed snout in dorsal view (vs. oval), head almost as wide as long, HW 9.3 ± 0.4 mm, HL 9.4 ± 0.4 mm, $N = 13$ (vs. head wider than long, HW 10.0 ± 1.0 mm, HL 9.1 ± 1.0 mm, $N = 5$), subarticular tubercle on finger IV1 is double (vs. single), lateral side of abdomen with dark-brown blotches alternated with light-grey patches (vs. lateral side of abdomen light grey with whitish spots), anterior surface of thighs and inner side of tibia with light chocolate-brown blotches, alternated with variable sized grey patches (vs. anterior surface of thighs and inner side of shanks dark brown); differs from *P. kaikatti* sp. nov. by its pointed snout in dorsal view (vs. oval), canthus rostralis sharp (vs. rounded), lateral side and posterior part of thighs shagreened and sparsely granular (vs. prominently granular), ventral surface of thighs and inner side of shanks with chocolate-brown bands (vs. ventral side of thighs and inner side of shanks uniform light brown), lateral side with dark-brown blotches alternated with light-grey patches (vs. light grey with white and dark-grey spots).

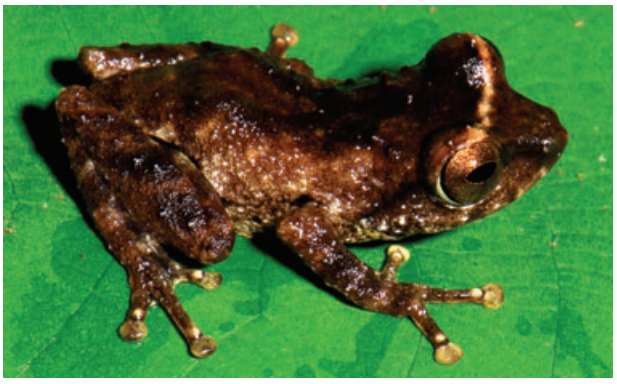

Figure 10. Paratype of *Philautus anili* (BNHS 4585) from Sulthanbathery.

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2006).

Variation: Measurements of 14 specimens, including six from the type series, are given in Table 2. In captivity, the frogs go through a considerable range of colour changes, which is reflected in the preserved specimens (Biju & Bossuyt, 2006).

Distribution and natural history: Mananthavady, Sulthanbathery, Kalpetta, and Ponmudi in Kerala (Fig. 6C, Table 1). In Wayanad, *P. anili* is found in secondary forest, in wayside vegetation, and in coffee plantations. Specimens from the Ponmudi population (about 400 km south of the type locality) were found in secondary moist forest patches. This species starts calling in the late evening, i.e. during or immediately after sunset. The calling height preference in all the populations studied was about 2 m above the ground, usually sitting on leaves.

Remarks: This species was previously discussed as *Philautus variabilis* (Günther, 1858) (FMNH 218134), and *P. signatus* (FMNH 218133) by Inger *et al.* (1984). The paratype TBGRI 2002.0057 (Biju & Bossuyt, 2006) was transferred to BNHS as BNHS 4585.

PHILAUTUS BEDDOMII (GÜNTHER, 1876)
(FIGS 2, 6D, 11, 12A, B, 19; TABLE 2)

Type material: Lectotype, NMW 22884, an adult male, SVL 16.8 mm, from 'Malabar' (Günther, 1876), corrected by (Boulenger, 1882) to 'Atray Mallay (i.e. Athirimala), Travancore'.

Other material studied: BMNH 1947.2.26.76–77 and BMNH 1947.2.26.67, three adult males, BMNH 1947.2.26.60 and BMNH 1947.2.26.61, two adult females, from 'Atray Mallay' (i.e. Athirimala); BNHS 4407–4409, three adult males, BNHS 4414, an adult

Figure 11. Lectotype of *Ixalus beddomii* (NMW 22884-2) from Atray Mallay (i.e. Athirimala).

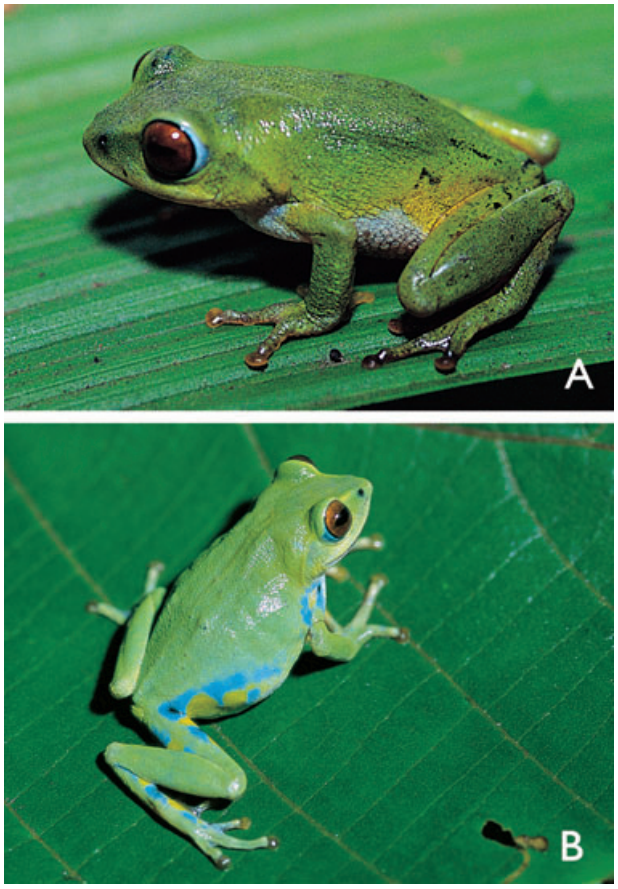

Figure 12. *Philautus beddomii*. A, specimen from Athirimala (BNHS 4408); B, specimen from Munnar (BNHS 4416).

female, from Athirimala; BNHS 4410, an adult male, from Kannikatti; BNHS 4411–4413, three adult males, BNHS 4415 and BNHS 4416, two adult females, from Munnar (Table 2).

Identity: Philautus beddomii was described as I*xalus beddomii* Günther, 1876 based on 'several specimens' (Günther, 1876), collected by Colonel Richard Henry Beddome from 'Malabar'. Later, the type locality was corrected by Boulenger (1882: 102) to 'Atray Mallay, Travancore'. Dutta (1997: 74) mentioned that NMW 22884 in the Naturhistorisches Museum Wien, is the 'type' of this species, and under the 1985 ICZN Code, this was an indirect designation of a lectotype. However, we found two specimens with the number 'NMW 22884', and Dutta (1997: 74) did not mention which specimen is the 'type'. Here, we consider the larger specimen (NMW 22884-2, SVL 16.8 mm, male) to be the lectotype (Fig. 11) of *I. beddomii*.

Diagnosis: Philautus beddomii can be distinguished from known congeners by the following combination of characters: (1) small male adult size (SVL 19.0 ± 2.8 mm, $N = 11$), small to medium female adult size (SVL 25.8 ± 3.0 mm, $N = 5$); (2) coloration nearly uniformly green on dorsum, dorsal side of forelimbs, hindlimbs, and loreal and tympanic regions; (3) iris reddish brown. See *P. chalazodes* for comparison with that species, and Figure 19 for an overview of the differences with green-coloured *Philautus* in the Western Ghats.

Description of the lectotype (all measurements in mm): Small frog (SVL 16.8) with a slender body (Fig. 11); head length (HL 6.7) equal to width (HW 6.7; MN 5.6; MFE 4.6; MBE 2.3); outline of snout in dorsal and ventral views oval, slightly protruding, snout length (SL 2.7) almost equal to horizontal diameter of eye (EL 2.8); canthus rostralis indistinct, loreal region acutely concave; distance between posterior margins of eyes (IBE 6.2) 1.8 times the distance between anterior margins of eyes (IFE 3.5); tympanum (TYD 0.9) rather indistinct; supratympanic fold rather indistinct; tongue without lingual papilla.

Forelimb (FLL 4.0) shorter than hand (HAL 4.3; TFL 2.5); fingers without lateral dermal fringe, webbing absent; subarticular tubercles rather prominent, rounded, single, IV1 weakly developed; prepollex rather distinct; single palmar tubercle; supernumerary tubercles absent.

Hindlimbs moderately long, shank (ShL 7.7) longer than thigh (TL 7.5), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 6.6); webbing reduced, reaching up to second subarticular tubercle on inside of toe IV, reaching above the second subarticular tubercle on outside of toe IV (Fig. 19); dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple, IV3 and V2 weakly developed; supernumerary tubercles absent.

Skin of snout, between eyes, upper eyelids, side of head, and anterior part of back shagreened; posterior part of back shagreened to granular; dorsal part of forelimbs and hindlimbs shagreened; throat shagreened, chest, belly, and posterior surface of thighs granular.

Colour in preservation: Dorsum, and loreal and tympanic regions uniform light-brownish grey; forelimbs and hindlimbs light-brownish grey without cross bands (Fig. 11); ventral side uniformly off-white.

Variation: Measurements of 16 specimens, including the lectotype, are given in Table 2. The population collected from Munnar has a slightly larger snout–vent length compared with the Athirimala population (Munnar, SVL 22.5 ± 1.1 mm, $N = 3$, male; SVL 28.9 ± 1.4 mm, $N = 2$, female vs. Athirimala, SVL 17.3 ± 1.7 mm, $N = 7$, male; SVL 23.8 ± 0.9 mm, $N = 3$, female).

Specimens from Athirimala (type locality, BNHS 4407–4409) and Kannikatti (BNHS 4410) have a uniform green dorsum, and loreal and tympanic regions (BNHS 4408, Fig. 12A). The iris is reddish brown, enclosed by a blue outer ring. The lateral region is bluish white, and the groin is yellowish. The dorsal colour completely extends to both limbs, fingers and toes are greenish yellow, and the discs are dark-yellowish brown. The ventral side of the throat is light-yellowish white, and the belly is white. Hands and feet are white or light yellow. In the population from Munnar (BNHS 4411–4413 and BNHS 4415–4416), the flank and lateral area are light yellow, intermixed with blue, and the posterior surface of the thighs is yellow with light-bluish markings (BNHS 4416, Fig. 12B).

Distribution and natural history: This species is known from Athirimala and Munnar in Kerala, and Kannikatti in Tamil Nadu (Fig. 6D, Table 1). It was found in moist forest patches at Athirimala (the type locality) and Kannikatti (about 50 km south of the type locality). In Munnar (about 300 km north of the type locality), it seems to prefer wayside vegetation and tea plantations. The calling microhabitat preference in all populations was about 1.5 m above the ground, usually on leaves.

PHILAUTUS BOBINGERI BIJU & BOSSUYT, 2005 (FIGS 2, 5, 13, 14A, 19; TABLE 2)

Type material: Holotype, BNHS 4272, an adult male, SVL 21.3 mm from Ponmudi, Thiruvananthapuram District, Kerala; paratypes, BNHS 4273–4274 and BNHS 4443 (ex TBGRI 2002.0055), three adult males, and BNHS 4275 and FMNH 218114, two adult females, from the same locality as the holotype.

Figure 13. Holotype of *Philautus bobingeri* (BNHS 4272) from Ponmudi.

Other material studied: FMNH 218111–218113, three adult males, from Ponmudi (Table 2).

Diagnosis: Philautus bobingeri can be distinguished from known congeners by the following combination of characters: (1) medium adult size (SVL 25.5 ± 2.0 mm, $N = 7$); (2) rather flat body; (3) finger tips oval; (4) uniformly granular dorsum; (5) upper arm yellowish, turns whitish in preservation; (6) anterior and posterior surface of thighs light red to dark fleshy red in life, turns greyish to white in preservation.

Because of the dorsal green coloration, this species may be confused with other green *Philautus* species of this region. However, this species differs from all other members by a number of constant characters, the most obvious being shown in Figure 19. *Philautus bobingeri* resembles *P. akroparallagi* sp. nov., *P. glandulosus*, and *P. jayarami* sp. nov. closely in overall morphology and coloration. However, the former differs largely from *P. glandulosus* and *P. jayarami* sp. nov. by a number of distinct characters: relatively small snout–vent length, SVL 22.5 ± 2.0 mm, $N = 7$, male (vs. relatively larger: SVL 25.2 ± 2.0 mm, $N = 4$, in *P. glandulosus*; SVL 26.3 ± 2.0 mm, $N = 6$, in *P. jayarami* sp. nov.) (Fig. 5), rather flat body (vs. slender body in *P. glandulosus* and *P. jayarami* sp. nov.), oval finger tips (vs. rounded finger tips in *P. glandulosus* and *P. jayarami* sp. nov.), light to dark fleshy red in life, without markings (vs. dorsal surface of forearm and loreal region yellow, in *P. glandulosus*; anterior and posterior parts of thigh, groin, and lateral side of abdomen white with occasionally large bluish black spots in life, in *P. jayarami* sp. nov.). For

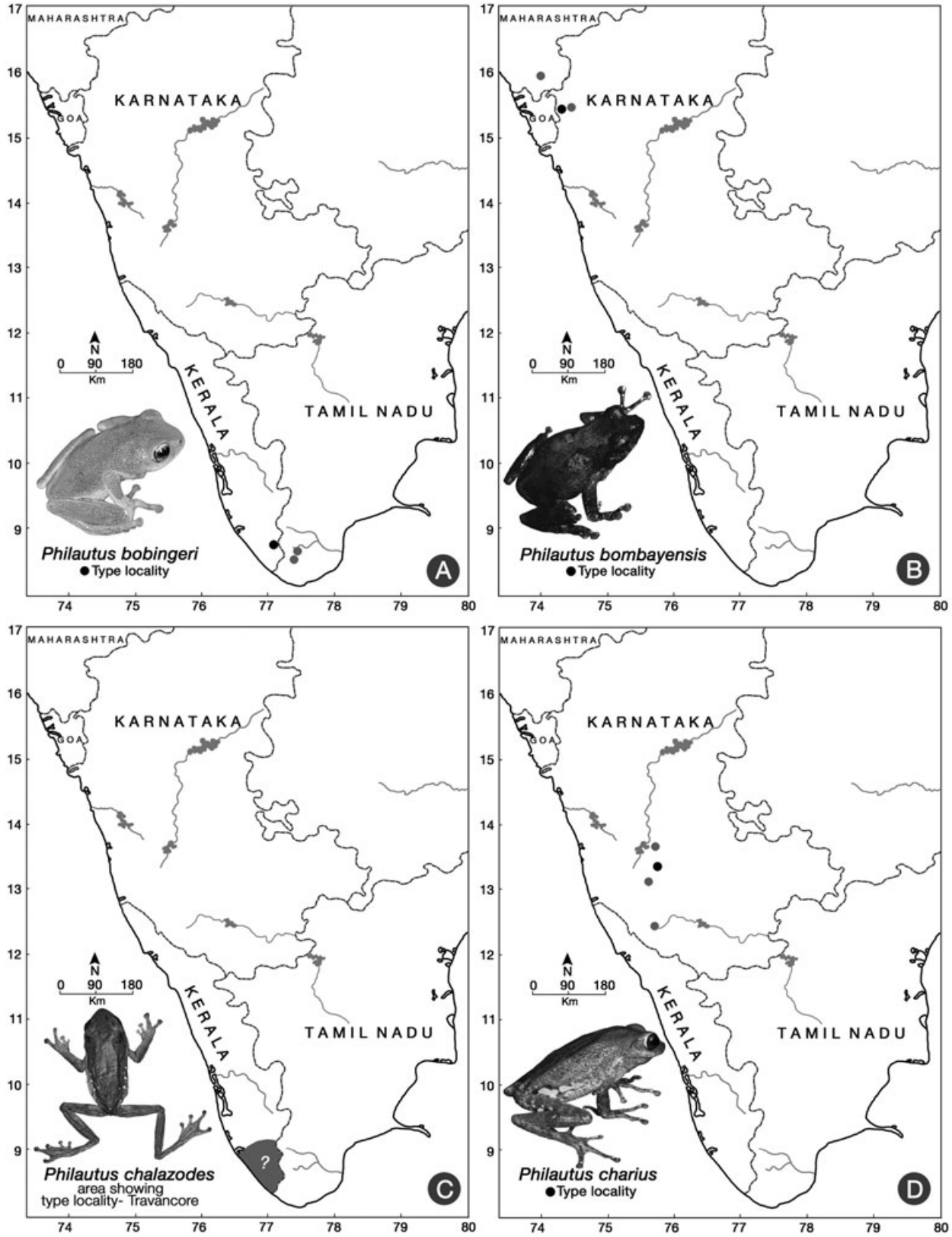

Figure 14. Distribution map. A, *Philautus bobingeri*; B, *Philautus bombayensis*; C, map showing Travancore (shaded in grey), from which the type of *Philautus chalazodes* was collected; D, *Philautus charius*.

differences with *P. akroparallagi* sp. nov. see 'comparison' of those species.

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2005b).

Colour in life: Dorsum uniform leaf green, without markings (Fig. 13), lateral side red, without markings, loreal and tympanic regions leaf green (Fig. 19), iris golden brown with dark-brown spots, encircled by a thin bluish black outer ring, lower arm leaf green, upper arm yellowish, hand yellowish red, finger tips light red, thigh with a leaf-green line extending from dorsum to knee, anterior and posterior margins red, without markings, shank almost completely leaf green, tarsus with an extremely thin leaf-green line, forelimbs and hindlimbs without cross bands; throat white or slightly light yellow, hands and feet light yellow.

Variation: Measurements of nine specimens, including six from the type series, are given in Table 2.

Distribution and natural history: Ponmudi in Kerala, and Kakachi and Sengaltheri in Tamil Nadu (Fig. 14A, Table 1). Most specimens were located on leaves, about 5 m high in shrubs and small trees from evergreen forest patches.

Remark: This species was previously considered as *P. femoralis* (FMNH 218111–218114) by Inger *et al.* (1984). The paratype TBGRI 2002.0055 (Biju & Bossuyt, 2005b) was transferred to BNHS as BNHS 4443.

PHILAUTUS BOMBAYENSIS (ANNANDALE, 1919)

(FIGS 2, 14B, 15, 16; TABLE 2)

Type material: Holotype, ZSIC 18287, an adult male, SVL 23.3 mm, from Castle Rock, Uttara Kannada, Karnataka.

Other material studied: BNHS 4418 and SDB 40205, two adult males, and BNHS 4419, an adult female, from Castle Rock; BNHS 4589 and SDB 2006B, two adult males, from Amboli; SDB 40196, an adult male, from Londa (Table 2).

Diagnosis: Philautus bombayensis can be distinguished from known congeners by the following combination of characters: (1) small male adult size; (2) snout oval in dorsal view; (3) canthus rostralis sharp; (4) presence of papilla on tongue; (5) groin and lateral side prominently marbled with creamy white blotches in a brown background; (6) distinct nuptial pad on first finger of male.

Philautus bombayensis is closely allied to *P. tuberohumerus*, but the former differs by its longer male snout–vent length, SVL 22.0 ± 1.6 mm, $N = 6$ (vs. SVL 18.4 ± 0.5 mm, $N = 6$), snout longer than horizontal diameter of eye, SL 3.4 ± 0.4 mm vs. EL 2.6 ± 0.2 mm, $N = 6$ (vs. snout subequal to horizontal diameter of eye, SL 2.4 ± 0.2 vs. EL 2.3 ± 0.2 mm, $N = 6$), presence of papilla on tongue (vs. absence of papilla), groin and lateral side prominently marbled with creamy white blotches in a brown background (vs. lateral side light greyish without prominent markings, groin dark brown with yellow blotches).

Description of the holotype (all measurements in mm): Small-sized frog (SVL 23.3) with a slender body; head length (HL 7.3) less than head width (HW 8.1; MN 6.0; MFE 4.9; MBE 1.8); outline of snout in dorsal and ventral views oval, snout length (SL 3.2) longer than horizontal diameter of eye (EL 2.6); canthus rostralis rounded, loreal region vertically concave; distance between posterior margins of eyes (IBE 7.4) 1.8 times the distance between anterior margins of eyes (IFE 4.2); tympanum rather indistinct; tongue with lingual papilla.

Forelimb (FLL 4.8) shorter than hand (HAL 6.0; TFL 2.2); fingers without lateral dermal fringe,

Figure 15. Holotype of *Philautus bombayensis* (ZSIC 18287) from Castle Rock.

Figure 16. *Philautus bombayensis*: male (BNHS 4418) and female (BNHS 4419) from Castle Rock.

webbing absent; subarticular tubercles rather prominent, rounded; prepollex rather distinct; nuptial pad present, prominent, slightly spinular.

Hindlimbs moderately long, shank (ShL 10.2) subequal to thigh (TL 10.3), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 8.2); webbing reduced, reaching up to second subarticular tubercle on inside of toe IV; dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple; supernumerary tubercles absent.

Skin of snout, between eyes, upper eyelids, side of head, and anterior part of back shagreened, posterior part of back shagreened to granular, dorsal part of forelimb, thigh, shank, and tarsus shagreened; ventral side of chest, belly, and posterior surface of thighs granular.

Colour in preservation: Dorsum uniform light-brownish grey, including loreal and tympanic regions, forelimbs and hindlimbs light-brownish grey with faint cross bands (Fig. 15); groin and lateral side with creamy white blotches in a light-brown background, anterior margin of thigh with large creamy white blotches; ventral side greyish white with prominent minute dark spots.

Variation: Measurements of seven specimens, including the holotype, are given in Table 2. BNHS 4418 (Fig. 16, amplexus, male) has a uniform dark-brownish grey dorsum, loreal and tympanic regions dark-brownish black, iris dark golden brown, with brown reticulation encircled by a bluish outer ring, groin and lateral side prominently marbled with light-yellowish white blotches in a light-brown background, and forelimbs and hindlimbs with faint blackish cross bands. The ventral side is uniformly light greyish white with prominent dark spots throughout; BNHS 4419 (Fig. 16, amplexus, female) has a uniform grey dorsum with a faint cross band between the eyes.

Distribution and natural history: Amboli in Maharashtra, and Castle Rock and Londa in Karnataka (Fig. 14B, Table 1). Annandale's report of this species from 'Khas, Satara district' (ZSIC 18782–18813) and 'Khandalla, Poona district' (ZSIC 1814–1818), which are severely damaged specimens still available at ZSIC (Annandale, 1919), was in error. At Castle Rock, specimen SDB 40205 was found at about 1-m high in vegetation, whereas BNHS 4418 and BNHS 4419 were found on the ground in a secondary forest patch.

PHILAUTUS CHALAZODES (GÜNTHER, 1876)

(FIGS 14C, 17A–C, 18, 19; TABLE 2)

Type material: Holotype, BMNH 1947.2.6.35 (ex BMNH 1874.4.29.267), an adult female, SVL 27.9 mm, from 'Travancore', Kerala, India.

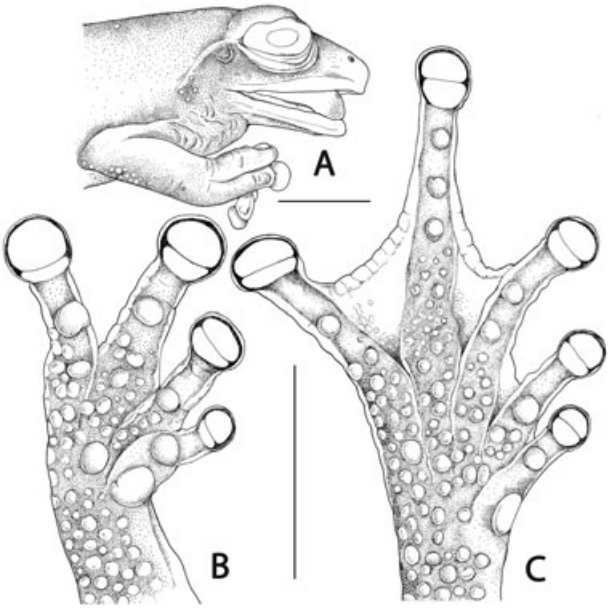

Figure 17. Holotype of *Philautus chalazodes* (BMNH 1947.2.6.35). A, lateral view of head; B, ventral view of hand; C, ventral view of foot. Scale bars: 5 mm.

Figure 18. Holotype of *Philautus chalazodes* (BMNH 1947.2.6.35) from 'Travancore'.

Other material examined: none.

Identity: Philautus chalazodes was described by Günther in 1876 based on a single female specimen from 'Travancore', collected by Colonel Richard Henry Beddome. The 'lead diagnostic' characters that were used by Günther (1876: 574) are 'tongue with a free, pointed papilla in the anterior part of the median line' and 'inguinal region there are several series of white, smooth tubercles; several smaller similar tubercles in the anal region and along the tarsus . . .' We presume that Günther considered the 'smooth tubercles' as the lead diagnostic character, because he named the species 'chalazodes', derived from the Greek word

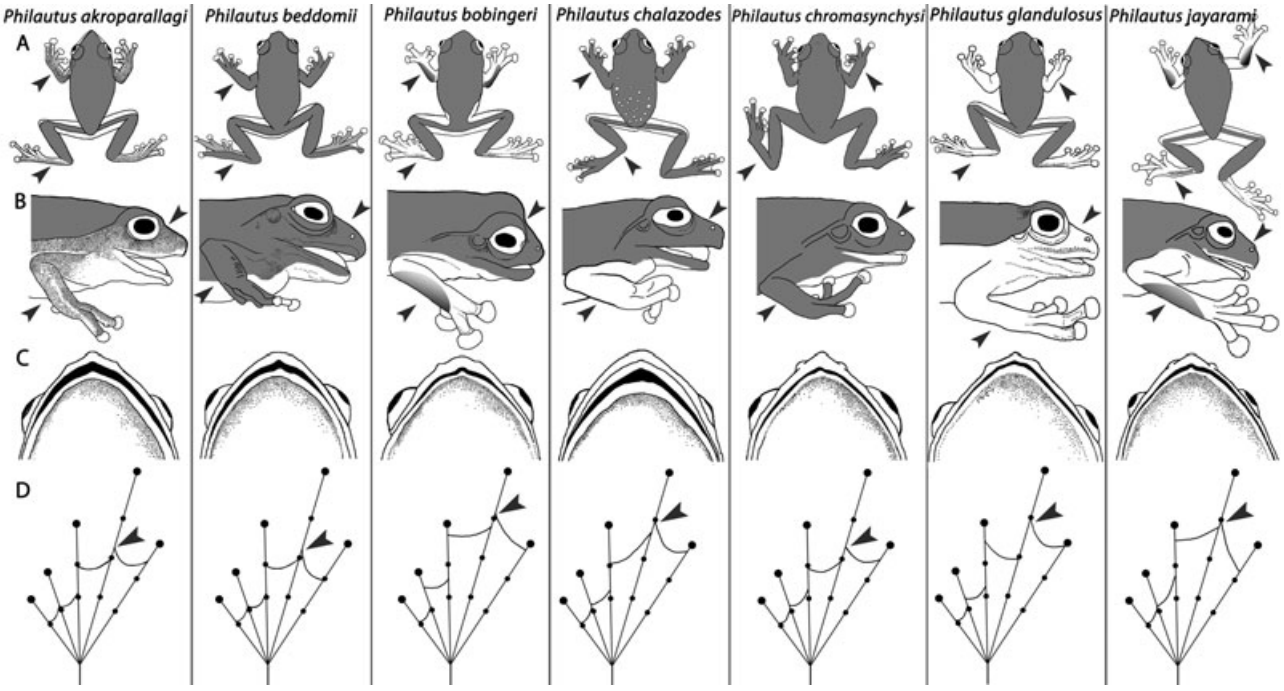

Figure 19. Schematic comparison of green-coloured *Philautus* from the Western Ghats. A, dorsal view, showing coloration of forelimbs and hindlimbs; B, lateral view of head, showing coloration of loreal/tympanic regions and forelimb; C, ventral view of snout, showing shape; D, webbing on feet. The arrows indicate extension of webbing at the fourth toe. Illustrations from left to right are: ***Philautus akroparallagi* sp. nov.**, *Philautus beddomii*, *Philautus bobingeri*, *Philautus chalazodes*, ***Philautus chromasynchysi* sp. nov.**, *Philautus glandulosus*, and ***Philautus jayarami* sp. nov.**

chalaza meaning grain and *odes* for the derived adjective, and because of the white granulation (tubercle) of the body. Das & Dutta (1998) provided an English common name for this species: white-spotted bush frog.

Diagnosis: Philautus chalazodes can be distinguished from known congeners by the following combination of characters: (1) medium adult female size (SVL 27.9 mm); (2) snout rounded; (3) prominent supernumerary tubercles on both limbs; (4) ventral side of lower arm and tarsus prominently granular (Fig. 17B); (5) dorsal coloration completely extended to forelimbs and hindlimbs.

The female holotype of *P. chalazodes* differs from *P. beddomii* (three females from Athirimala and two females from Munnar) by its rounded snout (vs. pointed to nearly oval), presence of a lingual papilla on the tongue (vs. absent), well-developed supernumerary tubercles on hands and toes (vs. absent or weakly developed), toe webbing moderate (Figs 17C, 19), reaching just below the third subarticular tubercle of toe IV on the inside, and just above the third subarticular tubercle of toe IV on the outside (vs. reduced, reaching up to second subarticular tubercle on either side of toe IV, Fig. 19), and foot length subequal to shank and thigh length, FOL 13.1 mm, ShL 13.3 mm, TL 13.2 mm, $N = 1$ (vs. shorter than shank and thigh length, FOL 9.5 ± 3.4 mm, ShL 11.8 ± 4.1 mm, TL 11.6 ± 4.1 mm, $N = 5$).

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 27.9) with a slender body; head length (HL 10.2) shorter than wide (HW 10.8; MN 9.3; MFE 7.1; MBE 3.4); outline of snout in dorsal and ventral views round, snout length (SL 4.1) equal to horizontal diameter of eye (EL 4.2) (Fig. 17A); canthus rostralis indistinct, loreal region acutely concave; distance between posterior margins of eyes (IBE 9.5) 1.7 times the distance between anterior margins of eyes (IFE 5.5); tympanum rather indistinct, supratympanic fold rather indistinct (Fig. 17A); tongue with lingual papilla.

Forelimb (FLL 6.6) shorter than hand (HAL 7.7; TFL 3.7); fingers with lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single, III2 and IV2 weakly developed; prepollex distinct; single palmar tubercle; supernumerary tubercles present (Fig. 17B).

Hindlimbs moderately long, shank (ShL 13.3) almost equal to thigh (TL 13.2), longer than distance

from base of inner metatarsal tubercle to tip of toe IV (FOL 13.1); webbing moderate (Figs 17C, 19), reaching up to third subarticular tubercle just below on the inside and just above on the outside of toe IV; dermal fringe along toe V present.

Skin of snout, between eyes, upper eyelids, side of head, and anterior part of back shagreened, posterior part of back, dorsal part of forelimb, thigh, shank, and tarsus shagreened; throat shagreened, chest, belly, and posterior surface of thighs granular, ventral side of lower arm and tarsus prominently granular.

Colour of holotype in preservation: Dorsum uniform bluish grey, scattered white tubercles on posterior half of dorsum, loreal and tympanic regions bluish grey, forelimbs and hindlimbs bluish grey with white tubercles (Fig. 18); ventral side greyish.

Distribution: The original description of this species mentioned 'Travancore' without a precise locality (Fig. 14C). No reliable observations have been made available for this species since its original description.

PHILAUTUS CHARIUS RAO, 1937

(FIGS 2, 14D, 20; TABLE 2)

Type material: Neotype, MNHN 1999.5597, an adult male, SVL 29.0 mm, from the hills around Chikmalagur (i.e. Chikmagalur), Chikmalagur district, Karnataka, India (Bossuyt & Dubois, 2001).

Other material studied: BNHS 4420 and BNHS 4421, two adult males, from Chikmagalur; BNHS 4422 and BNHS 4423, two adult males, from Mercara; BNHS 4424, an adult male, from Kottigehara; SDB 40213, an adult male, from Muthodi (Table 2).

Figure 20. *Philautus charius*: a specimen from Muthodi (BNHS 40213).

Diagnosis: Philautus charius can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (27.2–31.4 mm, $N = 7$); (2) dorsum with small horny spinules; (3) groin and posterior part of thighs uniform brownish black with large yellow blotches; (4) short head (HL/SVL = 0.309–0.345, $N = 7$).

Philautus charius, *P. coonoorensis* sp. nov., and *P. griet* form a strongly supported clade in our phylogenetic analyses (Fig. 2). These three species can be easily differentiated from each other on the basis of the characters listed below.

Philautus charius: (1) medium male adult size (27.2–31.4 mm, $N = 7$); (2) snout shorter than, or subequal to the horizontal diameter of the eye; (3) groin brownish black with yellow blotches; (4) posterior surface of thighs uniform brownish black with large yellow blotches; (5) relatively short hindlimbs, ShL/SVL ratio < 0.5.

Philautus coonoorensis sp. nov.: (1) small male adult size (20.7–23.8 mm, $N = 5$); (2) snout clearly longer than horizontal diameter of the eye; (3) groin light grey with dark-brown patches; (4) posterior surface of thighs dark brown with variable size of grey patches; (5) relatively long hindlimbs, ShL/SVL ratio > 0.5.

Philautus griet: (1) small male adult size (19.7–22.4 mm, $N = 5$); (2) snout shorter than, or subequal to the horizontal diameter of the eye; (3) groin light brown with minute white marbling; (4) posterior surface of thighs brown with minute grey spots; (5) relatively short hindlimbs, ShL/SVL ratio < 0.5.

Description of the neotype: A detailed description was published in Bossuyt & Dubois (2001).

Variation: Measurements are given in Table 2.

Colour variation in life: dorsum usually light brown with various numbers of deep-brown irregular patches, a brown stripe between the eyes demarcates a triangular grey snout, loreal and tympanic regions light brown with black spots, a pair of greyish brown concave bands extending from below the level of the eye to the groin (Fig. 20); iris light brown, encircled with thin greyish outer ring. Dorsal side of limbs with dark-grey cross bands. However, the groins and posterior part of the thighs are invariably uniform brownish black with large yellow blotches.

Distribution and natural history: Chikmagalur, Muthodi, Mercara, and Kottigehara in Karnataka (Fig. 14D, Table 1). These frogs mostly call from about 0.5 to 1.5-m high on the stems of shrubs.

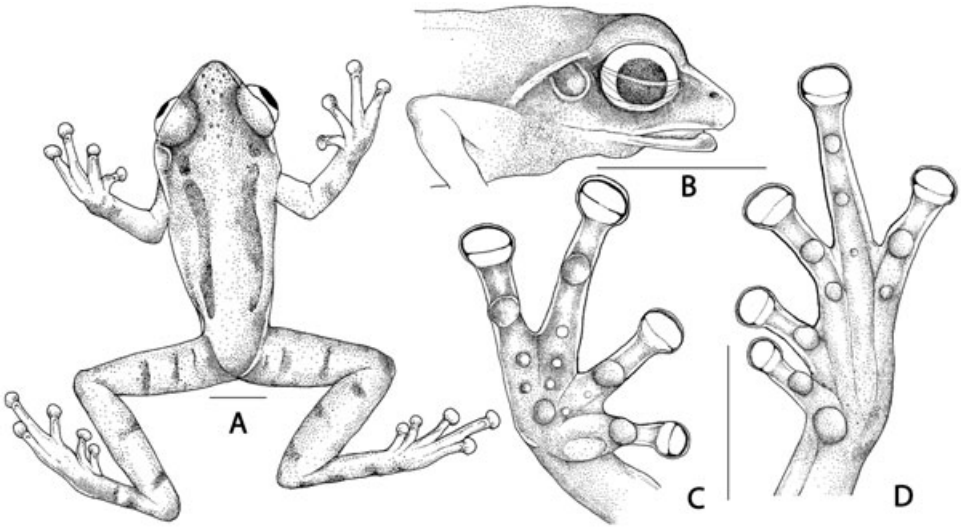

Figure 21. Holotype of ***Philautus chlorosomma* sp. nov.** (BNHS 4425). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

Figure 22. Holotype of ***Philautus chlorosomma* sp. nov.** from Munnar (BNHS 4425).

PHILAUTUS CHLOROSOMMA SP. NOV.

(FIGS 2, 21A–D, 22, 23A; TABLE 2)

Type material: Holotype, BNHS 4425, an adult male, SVL 27.5 mm, collected by SDB on 14 July 1989 from Munnar, Idukki, Kerala, India; paratypes, BNHS 4426, an adult male collected along with the holotype.

Other material studied: SDB 1061B, an adult male, from Munnar (Table 2).

Diagnosis: Philautus chlorosomma sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium adult size (SVL 26.8 ± 0.8 mm, $N = 3$, male); (2) shank longer than thigh (ShL 14.2 ± 0.5 mm vs. TL 12.8 ± 0.7 mm, $N = 3$); (3) absence of supernumerary tubercle on hand and foot; (4) webbing rudimentary (Fig. 21D), reaching just above the thirds subarticular tubercle on either side of toe IV; (5) greyish green iris (Fig. 22); (6) groin light-grey to brown, vermiculated with black patches of variable size.

Because of the overall appearance, this species could be confused with *P. graminirupes*. *Philautus chlorosomma* sp. nov. differs from the latter by its oval snout (vs. pointed), snout equal to the horizontal diameter of eye, SL 4.4 ± 0.1 mm vs. EL 4.4 ± 0.2 mm, male, $N = 3$ (vs. snout shorter than horizontal diameter of eye, SL 3.1 ± 0.1 mm vs. EL 4.0 ± 0.2, male, $N = 4$), thighs light grey, vermiculated with black patches of variable size (vs. thighs chocolate brown, vermiculated with bluish green), absence of horny ridge between the eyes (vs. presence of horny ridge in between the eyes).

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 27.5) with a rather slender body (Figs 21A, 22); head length (HL 10.6) shorter than width (HW 10.8; MN 9.3; MFE 7.3; MBE 3.3); outline of snout in dorsal view oval (Fig. 21A); snout length (SL 4.4) almost equal to horizontal diameter of eye (EL 4.6); canthus rostralis indistinct, loreal region acutely concave; distance between posterior margins of eyes (IBE 10.1) about twice the distance between anterior margins of eye (IFE 5.1); tympanum (TYD 1.6) distinct; supratympanic fold distinct, from back of eyes to shoulder (Fig. 21B); tongue without a lingual papilla.

Forelimb (FLL 6.5) shorter than hand (HAL 8.1; TFL 5.6); all fingers with dermal fringe on both edges, webbing absent; subarticular tubercles rather distinct, rounded, single, III2 and IV2 weakly developed

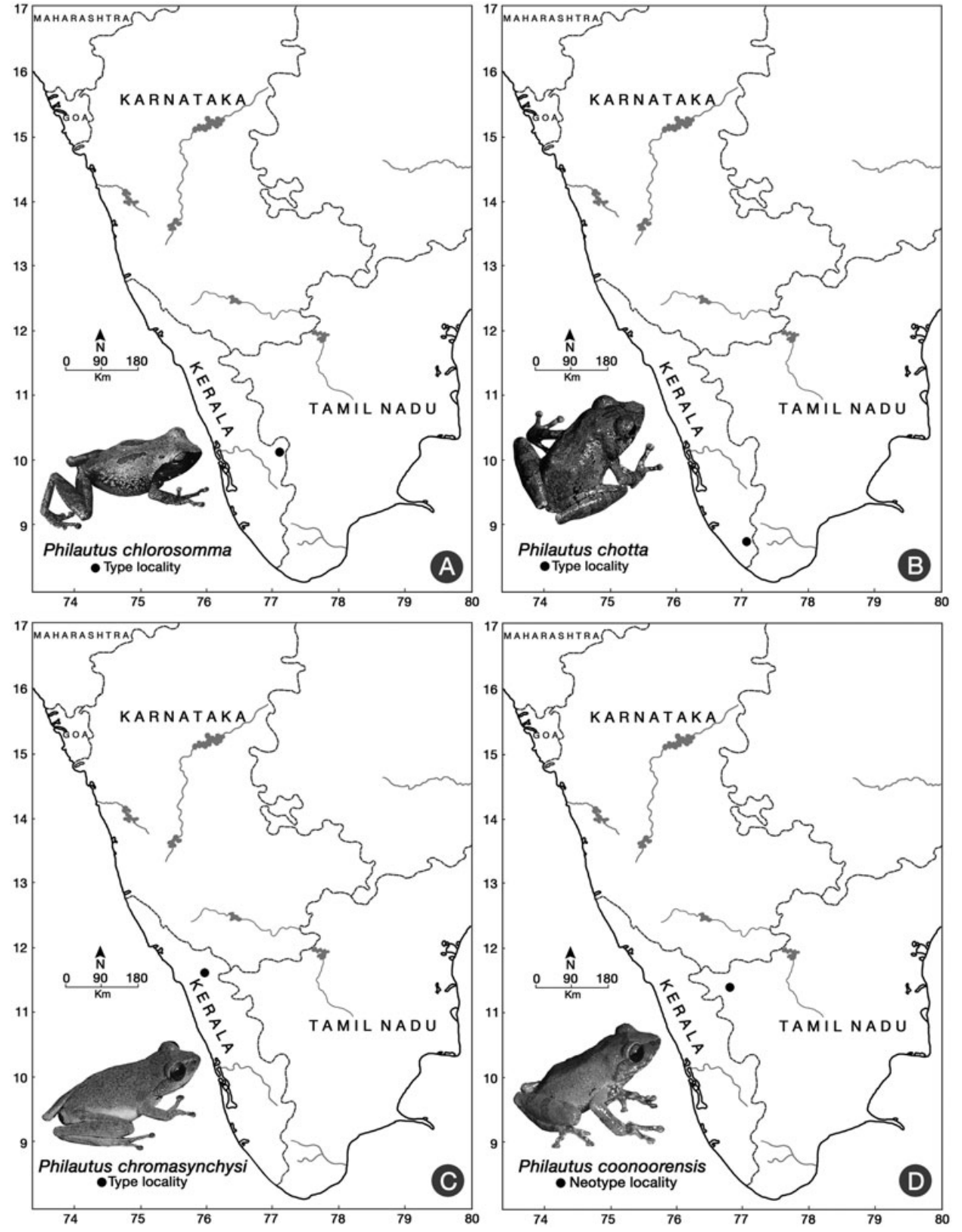

Figure 23. Distribution map. A, ***Philautus chlorosomma* sp nov.**; B, ***Philautus chotta* sp. nov.**; C, ***Philautus chromasynchysi* sp. nov.**; D, ***Philautus coonoorensis* sp. nov.**

(Fig. 21C); prepollex rather indistinct, rounded; single palmar tubercle, rounded; supernumerary tubercles present on fingers II, III, and IV (Fig. 21C); nuptial pad absent.

Hindlimbs moderately long, shank (ShL 14.6) longer than thigh (FL 13.6), longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 11.6); webbing rudimentary, reaching just above the third subarticular tubercle on either side of toe IV (Fig. 21D); dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple, and all present, but IV3 and V2 weakly developed; supernumerary tubercles absent (Fig. 21D).

Skin of snout, between eyes, and upper eyelids smooth, side of head shagreened, back and flanks smooth to shagreened, dorsal part of thighs, shanks, and tarsus smooth to shagreened; throat and chest slightly granular, belly and ventral side of thighs granular.

Colour of holotype: In life: dorsum light grey to brown with irregular spots, a pair of light black discontinuous parallel lines extending from behind the eye to the level of the groin (Fig. 22); groins and posterior surface of thighs light grey to brown, lateral side brown with light-grey spots (Fig. 22); loreal and tympanic regions dark brownish black; iris greyish green with brown discontinuous lines, encircled by a light-blue ring; limbs brownish grey dorsally; forelimbs and hindlimbs with light-brown cross bands; ventral side whitish, throat light grey with minute greyish spots; ventral surface of hands and feet fleshy white, with small grey spots.

In preservation: dorsum grey, with a pair of light-greyish black parallel lines extending from behind the eye to the groin; flank and groin light-greyish brown, vermiculated with blackish grey patches of variable size; limbs dorsally grey with faint cross bands; ventral side of feet and hands light grey with small black spots.

Variation: Measurements of three individuals are given in Table 2.

Etymology: The species name is derived from the Greek word *chloros*, meaning green and *omma*, meaning eye, referring to the greenish iris of this species.

Distribution and natural history: Philautus chlorosomma sp. nov. is known only from the type locality-Munnar (Fig. 23A, Table 1). The type series was collected from disturbed shola vegetation near tea and eucalyptus plantations. All individuals were collected after heavy rain, from about 1 m above the ground, from *Lantana* thickets or leaves of *Eupatorium glandulosum*.

PHILAUTUS CHOTTA SP. NOV.

(FIGS 2, 23B, 24A–D, 25A, B; TABLE 2)

Type material: Holotype, BNHS 4427, an adult male, SVL 16.0 mm, collected by SDB on 18 July 2002 from Ponmudi, Thiruvananthapuram District, Kerala, India; paratypes, BNHS 4428–4432, five adult males, collected along with the holotype, and FMNH 218101, an adult female collected by Robert F. Inger and Bradley Shaffer in May 1982 from the same locality.

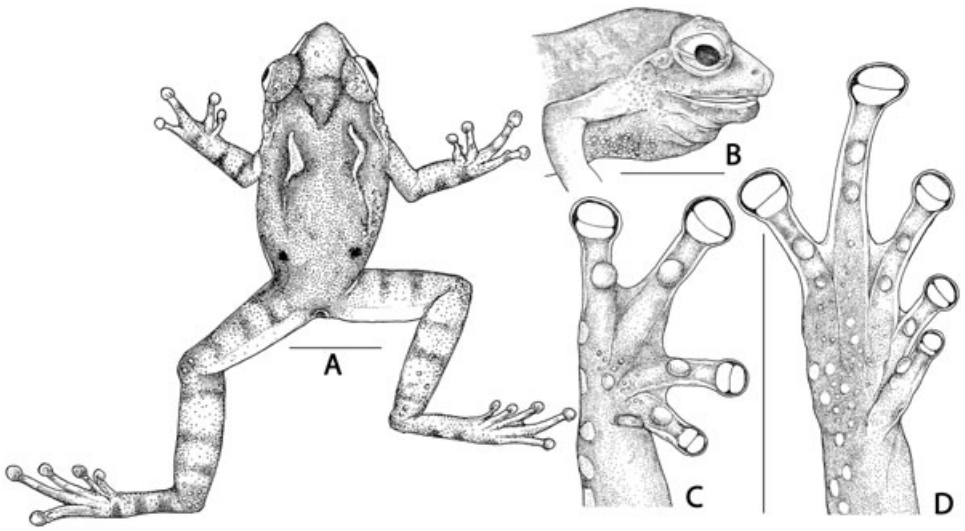

Figure 24. Holotype of ***Philautus chotta* sp. nov.** (BNHS 4427). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

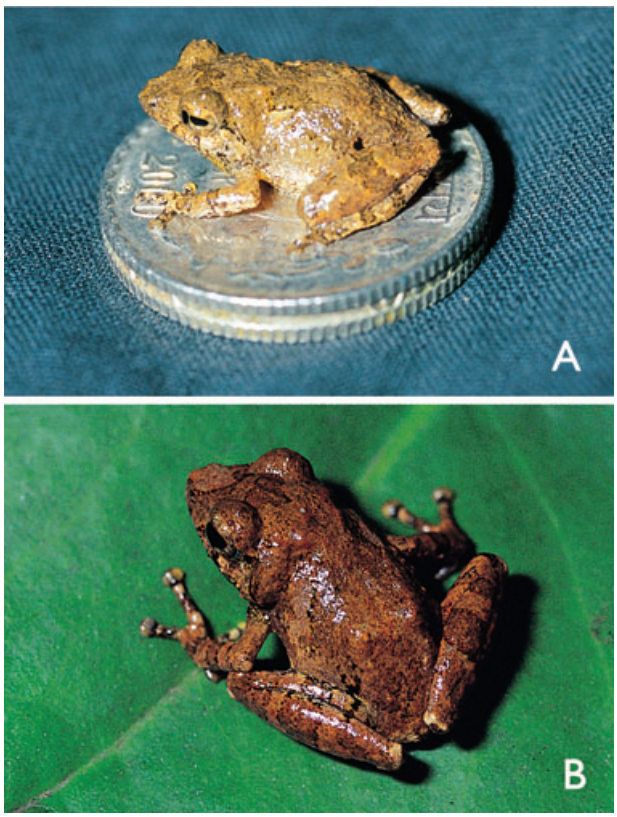

Figure 25. Holotype of ***Philautus chotta*** **sp. nov.** A, holotype (BNHS 4427) photographed on an Indian 5-rupee coin (24-mm in diameter); B, paratype (BNHS 4431) from Ponmudi.

Other material studied: FMNH 218107, adult male, from Ponmudi (Table 2).

Diagnosis: Philautus chotta sp. nov. can be distinguished from known congeners by the following combination of characters: (1) small adult size (SVL 16.7 ± 0.4 mm, $N = 7$, male; SVL 20.5 mm, $N = 1$, female); (2) snout in dorsal view sharply pointed; (3) prominent tubercles on upper eyelid; (4) dark spot on either side towards the vent; (5) vermiculated posterior surface of the shanks; (6) very long hindlimbs, strongly overlapping when folded at right angles.

Although this species is morphologically unique, we compare it here with *Philautus annandalii* (Boulenger, 1906) and *P. tuberohumerus*, both of which are of comparable size. However, *P. chotta* sp. nov. differs from *P. annandalii* by its sharply pointed snout (vs. oval), canthus rostralis sharp (vs. rounded), upper eyelids with a few prominent tubercles (vs. shagreened), a dark spot on either side towards the vent (vs. absent), inner side of shanks with light-brown blotches (vs. without markings), tibiotarsal articulation reaches up to nostril when stretched forwards along the body axis (vs. reaches below the eye); differs from *P. tuberohumerus* by its smaller snout–vent length, SVL 16.7 ± 0.4 mm $N = 7$, male (vs. SVL 18.4 ± 0.5 mm $N = 6$, male), snout sharply pointed (vs. subelliptical), canthus rostralis sharp (vs. rounded), posterior surface of thighs light grey (vs. dark brown with large yellow or reddish yellow blotches), inner side of shanks with light brown blotches (vs. without markings), tibiotarsal articulation reaches up to nostril when stretched forwards along the body axis (vs. reaches up to the eye).

Description of the holotype (all measurements in mm): Small frog (SVL 16.0) with a slender body (Figs 24A, 25A, B); head length (HL 5.8) slightly shorter than width (HW 6.0; MN 5.0; MFE 4.0; MBE 1.9); outline of snout in dorsal view sharply pointed (Fig. 24A), snout length (SL 2.6) almost equal to the horizontal diameter of the eye (EL 2.7); canthus rostralis sharp, loreal region acutely concave; distance between posterior margins of eyes (IBE 5.8) 1.7 times the distance between anterior margins of eyes (IFE 3.4); tympanum (TYD 0.8) rather indistinct; supratympanic fold rather indistinct (Fig. 24B); tongue without a lingual papilla.

Forelimb (FLL 4.0) shorter than hand (HAL 4.6; TFL 2.6); fingers without lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single, III2 and IV2 absent (Fig. 24C); prepollex rather indistinct; palmar tubercle small, rounded; supernumerary tubercles weakly developed on fingers (Fig. 24C); nuptial pad present, smooth.

Hindlimbs moderately long, shank (ShL 8.7) longer than thigh (TL 8.3), longer than distance from base of inner metatarsal tubercle to the tip of toe IV (FOL 6.6); distance from heel to tip of toe IV (TFOL 11.1); webbing rather rudimentary (Fig. 24D); reaching up to the third subarticular tubercle on either side of toe IV; dermal fringe along toe V absent; subarticular tubercles rather prominent, rounded, simple, IV2 and V2 weakly developed (Fig. 24D); supernumerary tubercles present throughout.

Skin of snout shagreened, between eyes granular, upper eyelids with a few prominent tubercles (Fig. 25A, B), side of head shagreened to slightly granular, anterior and posterior parts of back, upper and lower parts of flank shagreened; throat shagreened to glandular, chest slightly granular; belly and thigh prominently granular.

Colour of holotype: In life: dorsum yellowish grey (Fig. 25A) with various numbers of light-brown, tan, and brown markings, a pair of dark lines between eyes, filled with light brown, an hourglass-shaped area that is slightly darker than the dorsum, a dark spot towards the hindlimb, forming a continuation of

the largest leg bar when limbs are flexed into normal sitting posture, lateral abdominal area light brown, tinged with bronze, tympanic region light brown; iris light-grey–brown with dark-brown cross band, encircled with light golden ring; forelimbs and hindlimbs light brown, with dark-brown cross bands, finger tips grey, anterior and posterior margins of thigh light brown; ventral side off white, with various numbers of brown, light-grey and pale-yellow spots forming a vermiculated pattern, throat dark-brownish yellow, margins with dark bands interrupted with white bands, foot and hand light grey.

In preservation: dark-grey dorsum with light-brown spots, lateral region light brown, a black spot on either side towards the vent (Fig. 24A); dark-brownish band between eye and groin enclosing an hourglass marking filled with grey, loreal and tympanic regions grey with irregular white patches, dorsal surface of forelimb and hindlimb light grey with dark-brown cross bands; ventral side uniformly greyish with irregular spots, tibia with brownish black markings.

Variation: Measurements of eight specimens are given in Table 2. The dorsal coloration is relatively constant in the type series, but BNHS 4432 has a uniform dark-grey dorsum with a triangular light-grey snout from the tip to just above the level of the eyes, a dark-grey stripe between the eyes, and a pair of creamy bands on dorsum; BNHS 4428 has a dark-grey dorsum with a dark band in between the eyes, and a faintly greyish brown longitudinal marking on the dorsum. In captivity (BNHS 4431, Fig. 25B), the colour changes from light greyish brown to dark brown.

Etymology: The species epithet *chotta* (Hindi word) means small, referring to the diminutive adult size.

Distribution and natural history: Philautus chotta sp. nov. is known only from the type locality, Ponmudi (Fig. 23B, Table 1). The holotype and five male paratypes were collected from leaves of a tea plant (at about 1-m height) from an abandoned tea plantation near disturbed evergreen forest patches. All were located by their calls during a rainy night. The sixth female paratype, FMNH 218101, was collected from the ground along with other 12 other individuals by Inger and Shaffer 'either on the surface of dead leaves (9 specimens) or beneath leaves or logs (4 specimens)' (Inger *et al.*, 1984). During the present study, this species was surveyed at night-time, and all of the individuals were located at an average height of about 2 m, although a few individuals were sighted on the forest floor in the daytime during the non-breeding season.

Remarks: The new species was ascribed to *P. charius* (FMNH 218101, FMNH 218107) by Inger *et al.* (1984).

PHILAUTUS CHROMASYNCHYSI SP. NOV.

(FIGS 2, 19, 23C, 26A–E, 27A–C; TABLE 2)

Type material: Holotype, BNHS 4433, an adult male, SVL 23.3 mm, collected by SDB on 7 September 1997 from Kurichiyarmala, Wayanad, Kerala, India; paratypes, BNHS 4434–4437, four adult males, collected along with the holotype, BNHS 4438–4440, three adult males, and BNHS 4441 and BNHS 4442, two adult females, collected by SDB on 20 July 2002 from the type locality.

Other material studied: none.

Diagnosis: Philautus chromasynchysi is distinguished from known congeners by the following combination of characters: (1) medium adult size; (2) snout pointed; (3) canthus rostralis sharp; (4) tongue with pointed papilla; (5) posterior surface of thighs dark brown, and anterior surface of thighs and groins dark brown with yellow blotches.

Philautus chromasynchysi is allied to *Philautus marki* sp. nov., *P. signatus*, and *P. tinniens*. *Philautus chromasynchysi* differs from *P. marki* sp. nov. by the absence of horny ridges between the eyes (vs. horny ridges between eyes, arranged in a triangle directed posteriorly, Fig. 47A), flank and groin dark brown with yellow blotches (vs. flank and groin light grey with minute white marbling); differs from *P. signatus* and *P. tinniens* by its sparsely to prominent horny spinular dorsal skin (vs. shagreened to sparsely granular dorsum, in *P. signatus* and *P. tinniens*), and more specifically the new species differs from *P. signatus* by its small snout–vent length, SVL 22.9 ± 2.9 mm, $N = 8$, male (vs. large, SVL 29.6 ± 2.8 mm, $N = 8$), flank and groin dark brown with yellow blotches (vs. flank and groin flesh white or light-reddish brown, without markings); from *P. tinniens* by its tongue with pointed papilla (vs. without), flank and groin dark brown with yellow blotches (vs. flank and groin dark-brownish black), fingers uniform colour (vs. first two fingers yellow). Because of the overall green coloration, *P. chromasynchysi* could be confused with six other species of *Philautus* that have a predominantly green colour from this region, although it can be easily differentiated from these by both morphological and colour pattern differences (Fig. 19).

Description of the holotype (all measurements in mm): Small-sized frog (SVL 23.3) with a slender body

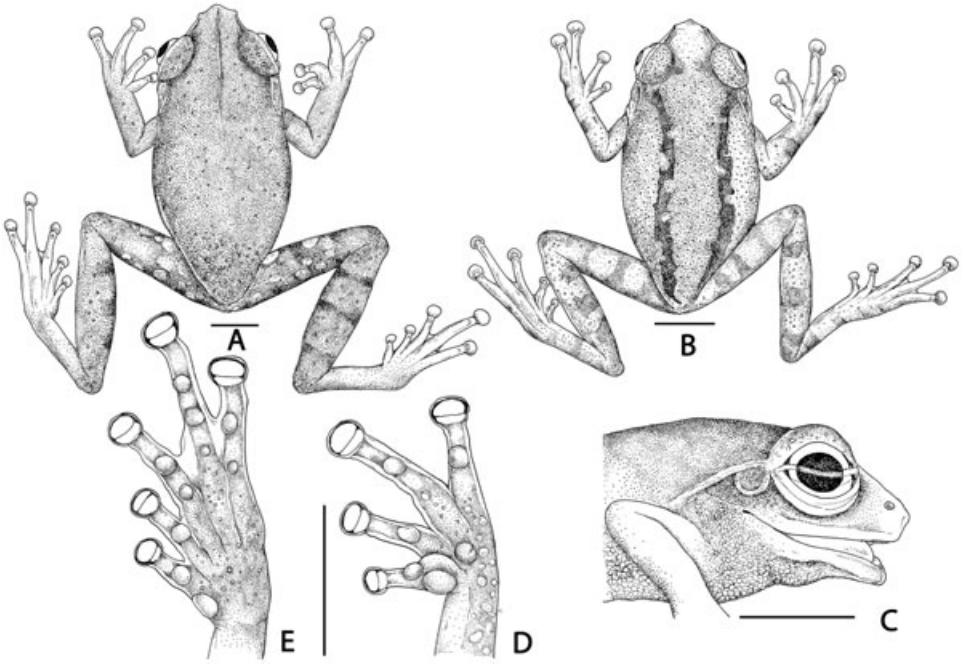

Figure 26. Holotype of ***Philautus chromasynchysi* sp. nov.** (BNHS 4433). A, dorsal view; B, dorsal view of paratype (BNHS 4438); C, lateral view of head; D, ventral view of hand; E, ventral view of foot. Scale bars: 5 mm.

(Fig. 26A); head length (HL 9.0) longer than width (HW 8.9; MN 7.9; MFE 6.1; MBE 3.3); outline of snout in dorsal and ventral views pointed, slightly protruding, snout length (SL 3.3) slightly shorter than horizontal diameter of eye (EL 3.5); canthus rostralis sharp, loreal region vertical to acute, slightly concave; distance between posterior margins of eyes (IBE 8.6) 1.7 times the distance between anterior margins of eyes (IFE 5.1); tympanum (TYD 1.3) distinct, rounded (Fig. 26C); supratympanic fold rather distinct; tongue with pointed lingual papilla, free.

Forelimb (FLL 5.1) shorter than hand (HAL 6.6; TFL 4.0); lateral dermal fringe present, webbing absent; subarticular tubercles prominent, rounded, single, III2 and IV2 weak (Fig. 26D); prepollex rather distinct; palmar tubercle distinct, rounded; supernumerary tubercles present on fingers III and IV; nuptial pad absent.

Hindlimbs moderately long, shank (ShL 12.7) subequal to thigh (FL 12.4), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 9.7); distance from heel to tip of toe IV (TFOL 15.9); webbing moderate (Fig. 26E); reaching up to second subarticular tubercle on either side of toe IV; dermal fringe along toe V present; subarticular tubercle rather prominent, rounded, simple, IV3 and V2 weakly developed; supernumerary tubercles weakly present on all toes (Fig. 26E).

Skin of snout and between eyes shagreened, upper eyelids with prominent tubercles, side of head shagreened to sparsely granular, anterior part of back with sparsely granular spinules, posterior part of back granular, upper and lower parts of flank granular, dorsal part of forelimb, thigh, tibia, and tarsus shagreened to sparsely granular; throat shagreened, chest, belly, and posterior surface of thighs granular.

Colour of holotype: In life: dorsum uniform dark green (Fig. 27A), completely extended to lateral side of snout, and loreal and tympanic regions, groin light yellow with brown blotches, posterior surface of thighs dark brown, and anterior surface of thighs and groins dark brown with yellow blotches, lateral side light yellowish green, iris dark golden brown, encircled by a thin bluish green outer ring, dorsal green colour completely extended to the limbs, forelimbs and hindlimbs with faint cross bands, fingers and toes light blackish green; ventral side light yellow, hands and feet greyish brown.

In preservation: dorsum uniform greyish black, loreal and tympanic regions light-greyish black, upper eyelids black, lateral abdominal area whitish; surface of thighs light brown, groins light grey with white patches; forelimbs and hindlimbs light-greyish black, hindlimbs with faint grey cross bands.

Variation: Measurements of ten type series are given in Table 2. Dorsal colour and pattern highly variable, ranging from uniform dark green through a variety of greens to light-greyish brown (Fig. 27A–C): (1) typical

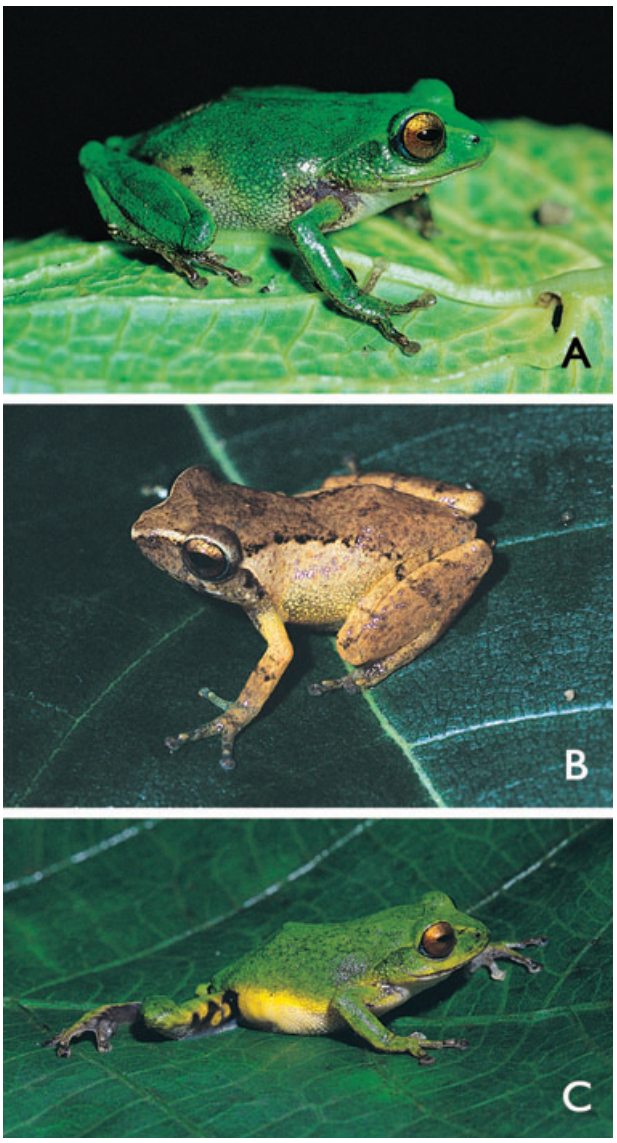

Figure 27. ***Philautus chromasynchysi*** **sp. nov.** A, holotype (BNHS 4433); B, paratype (BNHS 4438); C, paratype (BNHS 4442): all from Kurichiyarmala.

dark-green dorsum, without markings (holotype, BNHS 4433, Fig. 27A) in life, turns uniform greyish black in preservation; (2) dorsal skin prominently horny spinular, uniform greyish brown dorsum with dark discontinuous concave lines on either side, from just behind the eye level to vent (BNHS 4438, Fig. 27B); (3) uniform yellowish green dorsum with dark minute spots, groin dark brown with golden yellow blotches, lateral region golden yellow (paratype, BNHS 4442, Fig. 27C); (4) sparsely horny spinular skin, dorsum light green with a pair of faint concave lines, an inverted dark triangular patch in between the eyes (directed downwards), lateral region light-yellowish grey, anterior surface of thighs light yellow with brown blotches, faint dorsal cross bands on limbs, (paratype, BNHS 4435); (5) dorsum light greyish brown with a light broad band from snout to vent, lateral side dark brown (BNHS 4440); (6) sparsely spinular dorsum, a light-grey streak from either side of snout, along the side of head up to the lower level of upper eyelid, a pair of concave black lines from the lower level of upper eyelid to vent, filled with dark-greyish brown, lateral side light-greyish yellow (BNHS 4439); (7) prominent horny spinular dorsum, light brown with faint triangular marking between the eyes, a pair of concave lines on the middle of dorsum (BNHS 4437). In captivity, the dorsal colour does not change much other than a slight variation from light brown to dark brown or from light green to dark green. Significantly, the groin and thigh markings are highly constant, and hence the identification of this species is straightforward based on the combination of spinular dorsum, and groin coloration.

Etymology: The species name is derived from two Greek words: *chroma* meaning 'colour' and *synchysi* meaning 'confusion', referring to the species having confusing dorsal colour.

Distribution and natural history: Philautus chromasynchysi is known only from the type locality. This species is located in a small area of about 30 km^2, on an isolated mountain at Kurichiyarmala (Fig. 23C, Table 1). The holotype and four paratypes were collected from the ground under leaf litter during a late evening in the non-breeding season (September), the remaining six paratypes were collected during a rainy late evening in the breeding season (July), from leaves about 1-m high.

PHILAUTUS COONOORENSIS SP. NOV.

(FIGS 2, 23D, 28A–D, 29; TABLE 2)

Type material: Holotype, BNHS 4444, an adult male, SVL 22.4 mm, collected by SDB on 15 July 2005 from Coonoor, Sims Park, Tamil Nadu, India; paratypes, BNHS 4445–4447, three adult males, collected along with the holotype.

Other material studied: SDB 0003, an adult male, from Coonoor (Table 2).

Diagnosis: Philautus coonoorensis sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium male adult size; (2) dorsum with spinular projections; (3) flanks and groins deep-brown patches; (4) posterior surface of thighs dark brown with variable grey patches. See also 'Diagnosis' section of *P. charius*.

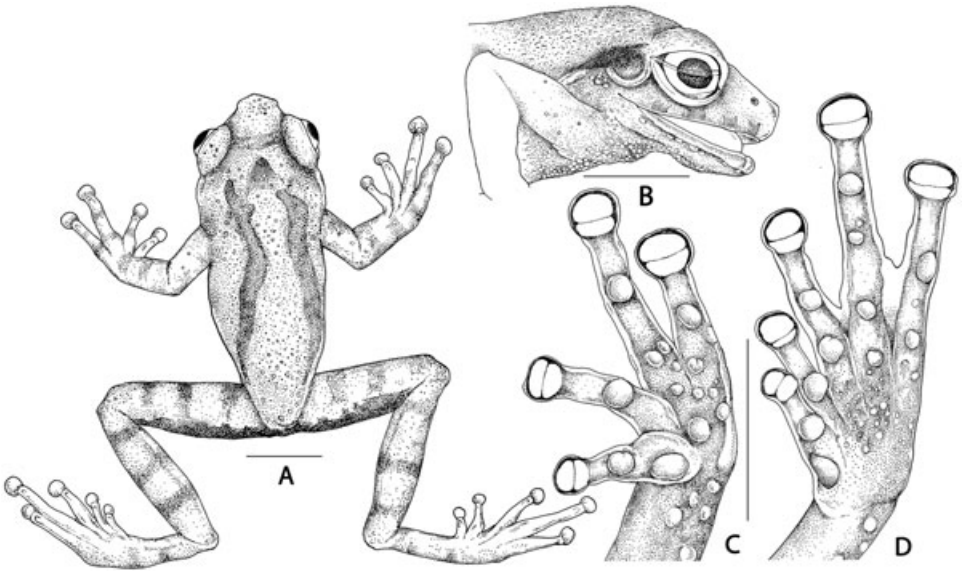

Figure 28. Holotype of ***Philautus coonoorensis* sp. nov.** (BNHS 4444). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

Figure 29. *Philautus coonoorensis* sp. nov. (BNHS 4444) from Coonoor.

Description of the holotype (all measurements in mm): Small-sized frog (SVL 22.4), with a slender to slightly elongate body (Fig. 28A); head length (HL 7.9) almost equal to width (HW 8.0; MN 6.6; MFE 5.5; MBE 2.3); outline of snout in dorsal view oval (Fig. 28A), snout length (SL 3.5) longer than horizontal diameter of eye (EL 2.8); canthus rostralis rounded, loreal region acutely flat; distance between posterior margins of eyes (IBE 7.4) 1.7 times the distance between anterior margins of eyes (IFE 4.4); tympanum (TYD 1.4) rather distinct (Fig. 28B), rounded; supratympanic fold distinct, from back of eye to shoulder (Fig. 28B); lingual papilla absent.

Forelimb (FLL 4.9) shorter than hand (HAL 6.5; TFL 3.8); all fingers with lateral dermal fringe on both edges, webbing absent; subarticular tubercles prominent, rounded, single, III2 double, IV2 weakly developed (Fig. 28C); prepollex rather distinct, oval; single palmar tubercle, oval, distinct; supernumerary tubercles present on fingers III and IV (Fig. 28C); nuptial pad absent.

Hindlimbs moderately long, shank (ShL 11.9) longer than femur (TL 11.6), longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 9.4); webbing reduced (Fig. 28D); reaching just above the third subarticular tubercle on the inside, and reaching the second subarticular tubercle on the outside of toe IV; dermal fringe along toe V present; subarticular tubercles rather prominent, rounded, simple, IV3 and V2 weakly developed; supernumerary tubercles present on toes II–V (Fig. 28D).

Skin of snout and between eyes shagreened with a few tubercles, upper eyelids shagreened with some prominent horny spinules, side of head shagreened with prominent tubercles, anterior and posterior parts of back with horny spinules; upper part of flank shagreened with some granular projections, lower part of flank granular, dorsal part of forelimb, femur, shank, and tarsus shagreened with granular projections; throat shagreened to granular, chest, belly, and posterior surface of thighs granular.

Colour of holotype: In life: dorsum light-reddish brown, a light black stripe between the eyes forming a triangular grey-coloured snout with blackish spots, a pair of brown concave stripes running from behind the eye to the vent, sparsely uniting at the top, a

light-brown inverted triangular marking between the eyes (Fig. 29), upper eyelids grey, loreal and tympanic regions dark-brownish black; upper and lower jaws with brownish bands alternated with light grey (Fig. 29); lateral side of abdomen with dark-brown blotches alternated with light-grey patches, iris light brown, encircled by a thin bluish grey outer ring; groin light-brownish black, limbs light-brown dorsally, forelimbs and hindlimbs with dark-brownish cross bands, fingers and toes with dark cross bands, posterior surface of thighs with light chocolate-brown blotches, alternated with variable size of grey patches; ventral side grey with variable sized dark-brown specks, hands and feet greyish.

In preservation: dorsal markings almost as in life, but faded, upper eyelid blackish, loreal and tympanic regions light-grey–brown, lateral abdominal area light brown with light-grey patches; forelimbs and hindlimbs light brown with strong dark-brown cross bands, posterior surface of thighs with light-brown patches, alternated with light grey; ventral side uniform grey with dark-brownish irregular spots.

Variation: Measurements of five specimens are given in Table 2. The colour and markings are slightly variable: BNHS 4446, with a light-grey dorsum and a light-brown inverted triangular marking between the eyes; BNHS 4447, with a light-grey dorsum and a faint and broken concave line; SDB 0003, with a grey dorsum and a black triangular patch between the eyes, and a dark concave line.

Etymology: The species is named after Coonoor, where the type series was collected. The specific name is considered an invariable noun in the nominative singular, standing in apposition to the generic name.

Distribution and natural history: Philautus coonoorensis sp. nov. is known only from the type locality, Coonoor (Fig. 23D, Table 1). The holotype and three paratypes were collected from leaves, between 1- and 1.5-m high, near an abandoned eucalyptus plantation adjacent to Coonoor Sims Park. All specimens were collected during rain in the late evening.

PHILAUTUS DUBOIS BIJU & BOSSUYT, 2005

(FIGS 2, 30A, B, 31A; TABLE 2)

Type material: Holotype, BNHS 4281, an adult male, SVL 20.5 mm, from Kodaikanal, Dindigal, Tamil Nadu, India; paratypes, BNHS 4282–4285, four adult males, and BNHS 4286 and BNHS 4287, two adult females, from Kodaikanal.

Figure 30. *Philautus dubois*: A, paratype (BNHS 4286); B, an individual (not preserved) from Kodaikanal.

Other material studied: BNHS 4448, an adult male, from Eravikulam; BNHS 4449, an adult male, from Konalar (Table 2).

Diagnosis: Philautus dubois can be distinguished from known congeners by the following combination of characters: (1) small adult snout–vent length; (2) body rather robust; (3) supernumerary tubercles well-developed on all toes; (4) dorsum and lateral side prominently granular; (5) thigh and shank coffee brown and intermingled with light-grey and yellow blotches; (6) ventral side of forelimb coarsely granular.

Because of the overall appearance, *P. dubois* could be confused with two brown species from the Western Ghats, *P. anili* and *P. tinniens*. The new species differs from *P. anili* by its smaller male snout–vent length, SVL 20.7 ± 1.0 mm, $N = 7$ (vs. medium male size, SVL 24.6 ± 1.6 mm, $N = 13$), snout oval (vs. pointed), shank shorter than thigh, ShL 9.1 ± 0.2 mm vs. TL 9.8 ± 0.3 mm, $N = 7$ (vs. shank longer than thigh, ShL 12.3 ± 0.5 mm vs. TL 11.4 ± 0.8 mm, $N = 13$), lateral side light yellowish with light-brown spots (vs. lateral side with dark-brown blotches alternated with

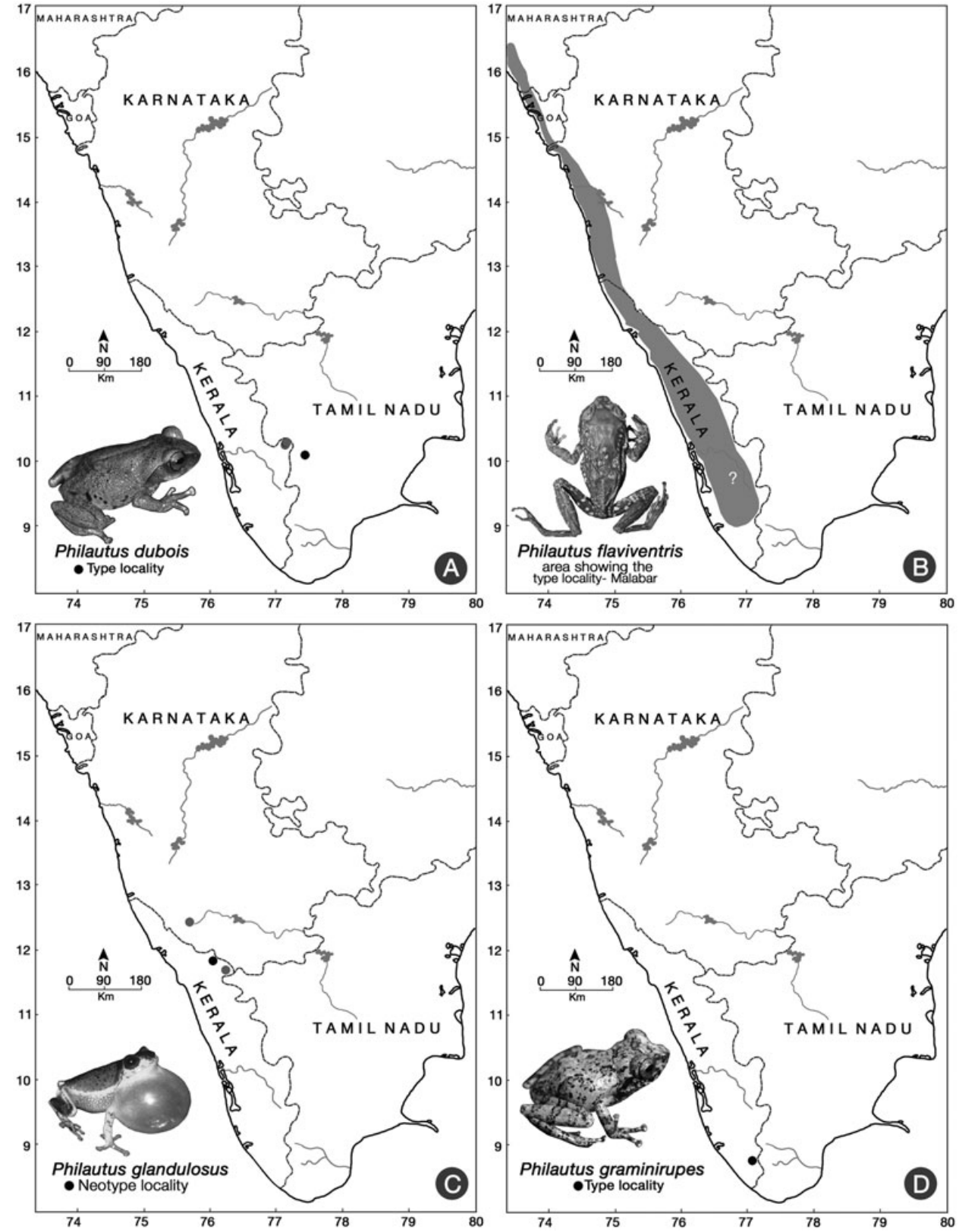

Figure 31. Distribution map. A, *Philautus dubois*; B, map showing Malabar (shaded in grey), from which the type of *Philautus flaviventris* was collected; C, *Philautus glandulosus*; D, *Philautus graminirupes*.

light-grey patches). Additionally, some colour morphs could be confused with *P. tinniens*. However, *P. dubois* differs from *P. tinniens* by its shank longer than foot length, ShL 9.1 ± 0.2 mm vs. FOL 7.7 ± 0.4 mm, $N = 7$, male (vs. shank subequal to foot length, ShL 8.5 ± 0.7 mm vs. FOL 8.4 ± 0.6 mm, $N = 3$), and colour of all fingers being grey (vs. first two fingers yellow).

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2006).

Variation: Measurements of nine specimens, including seven type series, are given in Table 2.

Colour in life: Philautus dubois is highly variable in dorsal coloration: dorsally greyish white, light green, yellowish green, dark-cobalt green, dark-orange reddish, brown, reddish brown, or brownish green; in all the colour forms, the dorsal markings are either in the form of an inverted 'V' or a pair of lateral concave lines/scattered spots extending from the posterior border of eyes to the vent. For a detailed discussion on colour variation, see Biju & Bossuyt (2006).

The colour during the breeding period is generally brighter than that of the non-breeding period (when the frogs hibernate under stones or in crevices). The skin texture also shows considerable variation, especially in female specimens. One female (BNHS 4286) collected from rock crevices has less granular projections on the lateral side (Fig. 30A).

Distribution and natural history: Eravikulam in Kerala, and Kodaikanal and Konalar in Tamil Nadu (Fig. 31A, Table 1). All specimens were collected during a rainy night from leaves, about 1-m high in shrubs.

PHILAUTUS FLAVIVENTRIS (BOULENGER, 1882)

(FIGS 31B, 32A–C, 33; TABLE 2)

Type material: Lectotype, BMNH 1947.2.26.98 (ex BMNH 1874.4.29.1202), an adult male, SVL 29.8 mm, from 'Malabar'.

Other material studied: None.

Diagnosis: Philautus flaviventris is distinguished from known congeners by its: (1) medium adult size (SVL 29.8 mm, male); (2) snout oval; (3) flank and groin deep brown with light-grey blotches; (4) ventral side grey and dark-brown vermiculated throughout; (5) absence of nuptial pad.

Philautus flaviventris is superficially similar to *P. signatus*, but differs by its oval snout (vs. sharply pointed snout), absence of nuptial pad in male (vs. presence of prominent nuptial pad), weakly developed supernumerary tubercles on hand (vs. supernumerary tubercles prominently present on hand).

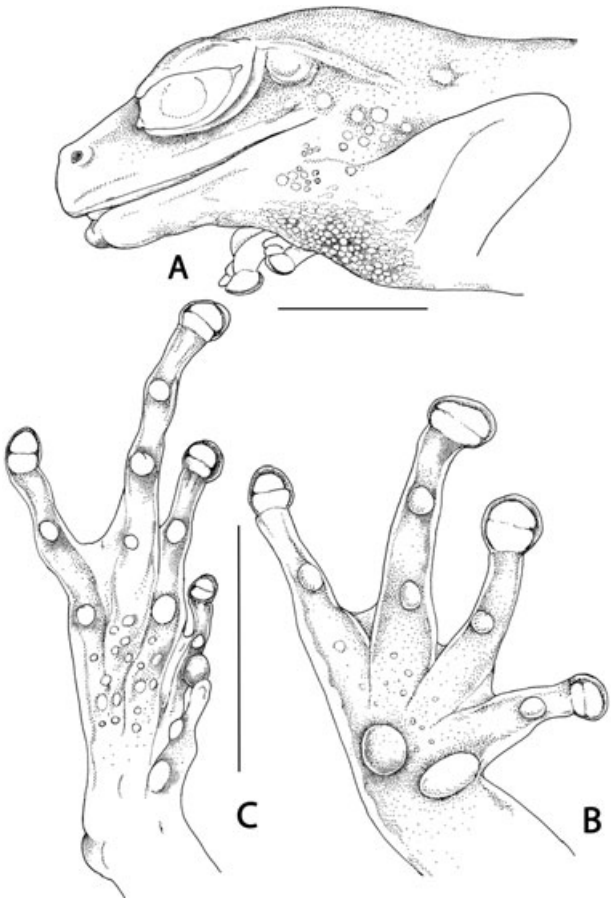

Figure 32. Lectotype of *Philautus flaviventris* (BNHS 1947.2.26.98). A, lateral view of head; B, ventral view of hand; C, ventral view of foot. Scale bars: 5 mm.

Figure 33. Lectotype of *Philautus flaviventris* (BNHS 1947.2.26.98) from 'Malabar'.

Description of the lectotype: A detailed description of the lectotype was published in Bossuyt & Dubois (2001). Measurements of the lectotype are given in Table 2.

Distribution and natural history: The original description mentioned 'Malabar' without precise locality (Fig. 31B).

Remarks: Philautus flaviventris is known only from the original collection. Recent extensive amphibian surveys of the Western Ghats have failed to rediscover this frog. No reliable observations have been made available for this species since its original description.

PHILAUTUS GLANDULOSUS (JERDON, 1853)

(FIGS 2, 5, 19, 31C, 34, 35; TABLE 2)

Type material: Neotype, BMNH 1947.2.27.22 (ex BMNH 1882.2.10.39), an adult male, SVL 22.3 mm, from 'Manantavadi' ('Manantodddy') (i.e. Mananthavady), Wayanad, Kerala (Bossuyt & Dubois, 2001).

Other material studied: BNHS 4453, an adult male, from Mercara; SDB 40239, an adult male, from Mananthavady; BNHS 4454, an adult male, from Sulthanbathery (Table 2).

Figure 34. Neotype of *Ixalus glandulosus* (BMNH 1947.2.27.22) from 'Manantavadi' (i.e. Mananthavady).

Figure 35. *Philautus glandulosus*: a specimen from Mananthavady (SDB 40239).

Identity: Bossuyt & Dubois (2001: 14–15) provided a detailed review on the nomenclatural history, and considered *Ixalus pulcher* Boulenger (1882) and *Rhacophorus pulcherrimus* Ahl, 1927 as synonyms of *Ixalus glandulosus* Günther, 1876. In the original description, Jerdon (1853: 533) stated the snout–vent length as roughly 30.5 mm, and described the unique yellowish colour on the side and limbs (Fig. 34), which exactly matches with the yellow forelimbs and lateral region of the syntype of *I. pulcher*, which presently is the neotype of *I. glandulosus*. Jerdon attributed the species epithet presumably because of its prominently granular ('glandular') yellow lateral side.

Diagnosis: Philautus glandulosus can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (SVL 25.2 ± 2.0 mm, $N = 4$); (2) snout pointed; (3) head length shorter than width, HW 10.0 ± 0.6 mm, HL 9.2 ± 0.9 mm, $N = 4$; (4) dorsum shagreened; (5) lateral abdominal area prominently glandular; (6) fingertips rounded; (7) dorsal surface of forearm and loreal region yellow; (8) anterior and posterior surface of thighs yellow.

Philautus glandulosus is the sole Western Ghats species in the genus with an invariable yellow dorsal surface of forearm and loreal region in life, and creamy white or yellowish in preservation (Figs 31C, 34, 35). It is closely related to *P. bobingeri* and *P. jayarami* sp. nov., which it resembles well in overall appearance (Fig. 5). For differences with *P. bobingeri* and *P. jayarami* sp. nov., see 'comparison' of those species.

Description of the neotype: A detailed description of the neotype was published in Bossuyt & Dubois (2001). Measurements are given in Table 2.

Colour in life: BNHS 4453 (in the wild), dorsum uniform dark green with a few scattered light-brown spots, lateral side yellow, loreal and tympanic regions yellow, iris reddish brown encircled by a thin bluish outer ring, forelimb yellow with a few dark-grey spots, thigh with a green line extending from dorsum to knee, anterior and posterior margins yellow, without markings, tibia almost completely green, tarsus yellow with a few scattered dark-greyish green spots; ventral side light yellow, throat, hands, and feet light yellow (Fig. 31C). In captivity (either in collection bags or in terrarium), this frog has the ability to change the dorsal green colour to dark purple or violet; however, the pattern is reliably constant. SDB 40239 (in captivity), dorsum uniformly dark purple, without markings, lateral side yellow, loreal and tympanic regions yellow, forelimb yellow, thigh with a purple line extending from dorsum to

knee, anterior and posterior margins yellow, without markings, tibia almost completely purple, tarsus yellow; ventral side yellowish, throat, hands, and feet yellow (Fig. 35).

Variation: Measurements of four specimens including neotype are given in Table 2.

Distribution and natural history: Mananthavady and Sulthanbathery of Kerala, and Mercara in Karnataka (Fig. 31C, Table 1). This species strongly prefers vegetation layers above 4 m in height. In Wayanad this species was located either from the rainforest canopy (about 10-m high in Mananthavady) or in forest fringes near coffee plantations (about 4-m high in Sulthanbathery). In Mercara it was observed in an isolated tree in a garden at heights above 4 m. Specimens were located by their calls, and were collected during rainy evenings after 20:00 h.

PHILAUTUS GRAMINIRUPES BIJU & BOSSUYT, 2005
(FIGS 2, 31D, 36; TABLE 2)

Type material: Holotype, BNHS 4264, an adult male, SVL 22.6 mm, from Ponmudi, Thiruvananthapuram, Kerala; paratypes, BNHS 4265–4266 and BNHS 4587 (ex TBGRI 2002.0055), three adult males; BNHS 4267 and FMNH 218118, two adult females, from Ponmudi.

Other material studied: None.

Diagnosis: Philautus graminirupes can be distinguished from known congeners by the following combination of characters: (1) small male adult snout–vent length (SVL 22.0 ± 0.6 mm, $N = 4$; SVL 27.3–29.4 mm, female); (2) pointed snout in dorsal view; (3) canthus rostralis sharp; (4) posterior surface of thighs chocolate brown, vermiculated with bluish green; (5) dorsum shagreened with a few granular projections; (6) between the eyes a horny ridge from the snout to the middle of the body; (7) long hindlimbs.

For comparison with the closely related species, *P. chlorosomma* sp. nov. and *P. graminirupes*, see 'comparison' of *P. chlorosomma* sp. nov.

Figure 36. Holotype of *Philautus graminirupes* (BNHS 4264) from Ponmudi.

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2005b). Measurements are given in Table 2.

Colour in life: Dorsum greyish brown with various numbers of irregular black patches, a brownish black band between the eyes, loreal and tympanic regions dark brown, inguinal region vermiculated with brown–yellow, tinted with bluish green, both lips with between three and five narrow light bands, iris silvery brown with dark-brown horizontal bands (Fig. 36); anterior surface of thighs vermiculated with brown–yellow, tinted with bluish green, posterior surface of thighs light-chocolate brown, vermiculated with bluish green.

Variation: Measurements of six specimens including type series are given in Table 2. BNHS 4265 is darker brown, BNHS 4266 has fewer markings, and BNHS 4587 has a discontinuous cross marking on the back. In captivity, the colour changes from light-greyish brown to dark brown.

Distribution and natural history: Philautus graminirupes is known only from the type locality, Ponmudi (Fig. 31D, Table 1). The holotype and three male paratypes were collected from leaf blades in grassland near evergreen forest patches. The female paratype BNHS 4267 was collected from a 2-m high moss-covered rock in grassland. Breeding was observed at the type locality. The eggs underwent direct development, and hatching of froglets took place after 24 days (Biju & Bossuyt, 2005b).

Remarks: This species was confused with *P. signatus* (FMNH 218123 and FMNH 218118) by Inger *et al.* (1984). The paratype TBGRI 2002.0055 (Biju & Bossuyt, 2005b) was transferred to BNHS as BNHS 4587.

PHILAUTUS GRIET BOSSUYT, 2002
(FIGS 2, 37A, B, 38A; TABLE 2)

Type material: Holotype, KBIN 1919, an adult male, SVL 21.3 mm, from Munnar, Idukki, Kerala; paratypes, KBIN 1920–1922 and KBIN 1926, four adult males, from Munnar.

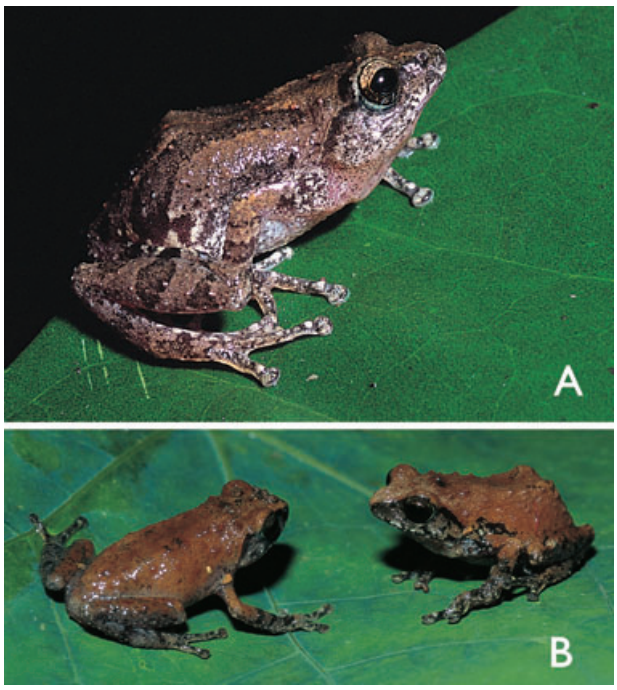

Figure 37. *Philautus griet*: A, specimen from Munnar (BNHS 4456); B, two specimens from Valparai (left: BNHS 4458; right: not preserved).

Other material studied: BNHS 4455–4457, three adult males, and BNHS 4464, an adult female, from Munnar; BNHS 4458, an adult male, from Valparai (Table 2).

Diagnosis: Philautus griet can be distinguished from known congeners by the following combination of characters: (1) small male adult snout–vent length (SVL 21.1 ± 1.0 mm $N = 5$); (2) skin of dorsum with small horny spinules; (3) horny ridges between the eyes, arranged in a triangle directed posteriorly; (4) flank and groin light brown with minute white marbling; (5) posterior part of thighs brown with minute grey spots. Also see the 'Diagnosis' section of *P. charius*.

Description of the holotype: A detailed description and illustrations were published in Bossuyt (2002).

Colour in life: Some colour variation has already been illustrated elsewhere (Bossuyt, 2002). SDB 046 has a light greyish brown dorsum with various numbers of irregular black patches in life, turns dark grey with faint irregular patches in preservation, with a pair of light-brown concave stripes running from behind the eye to the vent in life, dark grey in preservation; iris golden brownish with a bluish grey outer ring, groin, flank, and anterior and posterior side of thighs light brown with minute white marbling in life, turning light grey with white marbling in preservation; BNHS 4456 (Fig. 37A) has relatively more spinular dorsum compared with the holotype, dorsum light-brownish grey with a pair of dark concave stripes in life turning grey in preservation, both limbs having dark cross bands; BNHS 4457 light-reddish brown with a triangular light-greyish red snout and two light-red concave stripes on the back; BNHS 4458 (Fig. 37B, left) and BNHS 4455 uniformly light-reddish brown dorsum in life turning light-greyish brown in preservation.

Variation: Measurements of six specimens including the holotype are given in Table 2.

Distribution and natural history: Devikulam, Munnar, and Vagaman in Kerala, and Valparai in Tamil Nadu (Fig. 38A, Table 1). This species has a preference for calling from between ground level and a maximum height of 2 m. All of the individuals were observed at night-time after 19:00 h, either in road-side vegetation near isolated forest patches or in plantations near forests.

Remarks: The museum number of holotype KBIN 1919 was incorrectly stated by Bossuyt (2002: fig. 2) as 'holotype KBIN 1918', but is corrected here as 'holotype KBIN 1919'.

PHILAUTUS JAYARAMI SP. NOV.

(FIGS 2, 5, 19, 38B, 39A–F, 40A, B; TABLE 2)

Type material: Holotype, BNHS 4459, an adult male (SVL 26.0 mm), collected by SDB on 3 August 1998 from Valparai, Coimbatore District, Tamil Nadu, India; paratypes, BNHS 4460–4462 and BNHS 4543, four adult males collected along with the holotype.

Other material studied: SDB 40273, an adult male, collected along with the holotype (Table 2).

Diagnosis: Philautus jayarami sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium adult size; (2) pointed snout; (3) subarticular tubercles double in fingers III1 and IV1; (4) lateral region and thigh margin white, occasionally with bluish black spots; (5) elongated granulation on the ventral side (Fig. 39B).

Philautus jayarami sp. nov. can be distinguished from all green *Philautus* in the study area by its relatively large snout–vent length (largest green *Philautus* from the Western Ghats), in combination with a unique white lateral side and thigh margin in life, turning to ash grey in preservation, and yellowish upper arm and hands. Because of the overall

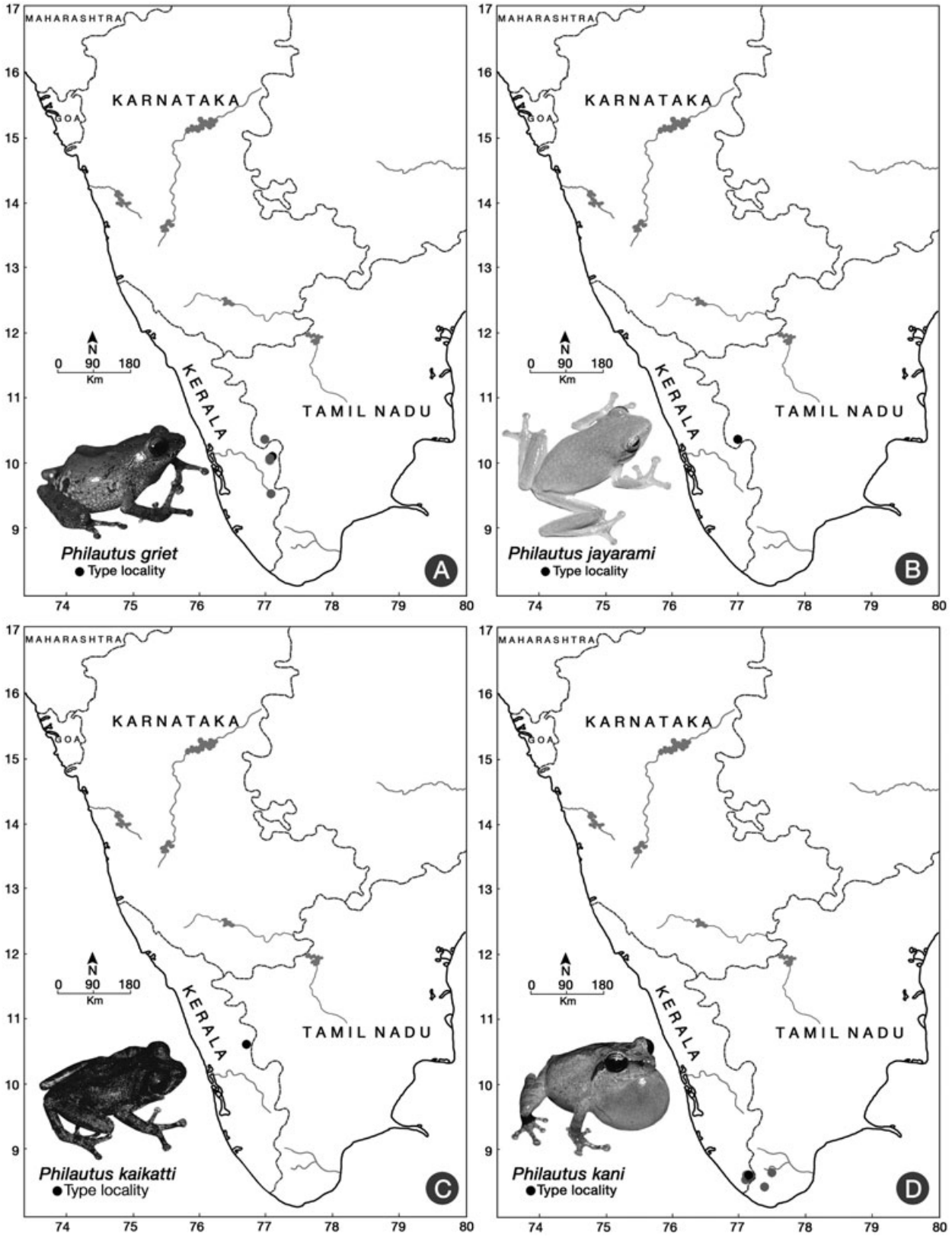

Figure 38. Distribution map. A, *Philautus griet;* B, ***Philautus jayarami* sp. nov.**; C, ***Philautus kaikatti* sp. nov.**; D, ***Philautus kani* sp. nov.**

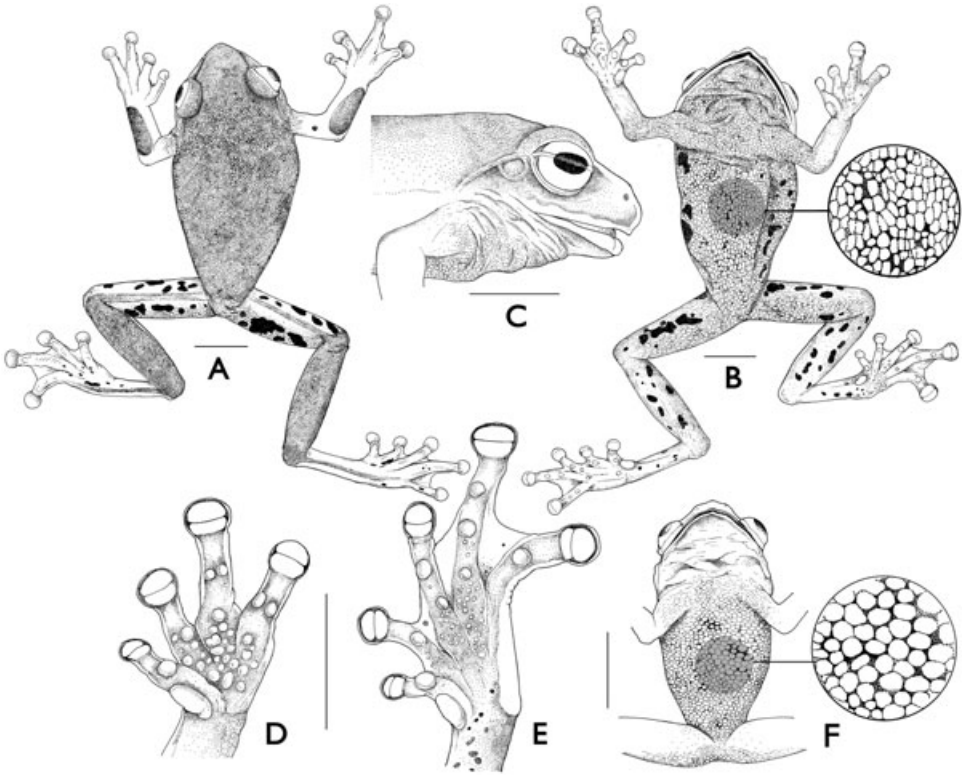

Figure 39. Holotype of ***Philautus jayarami* sp. nov.** (BNHS 4459). A, dorsal view; B, ventral view; C, lateral view of head; D, ventral view of hand; E, ventral view of foot; F, holotype of *Philautus bobingeri*, ventral view. Scale bars: 5 mm.

green coloration, *P. jayarami* sp. nov. could be confused with four other green species from the Western Ghats (Figs 5, 19): *P. akroparallagi* sp. nov., *P. beddomii*, *P. bobingeri*, and *P. glandulosus*. However, *P. jayarami* sp. nov. is distinct from *P. beddomii* by the relatively larger male snout–vent length, 26.3 ± 2.0 mm, $N = 6$ (vs. SVL 19.0 ± 2.8 mm, $N = 11$) and yellowish upper arm and hand (vs. forearm completely green in *P. beddomii*); *P. jayarami* sp. nov. is clearly distinguishable from *P. glandulosus* by its extension of dorsal green coloration only to the lower arm of forelimb (vs. dorsal coloration not extending to lower arm, forelimb completely yellow; Figs 31C, 34, 35), extension of dorsal colour on lateral side of head (vs. dorsal colour does not extend to lateral side of head, lateral side of head yellow; Figs 19, 31C, 35), lateral side, and anterior and posterior surface of thighs white in life and ash grey in preservation (vs. anterior and posterior surface of thighs yellow in life and creamy white or light yellowish in preservation). For differences with *P. akroparallagi* sp. nov., and *P. bobingeri*, see 'comparison' of those species.

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 26.0) with a slender body (Figs 39A, 40A, B); head length (HL 10.0) shorter than width (HW 11.0; MN 8.2; MFE 6.1; MBE 3.6); outline of snout in dorsal and ventral views pointed, snout length (SL 4.1) longer than horizontal diameter of eye (EL 3.2); canthus rostralis rounded, loreal region acutely concave; distance between posterior margins of eyes (IBE 9.8) about 1.7 times the distance between anterior margins of eyes (IFE 5.8); tympanum (TYD 1.2) rather indistinct (Fig. 39C); supratympanic fold indistinct; tongue without lingual papilla, and with a round depression towards the base.

Forelimb (FLL 5.7) shorter than hand (HAL 8.0; TFL 4.1); fingers without lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single on I1 and II1, double on III1 and IV1, absent on IV2 (Fig. 39D); prepollex distinct; palmar tubercle distinct, oval; supernumerary tubercles present on fingers II, III, and IV (Fig. 39D); nuptial pad weakly developed, creamy white.

Hindlimbs moderately long, shank (ShL 13.3) slightly longer than thigh (TL 13.0), and longer than distance from base of inner metatarsal tubercles to tip of toe IV (FOL 11.2); distance from heel to tip of toe IV (TFOL 18.7); webbing moderate (Figs 19, 39E); reaching almost up to first subarticular tubercle on either side of toe IV; dermal fringe along toe V present (Fig. 39E); subarticular tubercles rather prominent, rounded, simple, III2 and IV3 weakly developed, V2 absent; supernumerary tubercles present (Fig. 39E).

Figure 40. A, paratype of ***Philautus jayarami* sp. nov.** (BNHS 4461); B, specimen (SDB 40273) from Valparai.

Skin of snout, between eyes, upper eyelids, side of head shagreened to sparsely granular, anterior and posterior parts of back sparsely granular; lateral region shagreened, flank sparsely granular; dorsal part of forelimb, thigh, tibia, and tarsus shagreened to sparsely granular; throat shagreened to granular, chest, belly, and posterior surface of thigh granular (Fig. 39B).

Colour of holotype: In life: dorsum uniform light green, without markings, lateral side white with bluish black blotches, loreal and tympanic regions light green, iris golden yellow with brown spots, encircled by light-bluish outer ring, lower arm light green, upper arm and hand yellowish, thigh with a green line extending from dorsum to knee, anterior and posterior margins white with bluish black blotches, shank almost completely light green, tarsus with an extremely thin light green line, forelimbs and hindlimbs without cross bands; throat light-yellowish white, belly white, hands and feet light yellowish.

In preservation: dorsum uniform ash blue, lateral side ash white, loreal and tympanic regions ash blue, lateral region ash white; anterior and posterior surface of thighs ash white with dark blotches (Fig. 39A); limbs without cross bands; ventral side uniform white.

Variation: Measurements of five individuals from the type series are given in Table 2. BNHS 4460, dark green with a purplish streak from snout, along the side of head to near the vent in life, turns to dark purplish dorsum and light-purple streak in preservation; BNHS 4462, blue marking on the thigh is absent.

Etymology: The species is named after K. Jayaram, as a token of appreciation of him as a constant source of inspiration, and for his field support of SDB's research.

Distribution and natural history: Andiparai shola (Valparai), and several localities within a 10-km radius in and around the type locality (Fig. 38B, Table 1). All individuals were collected around 20:00 h after heavy rain, from forest undergrowth about 2 m above the ground.

PHILAUTUS KAIKATTI SP. NOV.

(FIGS 2, 38C, 41A–D, 42; TABLE 2)

Type material: Holotype, BNHS 4557, an adult male (SVL 24.2 mm), collected by SDB on 20 September 1998 from Kaikatti-Nelliyampathi, Palakkad, Kerala, India; paratypes, BNHS 4465–4466, and BNHS 4417, three adult males collected along with the holotype.

Other material studied: SDB 541, an adult male, collected along with the holotype (Table 2).

Diagnosis: Philautus kaikatti sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (SVL 24.9 ± 1.4 mm, $N = 5$); (2) snout oval in dorsal view; (3) canthus rostralis rounded; (4) tympanum rather indistinct; (5) lateral side prominently granular with light and grey spots; (6) posterior part of thighs prominently granular; (7) posterior part of thighs and groin brown.

For comparison with the closely related species *P. anili* and *P. sushili* sp. nov., see the 'Diagnosis' of *P. anili*.

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 24.2) with a rather robust body (Fig. 41A); head length (HL 9.5) equal to width (HW 9.5; MN 7.7; MFE 5.7; MBE 2.7); outline of snout oval in dorsal view (Fig. 41A), snout length (SL 3.6)

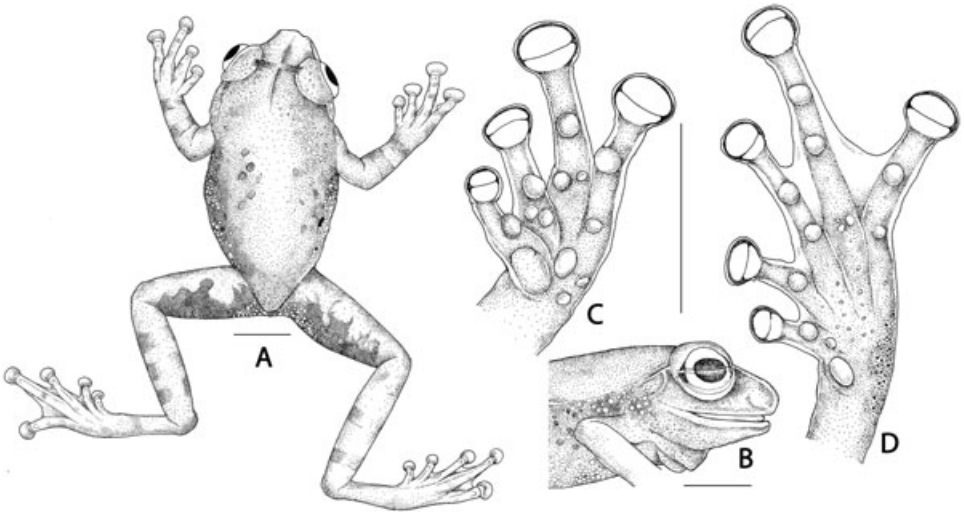

Figure 41. Holotype of ***Philautus kaikatti* sp. nov.** (BNHS 4557). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

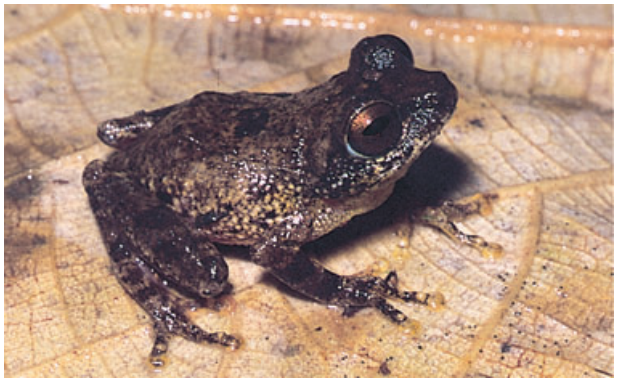

Figure 42. A specimen of ***Philautus kaikatti* sp. nov.** (SDB 541) from Kaikatti.

subequal to horizontal diameter of eye (EL 3.7); canthus rostralis rounded, loreal region vertical to acute, slightly concave; distance between posterior margins of eyes (IBE 9.2) 1.9 times that of distance between anterior margins of eyes (IFE 4.7); tympanum rather indistinct; supratympanic fold rather indistinct; tongue without lingual papilla.

Forelimb (FLL 5.4) shorter than hand (HAL 7.3; TFL 4.3); fingers with lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single, all present (Fig. 41C); prepollex distinct; palmar tubercle single, oval; supernumerary tubercles present on fingers II, III, and IV (Fig. 41C); nuptial pad absent.

Hindlimbs moderately long, shank (ShL 12.7) longer than thigh (TL 12.5), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 10.0); distance from heel to tip of toe IV (TFOL 16.9); webbing moderate (Fig. 41D); reaching up to distal subarticular tubercle on either side of toe IV; dermal fringe along toe V present; subarticular tubercles rather prominent, rounded, simple, IV3 and V2 weakly developed; supernumerary tubercles weakly present on all fingers (Fig. 41D).

Skin of snout, between eyes, upper eyelids, side of head, anterior part of back shagreened, posterior part of back granular; upper and lower parts of flank granular, lateral side prominently granular with white tubercles, lateral side and posterior part of thighs coarsely granular, dorsal part of forelimb, shank shagreened, tarsus shagreened to granular (Fig. 41A); throat shagreened to granular, chest, belly, and posterior surface of thighs granular, limbs coarsely shagreened.

Colour of holotype: In life: dorsum dark greyish brown with irregular light-grey and dark-brown blotches, dark horizontal grey band in between the eyes, loreal and tympanic regions dark brown, lateral abdominal area light grey with white and dark grey spots, groin and margin of thighs dark brown, limbs with faint brownish cross bands, iris dark brown; ventral side greyish white.

In preservation: dorsum greyish brown with light and dark brown irregular markings, loreal and tympanic regions dark brown, a faint grey band horizontally between the eyes, lateral area whitish with irregular black spots, groin and posterior margin of thighs dark brown, forelimbs and hindlimbs light-greyish brown, hindlimbs having faint grey cross bands; ventral side whitish.

Variation: Measurements of five specimens are given in Table 2. A specimen (SDB 541) has light-greyish

brown dorsum with a large spot in the middle (Fig. 42).

Etymology: The species is named after Kaikatti, where the type series was collected. The specific name is considered an invariable noun in the nominative singular, standing in apposition to the generic name.

Distribution and natural history: Philautus kaikatti sp. nov. is known only from the type locality in Kaikatti of Nelliyampathi Hills (Fig. 38C, Table 1). The holotype and three paratypes were collected from a 1-m high tree, in an evergreen forest patch after 18:00 h.

PHILAUTUS KANI SP. NOV.

(FIGS 2, 9, 38D, 43A–D, 44A, B; TABLE 2)

Type material: Holotype, BNHS 4467, an adult male, SVL 20.0 mm, collected by SDB on 12 July 2000 from Chathankod, Thiruvananthapuram, Kerala, India; paratypes, BNHS 4468–4472, five adult males collected along with the holotype; BNHS 4473, an adult male collected by SDB on 10 June 2001 from Palode, Thiruvananthapuram; BNHS 4474, an adult female collected by SDB on 15 June 2002 from the same locality as the holotype.

Other material studied: none.

Diagnosis: Philautus kani sp. nov. can be distinguished from known congeners by the following combination of characters: (1) small adult size; (2) body slender; (3) snout pointed; (4) upper two-thirds of tympanum dark black; (5) dorsum with spinular projections.

Philautus kani sp. nov. is similar to *P. amboli* sp. nov. and *P. wynaadensis* from the Western Ghats (Fig. 9). For differences with *P. amboli* sp. nov., see

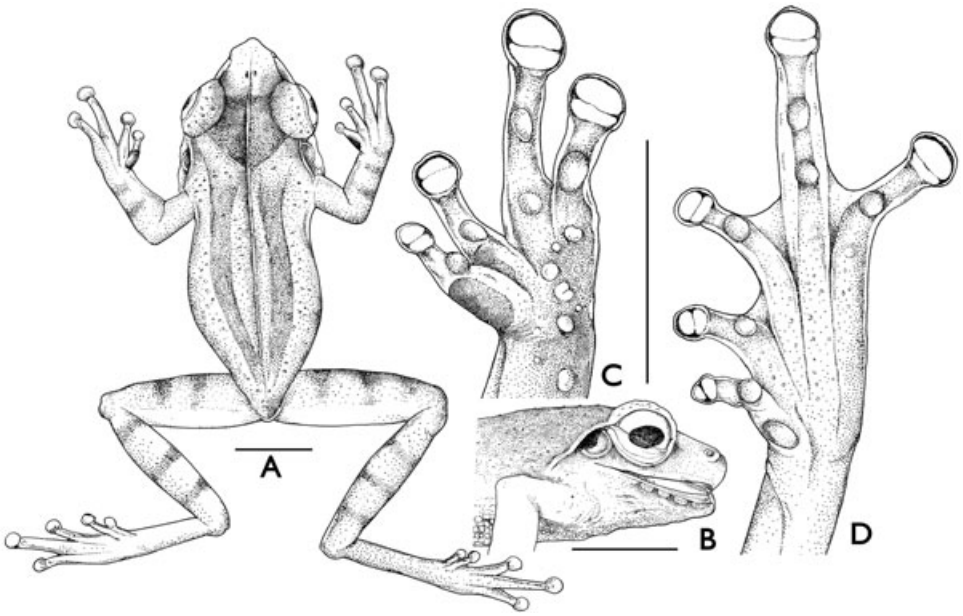

Figure 43. Holotype of ***Philautus kani* sp. nov.** (BNHS 4467). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

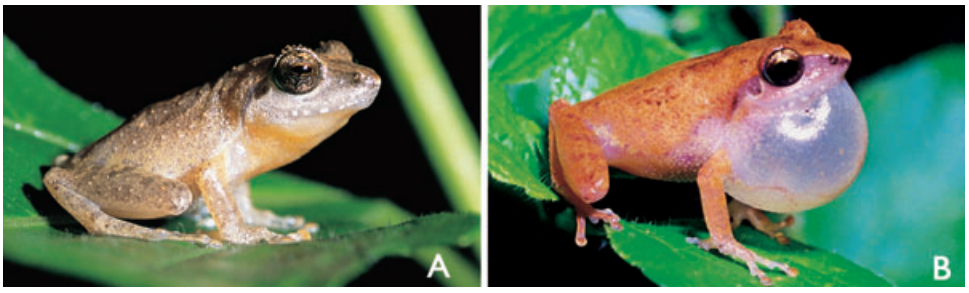

Figure 44. A, holotype of ***Philautus kani* sp. nov.** (BNHS 4467) from Chathankod; B, paratype (SDB 4473) from Palode.

the 'comparison' of that species. *Philautus kani* sp. nov. differs from *P. wynaadensis* by its short male snout–vent length, SVL 20.6 ± 1.5 mm, $N = 7$ (vs. medium, SVL 25.7 ± 1.5 mm, $N = 7$), snout sharply pointed in ventral view (vs. snout subelliptical), canthus rostralis rounded to sharp (vs. indistinct), shank almost equal to thigh, ShL 10.5 ± 0.6 mm vs. TL 10.3 ± 0.5 mm, $N = 7$, male (vs. shank longer than thigh, ShL 13.4 ± 0.7 mm vs. TL 12.6 ± 0.7 mm, $N = 7$). Comparison of members of the Sri Lankan *Philautus* radiation with Western Ghats species is provided under *P. amboli* sp. nov.

Description of the holotype (all measurements in mm): Small frog (SVL 20.0) with a slender body (Fig. 43A); head length (HL 8.1) longer than width (HW 7.6; MN 7.1; MFE 5.4; MBE 2.5); snout sharply pointed in dorsal (Fig. 43A) and ventral views, snout length (SL 4.0) longer than horizontal diameter of eye (EL 3.0); canthus rostralis rounded to sharp, loreal region acutely concave; distance between posterior margins of eyes (IBE 7.1) 1.6 times the distance between anterior margins of eyes (IFE 4.3); tympanum (TYD 1.4) distinct, rounded (Fig. 43B), supratympanic fold distinct, from posterior corner of upper eyelid to base of forelimb; tongue without lingual papilla.

Forelimb (FLL 4.7) shorter than hand (HAL 5.8); fingers without lateral dermal fringe, webbing absent; subarticular tubercles rather prominent, rounded, single, IV2 weakly developed (43C); supernumerary tubercles present on finger III; nuptial pad present (Fig. 43C), prominent, shortly spinular.

Hindlimbs moderately long, shank (ShL 10.6) as long as thigh (TL 10.6), longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 8.0); distance from base of tarsus to tip of toe IV (TFOL 14.1); webbing rudimentary (Fig. 43D); subarticular tubercles prominent, rounded, simple, IV3 absent and V2 weakly developed; supernumerary tubercles weakly present on all toes (Fig. 43D).

Skin of snout and between eyes shagreened, upper eyelids shagreened with prominent spinular projections, side of heads shagreened, anterior and posterior parts of back shagreened with spinular projections; upper and lower parts shagreened with sharp spinules; weakly developed horny ridge extends from snout halfway to vent; dorsal parts of forelimb, thigh, leg, and tarsus shagreened and sparsely granular; throat shagreened, chest shagreened to granular, belly and thigh granular.

Colour of holotype: In life: dorsally light-brownish grey, a pair of dark-brown concave stripes from behind the eye to the level of the hindlimb, an inverted triangular dark-brown patch in between the eyes, loreal and tympanic regions light brown, upper two-thirds of tympanum dark black (Fig. 44A); iris golden brown, limbs dorsally grey with light-grey cross bands; throat grey, belly light grey with dark spots, side of limbs light grey with variable size of brownish grey specks, hands and feet greyish.

In preservation: dorsally grey with a dark concave stripe and a triangular patch in between the eyes; ventrally uniform greyish with dark brownish irregular spots united into patches.

Variation: The type series is homogeneous in external morphology, and measurements of the type series are given in Table 2. The dorsal coloration has considerable variation in comparison with the holotype. BNHS 4470–4472, with almost similar colour patterns, and with the latter having less granular projections on the dorsum when compared with the holotype; BNHS 4473, uniform reddish grey dorsum with a dark-grey stripe in between the eyes, (Fig. 44B); BNHS 4469, uniform light grey with a thin median whitish line extending from the tip of the snout to the vent; BNHS 4468, dark-grey dorsum without prominent markings.

Etymology: The species is named after the Kani tribe of Chathankod of Kerala who live where the type series was collected. SDB enjoyed tremendous field support and guidance from the Kani tribes, particularly Mallan and Vijayan, for his field studies of the Western Ghats amphibians.

Distribution and natural history: One of the most common species in South Kerala and Mundanthurai (Tamil Nadu). It has been located and /or collected from Bonakkad, Chathankod, Kiriparai, Neyar, Palode, Ponmudi, and the foothills of Agasthyamala (Fig. 38D, Table 1). The type series was collected from about 0.5-m high in the vegetation of secondary forest patches near the Kani tribal settlement at Chathankod.

Remarks: This species was identified as *P. temporalis* (FMNH 218129, an adult female; FMNH 218125 and FMNH 218124, two adult males) from Ponmudi and as *P. variabilis* (FMNH 212990) (Inger *et al.*, 1984). Six specimens were found in the ZSIM from 'Kalakkad' Tamil Nadu, without any number and labelled as *P. leucorhinus*.

PHILAUTUS LUTEOLUS KURAMOTO & JOSHY, 2003

(FIGS 2, 45A, B, 46A, 60B; TABLE 2)

Type material: Holotype, BNHS 4191, an adult male, SVL 27.9 mm, from Kirundadu, Kodagu (formerly Coorg), India; paratypes, BNHS 4192, OMNH Am 11412, two adult males, from Kudremukh, Chikmagalur, Karnataka.

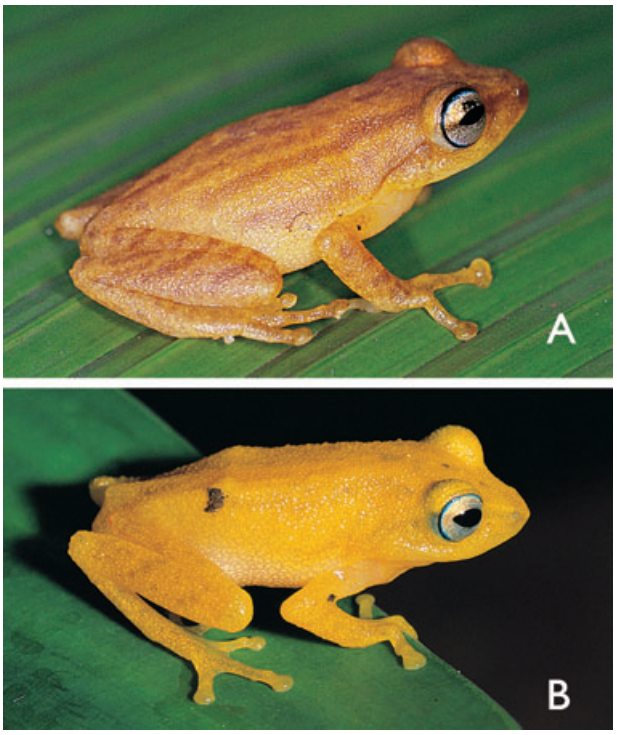

Figure 45. *Philautus luteolus*: A, specimen from Kudremukh (BNHS 4477); B, (BNHS 4479) from Muthodi.

Other material studied: BNHS 4476 and BNHS 4477, two adult males, from Kudremukh; BNHS 4478, an adult male, from Mercara; BNHS 4479, an adult male, from Muthodi; BNHS 4480, an adult male, from Sakleshpur; BNHS 4532, an adult male from Jog falls (Table 2).

Diagnosis: Philautus luteolus can be distinguished from known congeners by the following combination of characters: (1) medium adult male snout–vent length (SVL 26.8 ± 1.7 mm, $N = 7$); (2) snout pointed; (3) canthus rostralis rounded; (4) dorsum yellow or yellowish brown, usually with four–six faint brownish discontinuous lines from snout to vent; (5) loreal and tympanic regions golden yellow or yellowish brown.

Because of the typical dorsal coloration, *P. luteolus* cannot be confused with any of the Western Ghats *Philautus* except *P. travancoricus*. *Philautus luteolus* differs from *P. travancoricus* by its pointed snout (vs. oval snout), canthus rostralis rounded (vs. indistinct), dorsum uniformly granular (vs. shagreened), lateral side yellowish (vs. light brown), and absence of a dark-brown streak on either side of the snout (Figures 45A and B, 60B; vs. presence of dark-brown streak on either side of snout, Figs 59B, 60A, 61, 62).

Description of the holotype: A detailed morphological description and illustrations were published in Kuramoto & Joshy (2003). Measurements are given in Table 2.

Variation: Measurements of seven samples, including the holotype, are given in Table 2.

Colour in life: Some colour variation is observed in individuals of the same population within a small geographical area. The dominant colour form is yellowish brown with light-brownish lines (BNHS 4477, Fig. 45A), or discontinuous light-brown lines making a spotted appearance on a light-yellowish white background (BNHS 4476); however, the degree of brown colour is reduced in certain specimens, and the most extreme colour is golden yellow without markings (BNHS 4479, Fig. 45B), other than faint spots towards the snout and light-grey cross bands on limbs (which are more visible in preservation). In almost all of the colour forms (except SDB 1106), at least a few faint dorsal lines and cross bands on both limbs are visible in life and preservation: BNHS 4478 has a uniform light-brownish yellow dorsum with numerous minute brown spots, and faint brown cross bands on both limbs in life; the dorsum turns greyish brown with light-brown spots in preservation. In all colour forms the iris is light brown encircled with a bluish green outer ring (Fig. 45A, B).

Distribution and natural history: Jog Falls, Mavingundi, Kudremukh-Malleshwaram, Sakleshpur, Kempholay, Kirundadu, Madenadu, Mercara, and Muthodi in Karnataka (Fig. 46A, Table 1). This species was predominantly found in disturbed habitat near coffee estates adjacent to secondary forest or wayside vegetation. Individuals were observed either on leaves or stems of shrubs about 1 m above the ground. In Mercara, males started calling from under the leaf litter at dusk (about 18:00 h) in low frequencies, and then climbed onto the vegetation where they continued calling during the night-time until 22:00 h.

Remarks: Gururaja *et al.* (2007a) described a new taxon, *Philautus neelanethrus*, from Shimoga District in Karnataka state. We have examined the type series (BNHS 4510 and BNHS 4511, adult males) and could not find any substantial morphological difference with *P. luteolus*. The morphological distinctions mentioned in the original publication, 'lack (indistinct) of tympanum and supratympanic fold, snout length equal/subequal to eye diameter, and a distinct blue ring on the outer margin of the eye', are all present in our collection of *P. luteolus*. Furthermore, we compared the published sequence of the 16S rRNA gene of *P. neelanethrus* with our *P. luteolus* sequence from near the type locality. Apart from a few likely sequencing errors at the very start of the *P. neelanethrus* sequence (i.e. constant in all *Philautus*, except *P. neelanethrus*), the sequence of the remaining 520 bp only differed in a single substitution in a variable

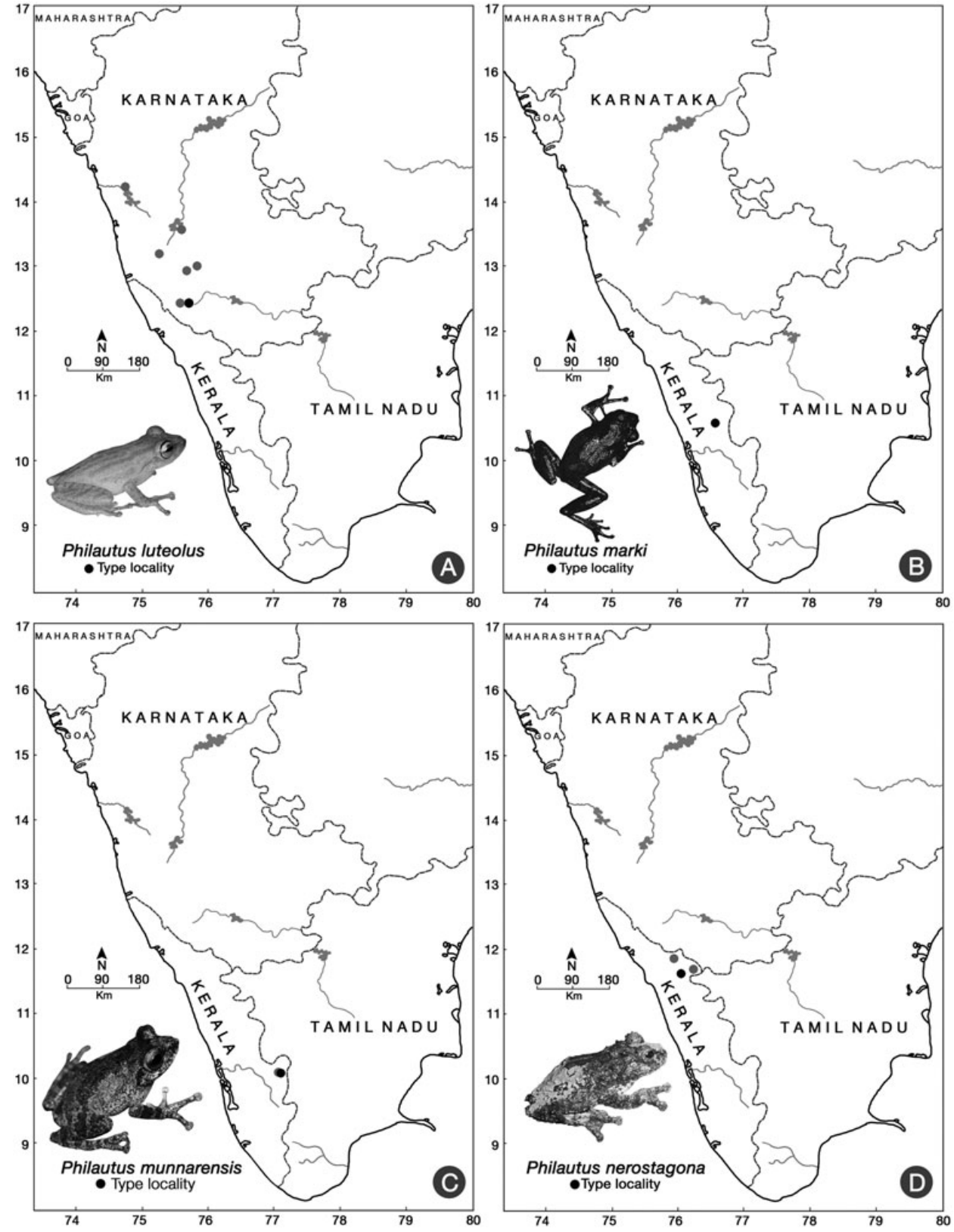

Figure 46. Distribution map. A, *Philautus luteolus*; B, ***Philautus marki* sp. nov.**; C, ***Philautus munnarensis* sp. nov.**; D, *Philautus nerostagona*.

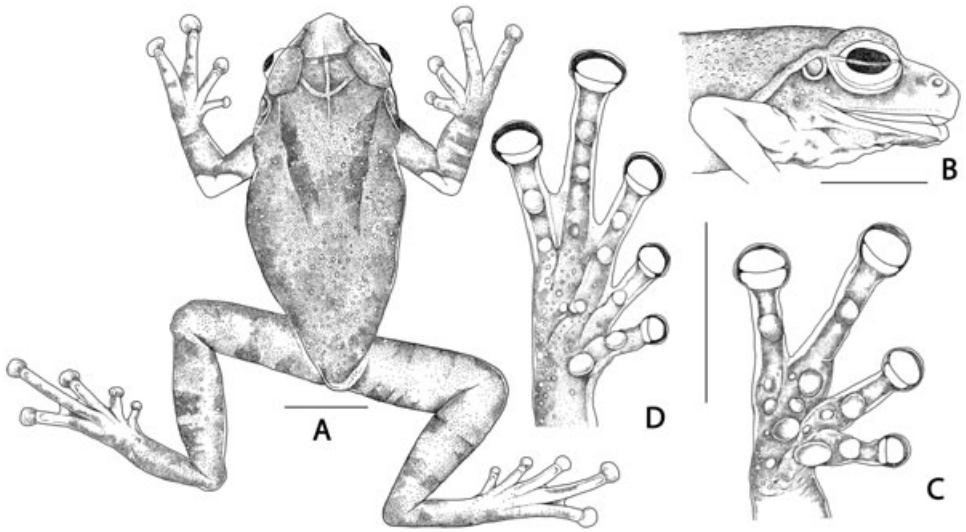

Figure 47. Holotype of ***Philautus marki* sp. nov.** (BNHS 4537). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

Figure 48. Holotype of *Philautus marki* sp. nov. (BNHS 4537) from Kaikatti.

region of this gene fragment. We therefore consider that there is currently no evidence for recognizing *P. neelanethrus* as distinct, and regard it as a new synonym of *P. luteolus*.

PHILAUTUS MARKI SP. NOV.

(FIGS 2, 46B, 47A–D, 48; TABLE 2)

Type material: Holotype, BNHS 4537, an adult male, SVL 22.8 mm, collected by SDB on 20 July 2000 from Kaikatti-Nelliyampathi, Palakkad, Kerala, India; paratypes, BNHS 4538 and BNHS 4539, two adult males, and BNHS 4540 and BNHS 4541, two adult females collected by SDB on 23 June 2006 from the same locality as the holotype.

Other material studied: SDB 028C, an adult male, collected along with the holotype (Table 2).

Diagnosis: Philautus marki sp. nov. can be distinguished from known congeners by the following combination of characters: (1) small male adult snout–vent length (SVL 22.2 ± 0.7 mm, $N = 4$); (2) snout pointed in dorsal view; (3) snout longer than the horizontal diameter of the eye; (4) skin of dorsum with small horny spinules; (5) horny ridges between the eyes, arranged in a triangle directed posteriorly; (6) flank and groin light grey with minute white marbling.

In general appearance, the new species could be confused with *P. griet* and *P. tinniens*. *Philautus marki* sp. nov. differs from *P. griet* by its pointed snout in dorsal view (vs. snout oval), snout longer than the horizontal diameter of the eye, SL 3.3 ± 0.1 mm vs. EL 2.7 ± 0.2 mm, $N = 4$, male, (vs. snout length subequal to horizontal diameter of the eye, SL 2.5 ± 0.1 mm vs. EL 2.6 ± 0.2 mm, $N = 5$, male); *P. marki* sp. nov. differs from *P. tinniens* by its pointed snout in dorsal view (vs. oval snout), shank longer than thigh length, ShL 10.8 ± 0.3 mm vs. TL 9.5 ± 0.3 mm, $N = 4$, male (vs. shank subequal to thigh length, ShL 8.5 ± 0.7 mm vs. TL 9.0 ± 0.6 mm, $N = 3$), posterior surface of thighs light grey without prominent markings (vs. thighs dark brown with variable grey patches), presence of horny ridge between eyes (vs. horny ridge absent).

Description of the holotype (all measurements in mm): Small frog (SVL 22.8) with a slender body (Figs 47A, 48); head length (HL 7.4) subequal to width (HW 7.2; MN 6.0; MFE 5.1; MBE 2.3); outline of snout in dorsal view pointed (Fig. 47A), slightly protruding, snout length (SL 3.4) longer than the horizontal diameter of

eye (EL 2.9); canthus rostralis sharp, loreal region acutely concave (Fig. 47B); distance between posterior margins of eyes (IBE 6.2) 1.5 times the distance between anterior margins of eyes (IFE 4.0); tympanum (TYD 1.2) distinct; supratympanic fold distinct, from back of eyes to shoulder; tongue with a lingual papilla.

Forelimb (FLL 4.5) shorter than hand (HAL 6.3; TFL 4.0); subarticular tubercles prominent, rounded, single (Fig. 47C); prepollex distinct, oval; supernumerary tubercles prominently present on all fingers, especially on palm (Fig. 47C); nuptial pad absent.

Hindlimbs moderately long; shank (ShL 10.6) longer than thigh (TL 9.4), distance from base of internal metatarsal tubercle to tip of toe IV (FOL 9.0); distance from heel to tip of toe IV (TFOL 14.5); webbing small (Fig. 47D), hardly reaching up to second subarticular tubercle on inside of toe IV, and reaching above the second subarticular tubercle on outside of toe IV; subarticular tubercles prominent, rounded, simple, IV3 weakly developed; supernumerary tubercles present on toes (Fig. 47D).

Skin of snout shagreened, between eyes shagreened to granular, horny ridges between the eyes, arranged in a triangle directed posteriorly (Fig. 47A), upper eyelids, side of head and back with horny spinules; flanks shagreened to granular, dorsal part of thighs shagreened, shanks with horny spinules, tarsus shagreened; throat weakly shagreened, chest, belly, and ventral side of thighs granular.

Colour of holotype: In life: dorsum dark grey, with a brownish concave stripe running from behind the eye (Fig. 48), a brownish stripe between the eyes, upper eyelids light grey, loreal and tympanic regions light greyish brown; groin light grey, minutely marbled with white; iris golden brown; limbs light brown with light-brown cross bands, both elbows brownish; posterior surface of thighs light grey; ventral side light grey.

In preservation: dorsum light-brownish grey with a pair of dark-grey concave stripes running from behind the eye to half of the dorsum, a light-grey stripe between the eyes forming a triangular grey-coloured snout; limbs light brown with dark-brown cross bands; both elbows light grey; ventral side uniform creamy white with dark-grey spots, especially on the throat.

Variation: Measurements of six specimens including the type series are given in Table 2. There is little colour variation, but the concentration of dorsal markings and cross bands on limbs is less in BNHS 4540 and BNHS 4541.

Etymology: This species is named after Mark Wilkinson of the Natural History Museum, London, in great appreciation of his contribution to Indian amphibian research, and his generous support of SDB's amphibian research.

Distribution and natural history: Philautus marki sp. nov. is presently known only from the type locality: Kaikatti (Fig. 46B, Table 1). The holotype and two male paratypes were collected during a rainy late evening from leaves about 1-m high near disturbed evergreen forest patches. The two female paratypes were collected from the ground on the surface of dead leaves.

PHILAUTUS MUNNARENSIS SP. NOV.

(FIGS 2, 46C, 49A–D, 50; TABLE 2)

Type material: Holotype, BNHS 4481, an adult male, SVL 28.8 mm, collected by SDB on 10 July 1998 from Munnar, on the way to Devikulam, Idukki, Kerala, India; paratypes, BNHS 4482 and BNHS 4533, two adult males collected along with the holotype.

Other material studied: SDB 029, an adult male collected along with the holotype; BMNH 97.10.13.2-a and BMNH 97.10.13.2-b, two adult males collected by H.S. Ferguson from 'Devicolum' (i.e. Devikulam), Kerala, India (Table 2).

Diagnosis: Philautus munnarensis sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (SVL 30.4 ± 2.0 mm, $N = 6$); (2) head shorter than wide (HW 12.1 ± 1.1 mm vs. HL 11.3 ± 0.7 mm, $N = 6$); (3) snout rounded in dorsal view; (4) loreal region obtusely concave; (5) tongue with a median lingual papilla; (6) groin light brownish yellow, marbled with brown; (7) ventral coloration light black; (8) supernumerary tubercles prominently present on all fingers and toes.

In general appearance, *P. munnarensis* sp. nov. could be confused with *P. signatus*, but it differs from *P. signatus* in having a rounded snout in dorsal view (vs. snout pointed), obtuse loreal region (vs. acute), shank shorter than thigh, ShL 14.6 ± 0.7 mm vs. TL 15.7 ± 0.8 mm, $N = 6$ (vs. shank longer than thigh, ShL 14.3 ± 1.1 mm vs. TL 13.4 ± 1.0 mm, $N = 8$), groin light-brownish yellow, marbled with brown (vs. flesh white or light reddish brown without any marbling).

Description of the holotype (all measurements in mm): Medium-sized frog (SVL 28.8) with a robust body (Figs 49A, 50); head length (HL 10.0) shorter than width (HW 11.2; MN 9.2; MFE 7.4; MBE 4.1); outline of snout in dorsal view rounded (Fig. 49A), slightly

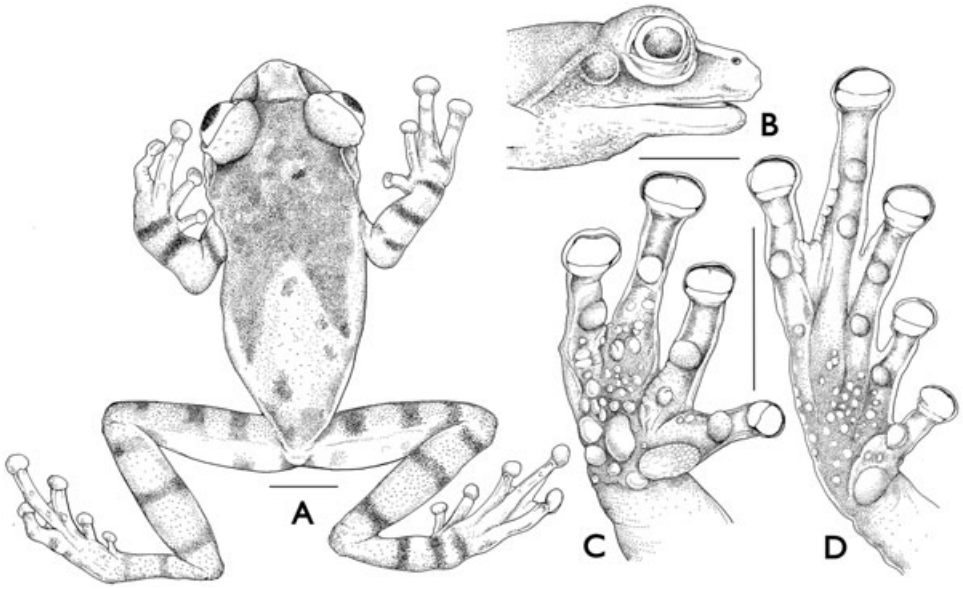

Figure 49. Holotype of ***Philautus munnarensis* sp. nov.** (BNHS 4481). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

Figure 50. Holotype of ***Philautus munnarensis* sp. nov.** (BNHS 4481) from Munnar.

protruding, snout length (SL 4.1) longer than horizontal diameter of eye (EL 3.9); canthus rostralis rounded, loreal region obtusely concave (Fig. 49A); distance between posterior margins of eyes (IBE 10.6) 1.8 times the distance between anterior margins of eyes (IFE 5.8); tympanum (TYD 1.5) rather distinct; supratympanic fold distinct, from back of eye to shoulder; tongue with a lingual papilla.

Forelimb (FLL 7.3) shorter than hand (HAL 9.4; TFL 5.8); fingers with dermal fringe on the edges; subarticular tubercles rather prominent, rounded, single, III2 and IV2 absent (Fig. 49C); prepollex distinct, oval; single palmar tubercle, oval; supernumerary tubercles prominently present on all fingers, especially on palm (Fig. 49C); nuptial pad present, oval, smooth to slightly granular.

Hindlimbs moderately long; shank (ShL 14.6) shorter than thigh (TL 15.2), longer than distance from base of internal metatarsal tubercle to tip of toe IV (FOL 12.6); distance from heel to tip of toe IV (TFOL 15.6); webbing moderate (Fig. 49D), hardly reaching up to second subarticular tubercle on inside of toe IV and reaching above the second subarticular tubercle on outside of toe IV; dermal fringe on toe V present; subarticular tubercles prominent, rounded, simple, IV3 absent and V2 extremely weak; supernumerary tubercles present on all toes (Fig. 49D).

Skin of snout, between eyes, upper eyelids, side of head, and back shagreened to granular, flanks shagreened, dorsal part of thighs, shank, and tarsus shagreened; throat weakly granular, chest, belly, and ventral side of thighs granular.

Colour of holotype: In life: dorsum light grey, with a dark-brownish grey inverted 'V' from the snout to the middle of the body (Fig. 50), and minute black spots on the dorsum; upper eyelids light brown, lighter brownish stripe between the eyes, groin light-brownish yellow, marbled with brown; loreal and tympanic regions dark brown, iris uniform coffee brown, limbs light brown with prominent dark-brown cross bands, posterior surface of thighs light-brownish yellow; ventral side dark-brownish black, margin of the lower jaw golden yellow; throat light-brownish yellow, lateral side yellowish brown marbled with dark-brown spots, hands and feet light grey, webbing grey, nuptial pad yellowish white.

In preservation: dorsum light brown with an inverted light grey 'V' marking, minute black spots

throughout, abdominal region light grey; limbs light brown with dark-brown cross bands; ventral side uniform creamy white with light-brown spots, especially on throat.

Variation: Measurements of six specimens including type series are given in Table 2. There is little colour variation, but the concentration of the inverted 'V' marking on the dorsum and cross bands on the limbs are lighter in BNHS 4482; the inverted 'V' marking is discontinuous in BNHS 4533.

Etymology: This species is named after Munnar, from where the type series was collected.

Distribution and natural history: Devikulam and Munnar (Fig. 46C, Table 1). The type series was collected after 19:00 h from the fringes of natural vegetation near a tea estate in Munnar. All specimens were found on leaves and twigs of *Lantana* thickets.

PHILAUTUS NEROSTAGONA BIJU & BOSSUYT, 2005
(FIGS 2, 46D, 51A, B; TABLE 2)

Type material: Holotype, BNHS 4244, an adult male, SVL 34.0 mm, from Kalpetta, Wayanad, Kerala, India; paratypes, BNHS 4245 and BNHS 4246, two adult males, from Kalpetta.

Other material studied: none.

Diagnosis: Philautus nerostagona can be distinguished from known congeners by the following combination of characters: (1) medium male adult snout–vent length (SVL 32.2 ± 2.0 mm, $N = 3$); (2) moderately webbed fingers; (3) almost completely webbed toes; (4) dermal fringe along the outer margin of the forelimbs and hindlimbs; (5) shortly spinular projections on upper eyelids; (6) tongue with a pointed papilla; (7) strongly adapted to life in the upper layers of the forest canopy.

Philautus nerostagona cannot be confused with any of the known *Philautus* from the Western Ghats because of its unique dermal ornamentation and extended webbing between fingers and toes (Biju & Bossuyt, 2005a).

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2005a). Measurements are given in the Table 2.

Variation: Measurements of the type series are given in Table 2. In general, the dorsum and dorsal side of the forelimbs and hindlimbs light brown with dark-green and reddish brown irregular patches of varying size, laterally bluish black vermiculated with brown patches, loreal and tympanic regions light brown with irregular light-green patches (Fig. 68B), iris reddish grey with a dark-brown ring; hands and feet grey, posterior margins of femur and tibia chocolate brown; ventral side off-white with various numbers of brown, light-grey and light-yellow spots forming a vermiculated pattern, throat grey, lips white with dark bands. The colour pattern of BNHS 4245 closely resembles the lichen-covered tree bark on which it was perched (Fig. 51A).

Distribution and natural history: Mananthavady, Sulthanbathery, and Kalpetta (Fig. 46D, Table 1). *Philautus nerostagona* is strongly adapted to life in the upper layers of the rainforest, and lives almost exclusively in the highest canopy layers between 10 and 20 m above the ground. We located a clutch of *P. nerostagona* eggs in a 10-cm-deep tree hole at about 10-m height at Kalpetta (for details, see Biju & Bossuyt, 2005a).

PHILAUTUS OCHLANDRAE GURURAJA *ET AL.*, 2007
(FIGS 52A, B, 53A; TABLE 2)

Type material: Holotype, ZSI/WGFRS/V/A/632, an adult male, SVL 25.6 mm, collected from Kakkayam Reserve Forest, Calicut District, Kerala, India;

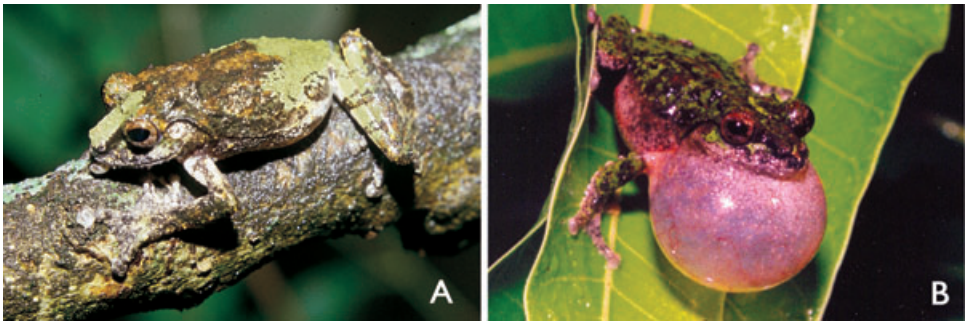

Figure 51. Holotype of *Philautus nerostagona*: A, paratype (BNHS 4245); B, holotype (BNHS 4244) from Kalpetta.

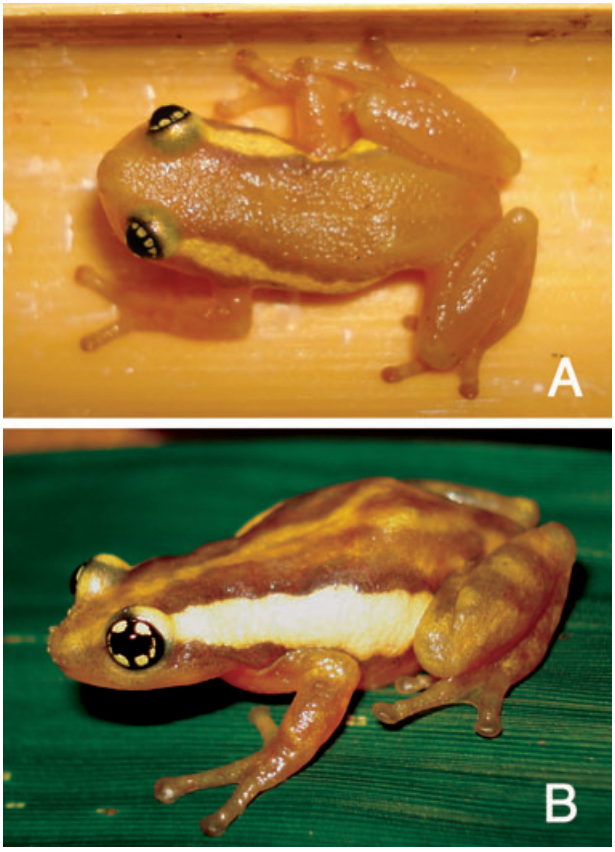

Figure 52. *Philautus ochlandrae*: A, specimen (SDB 6076) from Kakkayam Reserve Forest; B, specimen (BNHS 4559) from Kakkayam Reserve Forest.

paratypes, ZSI/WGFRS/V/A/633 and ZSI/WGFRS/V/A/637, two males, and ZSI/WGFRS/V/A636, a female, from the holotype locality.

Other material studied: SDB 6076 and BNHS 4559, two adult males collected from Kakkayam Reserve Forest, Kerala, India (Table 2).

Diagnosis: Philautus ochlandrae can be distinguished from known congeners by the following combination of characters: (1) medium male adult size (SVL 23.9 ± 1.3 mm, $N = 5$); (2) canthus rostralis rounded; (3) snout rounded; (4) pupil with striking golden yellow dentition-like marks in life; (5) light brown to creamy yellowish, with two invariable and distinct golden yellow streaks running from snout, along the side of head, to near the vent.

Philautus ochlandrae can be differentiated from all other known species of *Philautus* from the Western Ghats by its two distinct golden yellow streaks, extending from the snout along the side of head to near the vent, and by a pupil with striking golden yellow dentition-like marks in all colour morphs (Figs 52A, B, 53A). This combination of characters can also be observed in variations of *Philautus akroparallagi* sp. nov. (Fig. 4D) and *P. signatus* (Fig. 55B). However, *P. ochlandrae* differs from *P. akroparallagi* sp. nov. by its medium male adult size, SVL 23.9 ± 1.3 mm, $N = 5$ (vs. small male adult size, SVL 20.7 ± 1.0 mm, $N = 16$), rounded snout (vs. pointed), head wider than long, HW 8.3 ± 0.3 mm, HL 6.6 ± 0.6 mm, $N = 5$ (vs. head length equal to width, HW 7.8 ± 0.4 mm, HL 7.8 ± 0.5 mm, $N = 10$), and from *P. signatus* by its rounded snout (vs. pointed), canthus rostralis rounded (vs. acute), head wider than long, HW 8.3 ± 0.3 mm, HL 6.6 ± 0.6 mm, $N = 5$ (vs. head length subequal to width, HW 10.8 ± 1.1 mm, HL 10.6 ± 1.1 mm, $N = 8$), and absence of a lingual papilla on the tongue (vs. tongue with a lingual papilla).

Description of the holotype: The detailed description and illustrations were published by Gururaja *et al.* (2007b).

Variation: Measurements of six specimens including the type series are given in Table 2.

Distribution and natural history: Philautus ochlandrae is known only from the type locality in the Kakkayam Reserve Forest of the Calicut District (Fig. 53A). The type series was collected from the hollow tube of the internodal region of reed brake, about 2.5 m above the ground. Breeding (amplexus) and oviposition also take place inside hollow reeds (Gururaja *et al.*, 2007b).

PHILAUTUS PONMUDI BIJU & BOSSUYT, 2005

(FIGS 2, 53B, 54A, B; TABLE 2)

Type material: Holotype, BNHS 4257, an adult male, SVL 35.9 mm, from Ponmudi, Thiruvananthapuram, Kerala, India; paratypes, BNHS 4258 and BNHS 4259 and BNHS 4588 (ex TBGRI 2002.0050), three adult males, from Ponmudi.

Other material studied: BNHS 4483, an adult male, from Vagaman; BNHS 4484, an adult male, from Gavi; BNHS 4574–4579, six adult males, and BNHS 4580, an adult female, from Kalpetta (Table 2).

Diagnosis: Philautus ponmudi can be distinguished from known congeners by the following combination of characters: (1) large adult snout–vent length; (2) rather robust body; (3) snout rounded in dorsal view; (4) protruding eyes; (5) tongue with lingual papilla; (6) posterior surface of shanks banded; (7) presence of prominent nuptial pad in male.

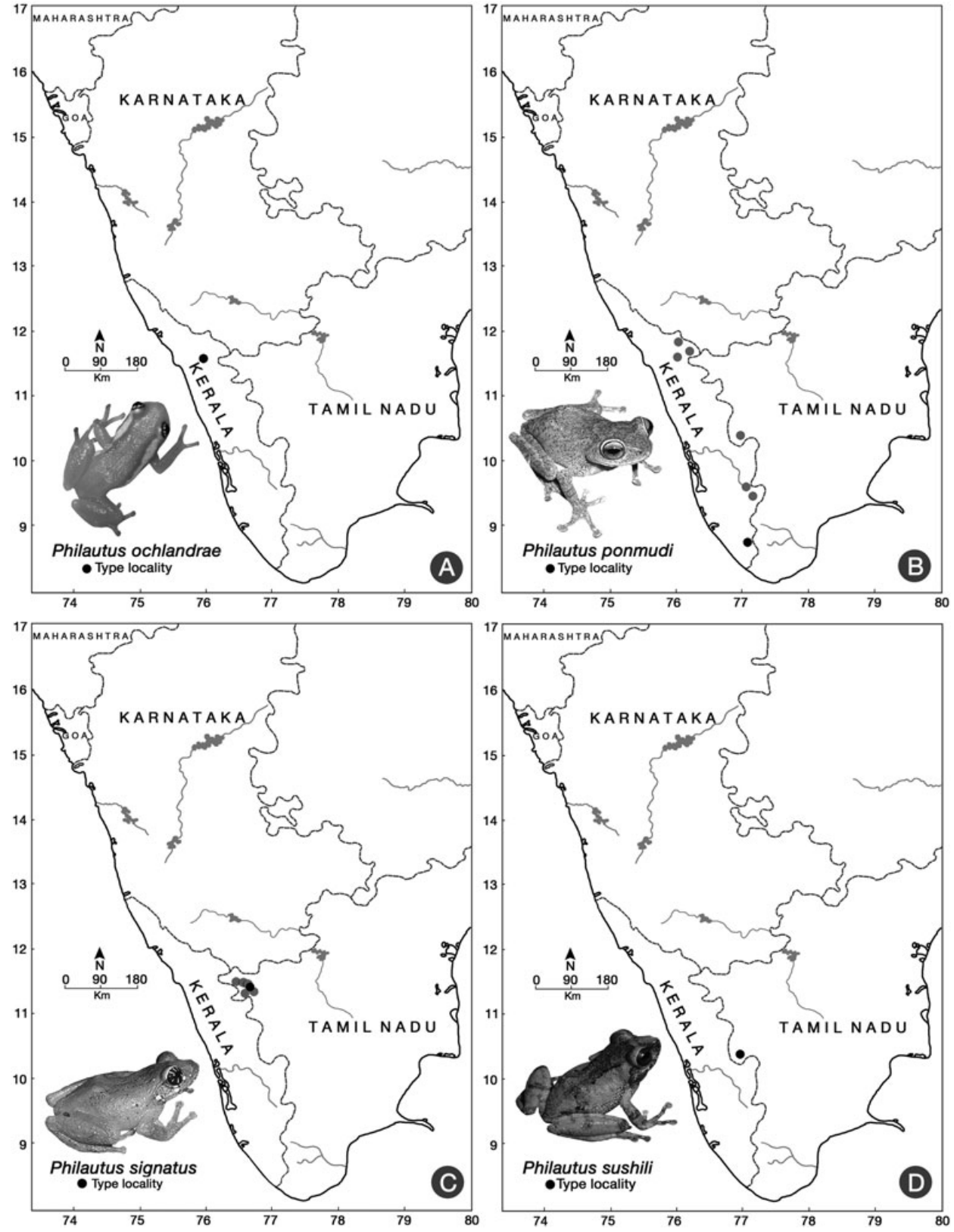

Figure 53. Distribution map. A, *Philautus ochlandrae*; B, *Philautus ponmudi*; C, *Philautus signatus*; D, ***Philautus sushili* sp. nov.**

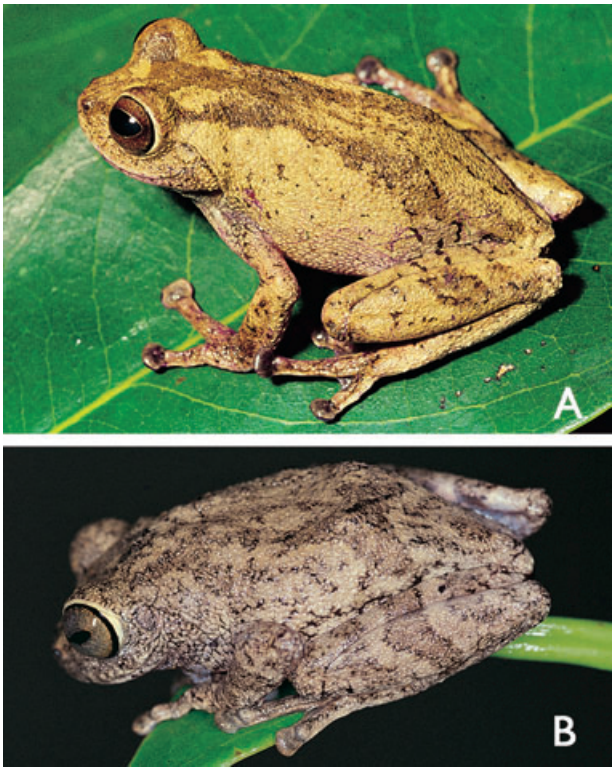

Figure 54. Holotype of *Philautus ponmudi*: A, holotype (BNHS 4257); B, specimen (SDB 3453) from Ponmudi.

Philautus ponmudi can be easily differentiated from all of the reported Western Ghats species of this genus by the combination of its vermiculated posterior surface of the shanks, and by its large snout–vent length (this is the *Philautus* species with the largest snout–vent length from the Western Ghats). It could be confused with *P. flaviventris* and *P. signatus* because all of them have comparable size and papilla on the tongue. However, *P. ponmudi* differs from *P. flaviventris* by its larger male size, SVL 36.4 ± 1.9 mm, $N = 12$ (vs. SVL 29.8 mm, $N = 1$), sharp canthus rostralis (vs. rounded), toe webbing reaching almost up to the distal subarticular tubercle on both sides of toe IV (vs. toe webbing reaching only up to the penultimate subarticular tubercle on both sides of toe IV), presence of a prominent nuptial pad on finger I of the male (vs. nuptial pad absent), and differs from *P. signatus* by its larger male size, SVL 36.4 ± 1.9 mm, $N = 12$ (vs. 29.6 ± 2.8 mm, male, $N = 8$), rounded snout (vs. sharply pointed), sharp canthus rostralis (vs. rounded), and posterior surface of thighs light chocolate brown, vermiculated with grey patches of variable size (vs. flesh white or light-reddish brown).

Description of the holotype: A detailed description and illustrations were published in Biju & Bossuyt (2005c).

Variation: Measurements of 13 specimens including the type series are given in Table 2. BNHS 4257, dorsum light-greyish yellow to dark grey with minute black spots, rarely with a few scattered white blotches, a pair of brown concave stripes running from behind the eye to the vent, uniting at the middle in a light-brown colour, and forming an 'X' mark on the back, a light-brown inverted triangular marking between the eyes, extending up to the upper eyelids (Fig. 54A), groin light grey with numerous dark-brown spots; hindlimbs light brown with dark-grey cross bands, posterior surface of thighs light chocolate brown, vermiculated with dark-grey patches of variable size, posterior surface of shanks banded (dark brown alternating with grey); BNHS 4588, 'X' mark on dorsum discontinuous; SDB 3453, dorsum uniform greyish brown without 'X' marking other than minute spikes throughout, lateral side light greyish white (Fig. 54B). In all colour forms the iris is light-golden brown encircled by a light-greyish white ring (Fig. 54A, B), posterior surface of thighs light chocolate brown, vermiculated with dark-grey patches of variable size in life, turns to light brown vermiculated with grey patches in preservation, posterior surface of shanks banded, dark brown alternating with grey in life, turns to light brown alternating with light grey in preservation.

Distribution and natural history: Gavi, Kalpetta, Mananthavady, Ponmudi, Sulthanbathery, Vagaman of Kerala, and Valparai in Tamil Nadu (Fig. 53B, Table 1). At Ponmudi and Valparai, this species was collected from between 8- and 15-m high in a tree from an evergreen forest patch. The population that was observed occasionally in Kalpetta was found about 2–4-m high on coffee plants near to forest fringes. The paratype TBGRI 2002.0050 (Biju & Bossuyt, 2005c) was transferred to BNHS as BNHS 4588.

PHILAUTUS SIGNATUS (BOULENGER, 1882)
(FIGS 2, 53C, 55A–C; TABLE 2)

Type material: Lectotype, BMNH 1947.2.27.36 (ex BMNH 1868.4.3.120), an adult male, SVL 31.5 mm, from 'Nilgherries' i.e. Nilgiri Hills), Tamil Nadu, India.

Other material studied: BMNH 1947.2.27.37, an adult male, from 'Nilgiri Hills'; BNHS 4486, an adult male, from Coonoor; BNHS 4487, an adult male, from Parsons Valley; BNHS 4488, an adult male, from Naduvattam; BNHS 4489, an adult male, and BNHS 4492, an adult female, from Avalanche; BNHS 4558 and BNHS 4491, two adult males, from Udhagamandalam (Table 2).

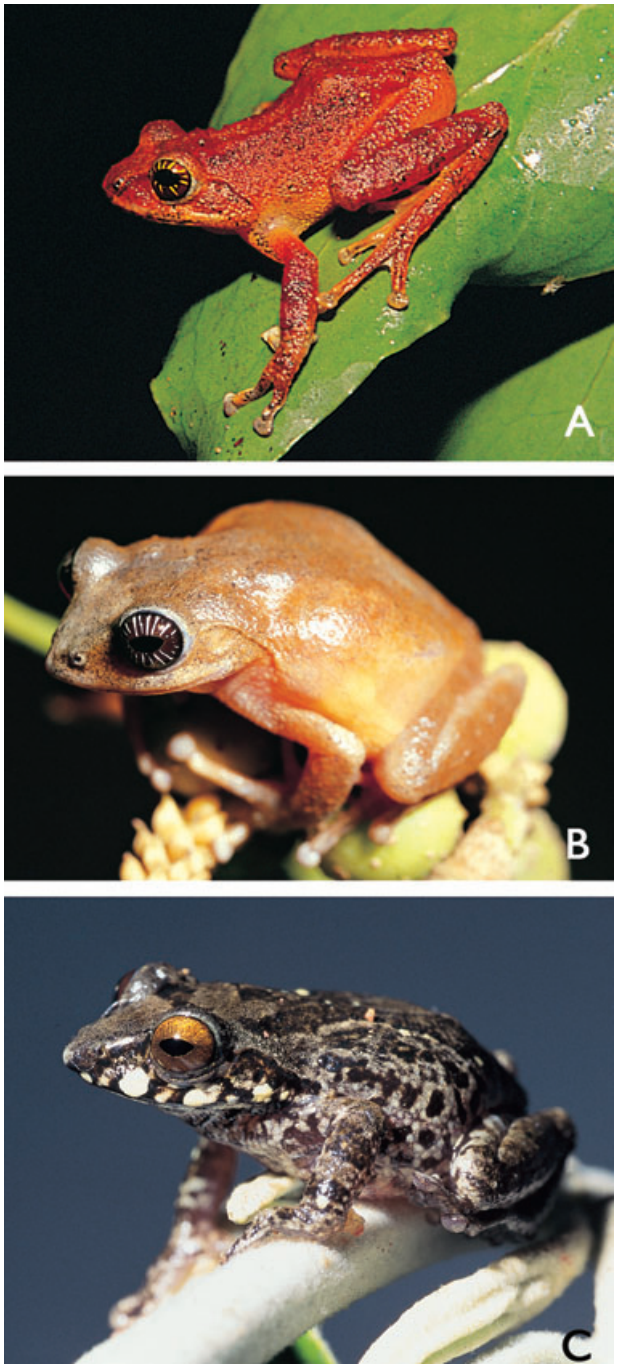

Figure 55. *Philautus signatus*: A, specimen (SDB 098) from Avalanche; B, specimen (BNHS 4492) from Avalanche; C, specimen (BNHS 4558) from Udhagamandalam.

Diagnosis: Philautus signatus can be distinguished from known congeners by the following combination of characters: (1) medium to large male adult size; (2) snout pointed in dorsal view; (3) canthus rostralis acute; (4) tongue with a lingual papilla; (5) flanks and groin flesh white or light-reddish brown, without markings.

Description of the lectotype: A detailed description of the lectotype was published in Bossuyt & Dubois (2001).

Variation: Measurements of nine specimens, including the lectotype, are given in Table 2. The skin texture is slightly variable: BNHS 4558 has a prominently granular dorsum, whereas BNHS 4489 has a shagreened to sparsely granular dorsum. This species has an array of dorsal coloration from light-greyish brown to dark red, and moreover, the same population shows marked difference in eye markings: iris dark-reddish brown with radiating golden stripes (Fig. 55A, B) and light brown iris without stripes (Fig. 55C). BNHS 4488, light-grey dorsum with dark 'X' marking; BNHS 4558, uniform reddish brown dorsum with irregular grey spots in life, dorsum turns greyish brown in preservation, light-blackish brown stripe between the eyes, dark-grey 'X' mark on dorsum (Fig. 55C); SDB 089, dark-brown dorsum with irregular black spots, light-grey stripe in between the eyes making a triangular grey snout with dark irregular brown spots, an inverted blackish brown 'V' mark on the middle of the dorsum in life, turns light-greyish brown dorsum with dark markings in preservation, throat with blackish patches; BNHS 4486 with almost similar markings as the lectotype, uniformly dark-brownish dorsum with an 'X' marking and a stripe in between the eyes; BNHS 4491 with uniform reddish grey dorsum with a light marking; SDB 098, uniformly dark reddish with a faint 'X' marking on dorsum and limbs (Fig. 55A); BNHS 4487, grey dorsum with a light-blackish 'X' marking and stripe in between the eyes, scattered white spots on loreal and tympanic regions, lateral side greyish white with light-brown patches, ventral side light grey with irregular light-brown spots, both the limbs have dark cross bands. BNHS 4492, light reddish with a faint 'X' marking (Fig. 55B).

Distribution and natural history: Nilgiri Hills and surroundings: Coonoor, Kothagiri, Udhagamandalam, Naduvattam, Avalanche, and Parsons Valley (Fig. 53C, Table 1). In Avalanche, Coonoor, and Naduvattam, this species was located from heights of about 4 m in shola vegetation. However, in Parsons Valley, calling individuals were observed invariably in the moss-covered earthen bank inside the forest patch.

Remarks: This species was considered to be I*xalus variabilis* Günther, 1858 (BMNH 74.4.29.458, BMNH 74.4.29.625–652 from Malabar, and BMNH 74.4.29.748–764 from Pycara, by Boulenger 1882).

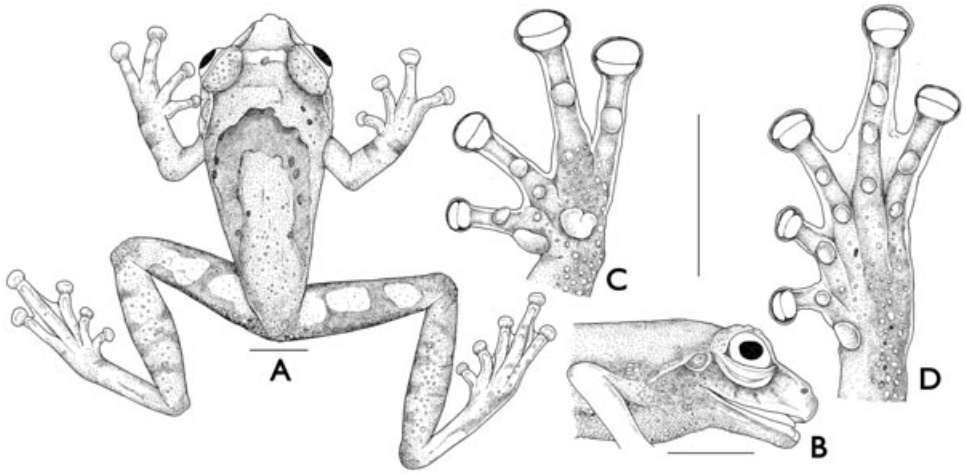

Figure 56. Holotype of ***Philautus sushili* sp. nov.** (BNHS 4544). A, dorsal view; B, lateral view of head; C, ventral view of hand; D, ventral view of foot. Scale bars: 5 mm.

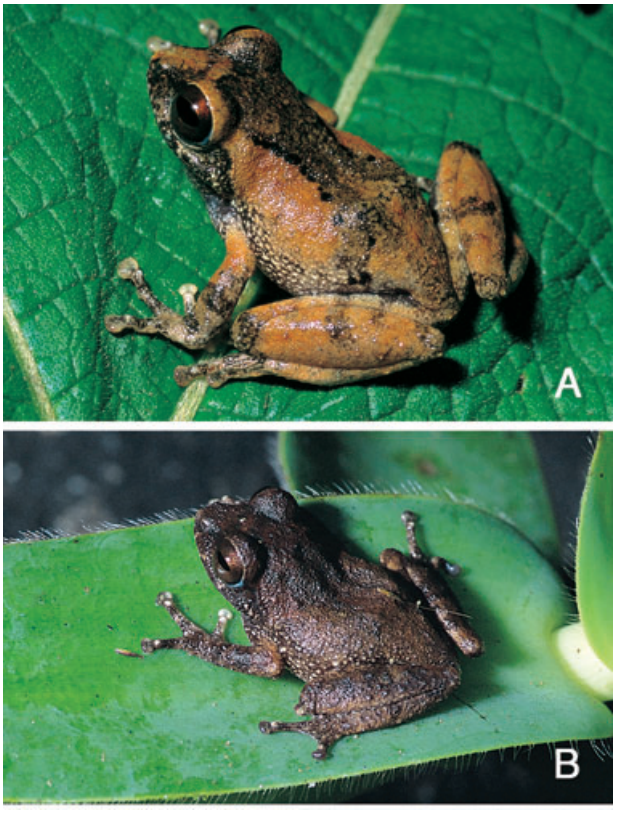

Figure 57. ***Philautus sushili* sp. nov.**: A, specimen (SDB 016B); B, paratype (BNHS 4450) from Valparai.

PHILAUTUS SUSHILI SP. NOV.

(FIGS 2, 53D, 56A–D, 57A, B; TABLE 2)

Type material: Holotype, BNHS 4544, an adult male, SVL 25.0 mm, collected by SDB on 13 August 1999 from Andiparai Shola, Valparai, Tamil Nadu, India; paratypes, BNHS 4450–4452, three adult males collected along with the holotype.

Other material studied: SDB 016B, an adult male collected from the holotype locality (Table 2).

Diagnosis: Philautus sushili sp. nov. can be distinguished from known congeners by the following combination of characters: (1) medium adult size (SVL 24.9 ± 2.3 mm, $N = 5$, male); (2) slender to elongate body; (3) head wider than long, HW 10.0 ± 1.0 mm, HL 9.1 ± 0.1 mm, $N = 5$; (4) snout oval in dorsal view; (5) shank longer than thigh, ShL 13.1 ± 1.3 mm, TL 12.3 ± 1.4 mm, $N = 5$; (6) ventral side of limbs coarsely granular; (7) lateral side of abdomen light grey with white spots; (8) anterior and posterior part of thighs and groin dark brown.

For comparison with closely related species *P. anili* and *P. sushili* sp. nov., see the 'comparison' of *P. anili*.

Description of the holotype (all measurements in mm): Medium frog (SVL 25.0), with slender to elongate body (Fig. 56A); head length (HL 9.5) shorter than width (HW 10.3; MN 8.0; MFE 6.1; MBE 3.2); outline of snout in dorsal view oval (Fig. 56A), snout length (SL 4.0) longer than horizontal diameter of eye (EL 3.7); canthus rostralis rounded to sharp, loreal region acute to obtuse, concave; distance between anterior margins of eyes (IFE 5.5) 1.7 times the distance between posterior margins of eyes (IBE 9.5); tympanum (TYD 1.1) rather distinct, rounded, 3.4 times smaller than eye diameter (Fig. 56B); supratympanic fold rather distinct, from posterior corner of upper eyelid to near shoulder; tongue without lingual papilla.

Forelimb (FLL 5.1) shorter than hand (HAL 7.3; TFL 4.5); finger with lateral dermal fringe, webbing absent; subarticular tubercles prominent, rounded, single, II2 and III2 weakly developed, IV2 absent (Fig. 56C); prepollex rather distinct; palmar tubercle distinct, rounded; supernumerary tubercles (smaller) weakly present on fingers; nuptial pad absent.

Hindlimbs moderately long, shank (ShL 14.0) shorter than thigh (TL 13.4), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 10.1); distance from heel to tip of toe IV (TFOL 17.1); webbing reduced (Fig. 56D); reaching up to penultimate subarticular tubercle on either side of toe IV; dermal fringe along toe V present; subarticular tubercles rather prominent, rounded, simple; supernumerary tubercles weakly present (Fig. 56D).

Skin of snout shagreened to slightly granular, between eyes shagreened, upper eyelids, side of head sparsely granular, anterior part of back shagreened to granular, posterior part of back granular, lateral side shagreened to granular, vent granular, upper and lower parts of flank sparsely granular, dorsal part of forelimb and hindlimb shagreened to granular; throat shagreened to granular, chest, belly, and posterior surface of thighs granular; limbs coarsely granular.

Colour of holotype: In life: dorsum brown with various numbers of deep-brown irregular spots, a dark-grey stripe between the eyes forming a triangular grey snout, loreal and tympanic regions blackish brown, a broad dark-brown inverted 'V' on the back, from the level of the forelimb, reaching to the level of the hindlimb, numerous minute blackish brown spots throughout the dorsum, lateral side of abdomen light grey with white spots; iris golden brown, encircled by a dark bluish grey outer ring; limbs light-brown dorsally, forelimbs and hindlimbs with brownish black cross bands, anterior surface of thighs and inner side of shanks dark brown; ventrally greyish white.

In preservation: dorsum uniform light brown with a few scattered dark spots, a greyish stripe between the eyes forming a triangular grey snout; loreal and tympanic region light brown, a broad brown inverted 'V' on the back (Fig. 56A); lateral region light grey with white spots; anterior surface of thighs and inner side of shanks brownish; ventral side grey; limbs with faint brownish grey cross bands.

Variation: Measurements of the type series are given in Table 2. Dorsal colour and pattern slightly variable from light greyish brown to dark brown; SDB 016B, light-greyish brown dorsum with dark-grey marking (Fig. 57A); paratype (BNHS 4450, Fig. 57B), dark-brown dorsum with light-grey stripe in between the eyes, faint dorsal black concave line (instead of an inverted 'V').

Etymology: This species is named after S. K. Dutta of the Utkal University, Orissa, for his encouragement of SDB in his early period of frog research.

Distribution and natural history: Philautus sushili sp. nov. is known only from Valparai and its vicinity (Fig. 53D, Table 1). This species is restricted to elevations above 600 m a.s.l., and all individuals were caught either from leaves or stems of undergrowth, between 1 and 2-m high. All were collected during rainy evenings after 19:00 h. Five juveniles (SVL 7.6 ± 0.3, $N = 5$) were located by the end of September from the ground under the litter, away from any permanent water sources.

PHILAUTUS TINNIENS (JERDON, 1853)

(FIGS 2, 58, 59A; TABLE 2)

Type material: Neotype, MNHN 1985.0527, an adult female, SVL 25.0 mm, from 'the South-East of the Ooty Lake, Udhagamangalam ["Ootacamund", "Ooty"]', Nilgiri Hills, Tamil Nadu, India.

Other material studied: BNHS 4497, an adult female, from Avalanche; BNHS 4548, an adult female, and BNHS 4495, an adult male, from Udhagamandalam; BNHS 4494, an adult male, from Coonoor; BNHS 4496, an adult male, from Naduvattam (Table 2).

Identity: Presently, *Ixalus punctatus* Anderson, 1871, *Ixalus montanus* Günther, 1876, and *Philautus melanensis* Rao, 1937 are considered synonyms of *P. tinniens* (Bossuyt & Dubois, 2001).

As already noted by Bossuyt & Dubois (2001), specimens at the Natural History Museum, London, from Kudremukh under the nomen *I. montanus* are different from *P. tinniens* from the Nilgiri Hills. We made a detailed examination of the 14 specimens at the Natural History Museum, London, from

Figure 58. *Philautus tinniens*: *specimen* (BNHS 4495) from Udhagamandalam.

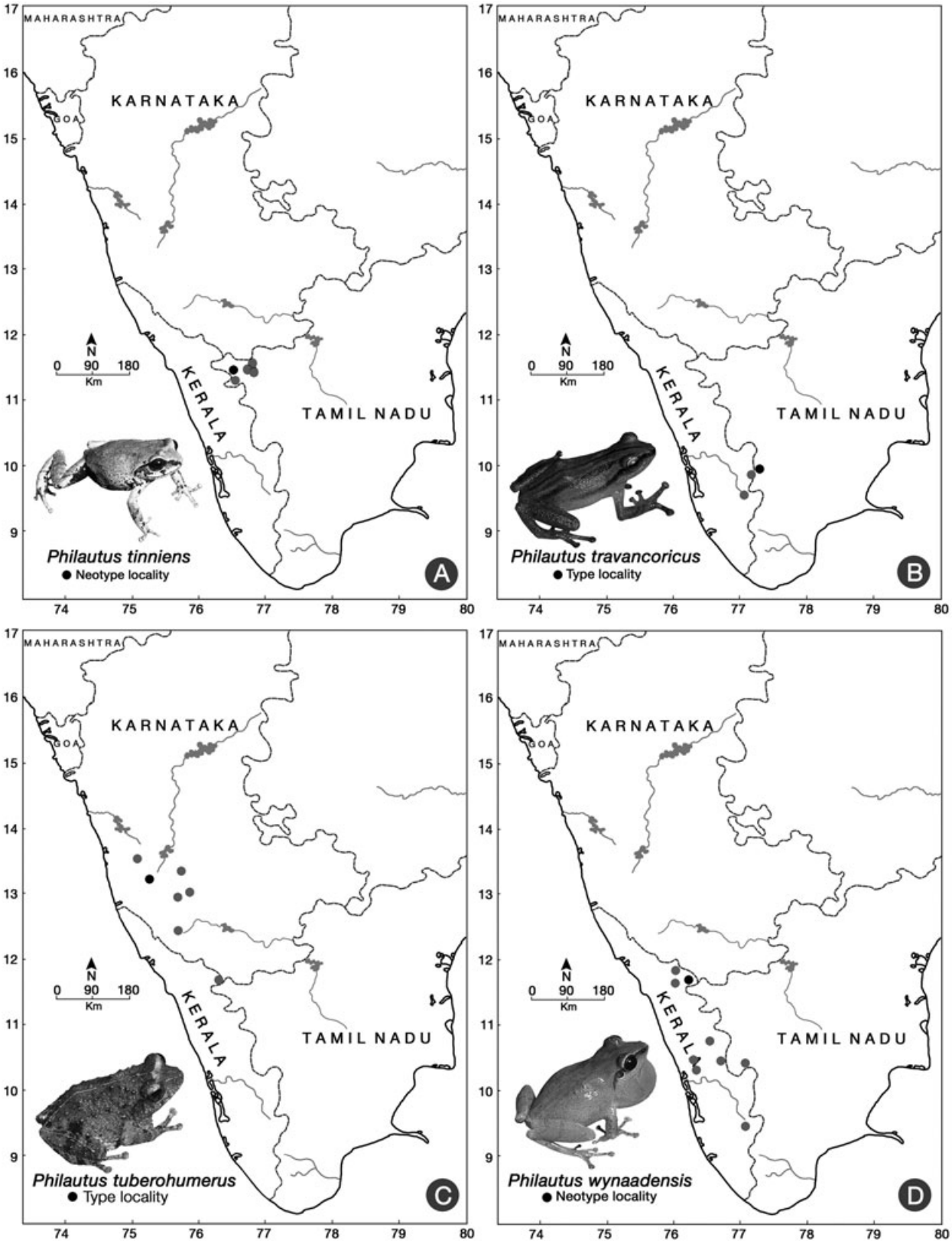

Figure 59. Distribution map. A, *Philautus tinniens*; B, *Philautus travancoricus*; C, *Philautus tuberohumerus*; D, *Philautus wynaadensis.*

Kudremukh under the nomen *I. montanus*, and revealed that they are different in identity from *P. tinniens* and other species described from this region. *Philautus montanus* (Günther, 1876) chiefly differs from *P. tinniens* by its longer snout–vent length, male SVL 29.0 ± 2.3 mm, $N = 5$; female SVL 35.6 ± 2.6 mm, $N = 9$ (vs. male SVL 20.5 ± 1.8, $N = 3$; female SVL 26.8 ± 1.6 mm, $N = 3$), and by flanks and groin yellowish brown (vs. dark brown), apart from other morphometric characters. However, we await fresh collections and DNA analyses before taking a taxonomic decision.

Diagnosis: Philautus tinniens can be easily distinguished from known congeners by the following combination of characters: (1) small adult size (male SVL 20.5 ± 1.8 mm, $N = 3$; female SVL 26.8 mm ± 1.6 mm, $N = 3$); (2) shank very short; (3) lateral side coarsely granular; (4) flanks and groin dark-brownish black; (5) first two fingers yellow in life, and light-yellowish white in preservation; (6) tibiotarsal articulation reaches below the level of the eye.

Description of the neotype: A detailed description of the neotype was published in Bossuyt & Dubois (2001).

Variation: Measurements of six specimens including the neotype are given in Table 2. This species has a relatively constant dorsal coloration, with only a slight degree of variation. BNHS 4495 (typical coloration), dorsum grey–brown; iris dark-blackish brown, without markings; lateral side grey with irregular brownish black patches, either side of snout including loreal and tympanic regions light grey with dark-brownish black markings, limbs light brownish with light cross bands, flanks and groins dark brownish black, anterior and posterior side of thighs, posterior surface of shanks dark brownish black in life, turns to black in preservation, first two fingers distinctively yellow (Fig. 58); ventral side light-whitish yellow with dark spots.

Distribution and natural history: Nilgiri Hills and surroundings: Avalanche, Coonoor, Kothagiri, Naduvattam, Parsons Valley, and Udhagamandalam (Fig. 59A, Table 1). All individuals were observed and collected either from the ground or from a maximum height of 0.6 m in shrubs (Avalanche). This frog even calls during the daytime, mainly from earthen bank or grasslands. Breeding was observed at Avalanche. Amplexus was axillary and 41 eggs were laid in a hole in an earthen cutting. The eggs were non-pigmented white and were protected by a dense jelly layer. Eggs were large and measured 4.3 ± 0.6 mm ($N = 41$) in diameter. The eggs underwent direct development and hatching of froglets took place after 19 days.

Remarks: This species was incorrectly identified as I. *variabilis* (BMNH 74.4.29.625, SVL 16.0 mm, and BMNH 74.4.29.652, SVL 16.1 mm) from 'Malabar' by Boulenger (1882).

PHILAUTUS TRAVANCORICUS (BOULENGER, 1891)

(FIGS 2, 59B, 60A, 61, 62; TABLE 2)

Holotype: BMNH 1947.2.6.20 (ex BMNH 1891.7.2.15), an adult female, SVL 29.8 mm, from 'Bodanaikanur' (i.e. Bodinayakkanur), Tamil Nadu, India.

Other material studied: BNHS 4546, an adult male, from Vandiperiyar; BNHS 4547 and SDB 4592, two adult males, from Vagaman (Table 2).

Identity: Philautus travancoricus was described as I*xalus travancoricus* Boulenger, 1891 based on a single female specimen (Fig. 60A) collected by H.S. Ferguson from Bodinayakkanur, Tamil Nadu, close to the Kerala border. We rediscovered one male frog

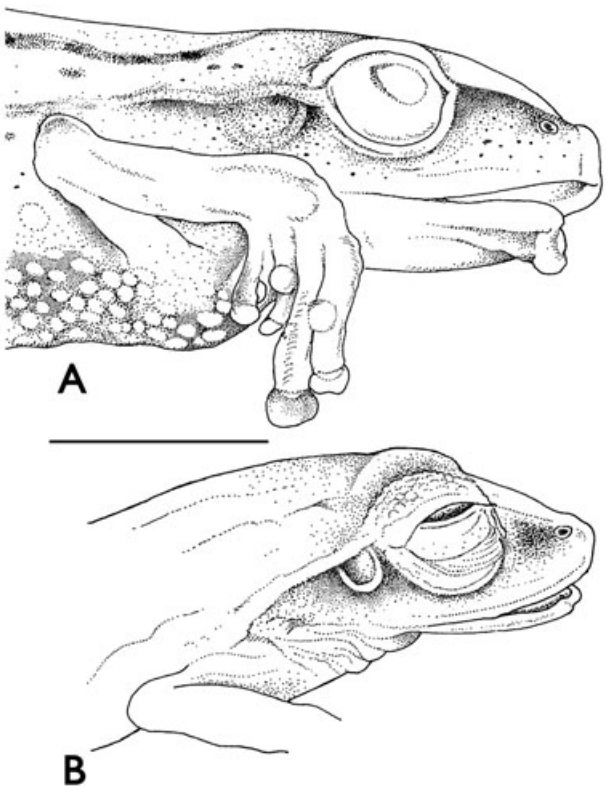

Figure 60. A, holotype of *Philautus travancoricus* (BMNH 1947.2.6.20), lateral view of head; B, *Philautus luteolus* (SDB 2567), lateral view of head. Scale bars: 5 mm.

Figure 61. Holotype of *Philautus travancoricus* (BMNH 1947.2.6.20) from Bodinayakkanur.

Figure 62. *Philautus travancoricus*: specimen (BNHS 4546) from Vandiperiyar.

after a gap of more than a century from Vandiperiyar, about 70 km north-west of the type locality in 2004, and later in 2006 located two males from Vagaman, about 20 km north of Vandiperiyar. Morphologically, our collection matches well with the holotype of *P. travancoricus* by having an oval snout, distinct lines on the dorsum, and a dark-brown streak on each side of the snout (Fig. 61). The type locality is also close to the present collection area. However, many of the characters cannot be obtained from the type because of its extremely dehydrated condition, although the colour pattern is clearly visible, especially the dark streak on each side of the snout running up to the level of the tympanum (Figs 60A, 61).

Diagnosis: Philautus travancoricus can be distinguished from known congeners by the following combination of characters: (1) small adult size, male SVL 23.5 ± 1.7 mm, $N = 3$; female SVL 29.8 mm, $N = 1$); (2) snout oval in dorsal view; (3) loreal and tympanic regions light brown with a prominent streak on each side of the snout, from the extreme tip of the snout to the lower level of the supratympanic fold (Figs 59B, 60A, 61, 62); (4) nuptial pad absent.

Philautus travancoricus is closely allied to *P. luteolus* (see *P. luteolus* for the 'comparison').

Description of the holotype (all measurements in mm): Medium frog (SVL 29.8) with slender body (Fig. 61); head longer (HL 12.3) than wide (HW 10.3; MN 9.9; MFE 7.5; MBE 4.4); outline of snout in dorsal view oval, slightly protruding, snout length (SL 4.1) longer than horizontal diameter of eye (EL 3.3) (Fig. 60A); canthus rostralis indistinct, loreal region acutely concave; distance between anterior margins of eyes (IFE 5.1) 1.5 times the distance between posterior margins of eyes (IBE 7.9); tympanum indistinct; tongue without lingual papilla; supratympanic fold indistinct.

Forelimb (FLL 6.8) shorter than hand (HAL 7.3; TFL 4.0); fingers without lateral dermal fringe; subarticular tubercles prominent, rounded, single, IV2 weakly developed; supernumerary tubercles weakly developed.

Hindlimbs moderately long, shank (ShL 13.7) almost equal to thigh (TL 13.6), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 11.0); distance from heel to tip of toe IV (TFOL 18.1); webbing reduced; subarticular tubercles rather prominent, rounded, simple.

Skin of snout, between eyes, upper eyelids, side of head, and anterior and posterior parts of back shagreened, upper and lower parts of flank shagreened to sparsely granular, dorsal part of forelimb and hindlimb shagreened; throat shagreened, chest, belly and posterior surface of thighs granular.

Colour of holotype: In preservation: dorsum uniform greyish brown with three brownish longitudinal lines, one from snout to near the vent, and the other two on either side from just behind the eye to near the vent (Fig. 61), numerous dark-brown spots throughout the dorsum and both limbs; loreal and tympanic regions slightly darker than dorsal colour, a dark prominent streak on each side of snout from the tip of the snout up to the lower level of the tympanum (Figs 60A, 61); ventral side greyish white.

Variation: BNHS 4546, light-greyish red with prominent brown broad lines alternating with thin faint lines on dorsum (Fig. 62), lateral side light-reddish brown, upper eyelids slightly lighter than the dorsal colour, iris yellowish brown, loreal and tympanic regions light brown with a prominent streak on either side of the snout, from the extreme tip of the snout to the lower level of the supratympanic fold, limbs with dark-brown cross markings; ventral side light-reddish white, without markings. BNHS 4547, dorsum light brown to dark brown in life (Fig. 59B), turns light-brownish grey in preservation.

Distribution and natural history: Bodinayakkanur, Vandiperiyar, and Vagaman (Fig. 59B, Table 1). In Vandiperiyar, about 70 km north-west from the type locality, a specimen (BNHS 4546) was found under leaf litter during the daytime in secondary vegetation outside of the breeding season (October). In Vagaman, about 20 km from Vandiperiyar, specimens BNHS 4547 and SDB 4592 were located during the breeding season (July) from heights of about 1 m in an isolated shrub surrounded by a tea plantation. This species is extremely rare in these two localities (we located only eleven individuals in two successive nights after a continuous search in the night for around 10 h), compared with the other *Philautus* species from the Western Ghats, and its distribution range is also restricted to those two regions. A more extensive field survey is essential to ascertain its range of distribution. The current distribution is restricted to the most disturbed habitat (tea plantation) outside protected areas.

PHILAUTUS TUBEROHUMERUS KURAMOTO & JOSHY, 2003

(FIGS 2, 59C, 63A, B; TABLE 2)

Type material: Holotype, BNHS 4193, an adult male, SVL 18.2 mm, from Kudremukh, Chikamagalur, Karnataka; paratypes, SDB 4512 and OMNH Am 11413, two adult males.

Other material studied: BNHS 4498 and BNHS 4499, two adult males, from Kudremukh; BNHS 4590, an adult male, from Mercara; VUB 002, an adult male, from Sakleshpur; SDB 4512, an adult male, from Muthanga (Table 2).

Diagnosis: Philautus tuberohumerus can be distinguished from known congeners by the following combination of characters: (1) small adult size; (2) snout subelliptical in dorsal view; (3) head as wide as long; (4) shank shorter than thigh; (5) absence of papilla on the tongue; (6) groin and anterior surfaces of thighs dark brown with yellow blotches; (7) presence of slightly spinular nuptial pad.

This species is unique with the combination of short adult snout–vent length and being yellow with brown spots on groin and thigh, but could be comparable with *P. bombayensis* (see 'comparison' of the latter).

Description of the holotype: A detailed description and illustrations were published in Kuramoto & Joshy (2003).

Variation: Measurements of six specimens including the holotype are given in Table 2. The skin texture is slightly variable from typically shagreened to sparsely granular. SDB 4512, uniformly shagreened dorsum with prominent spinular projections (Fig. 63B). The typical colour form is light brown with a faint grey stripe in between the eyes, faint grey 'X' behind the eye to vent, loreal and tympanic regions light-brownish grey, iris light-golden brown, encircled by a bluish outer ring, lateral side light-greyish white, flank and groin with yellow patches in a brown background, limbs with cross bands; ventral side greyish white, minute black spots on the throat, thigh light bluish with light-grey spots (BNHS 4499, Fig. 63A); SDB 4512, dark-bluish black dorsum with light-bluish spots on lateral side; ventral side dark-bluish black with light-blue spots (Fig. 63B); SDB 4599, dark-grey dorsum with blackish irregular patches, slightly broader greyish brown stripe between the eyes, a greyish brown line from snout to vent, dorsally at the point of vent, two lines extending from femur to tibia and finally ending on the tarsus (Fig. 59C).

Distribution and natural history: Chikmagalur, Kudremukh-Malleshwaram, Sakleshpur, Kempholay, Mercara, Someshwar-Agumbae in Karnataka, and Muthanga in Kerala (Fig. 59C, Table 1). Kudremukh populations were found in moist forest patches, but in

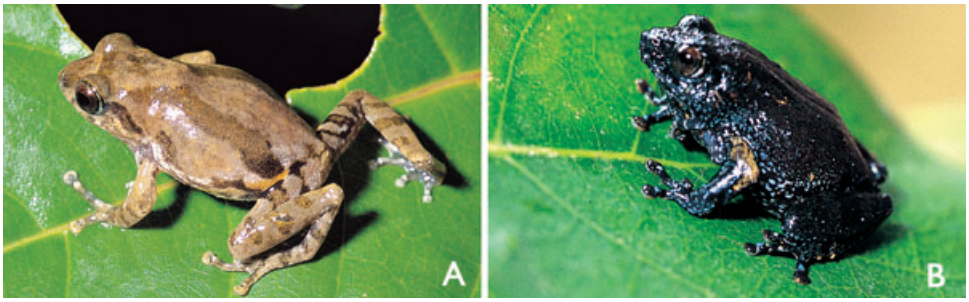

Figure 63. *Philautus tuberohumerus*: A, *specimen* (BNHS 4499) from Kudremukh; B, specimen (SDB 4512) from Muthanga.

Sakleshpur and Mercara, this species was found in the wayside vegetation near disturbed secondary forest. The calling height preference in all of the populations was a maximum of about 2 m above the ground, usually on leaves. The reproductive mode of this species was discussed (as *P. bombayensis*) by Bossuyt *et al.* (2001).

PHILAUTUS WYNAADENSIS JERDON, 1853
(FIGS 2, 9, 59D, 64A–C, 65A, B; TABLE 2)

Type material: Neotype, MNHN 1999.5596, an adult male, SVL 28.3 mm, from 'Sultan's Battery' (i.e. Sulthanbathery), Wayanad, Kerala, India.

Other material studied: BNHS 4551 and BNHS 4552, two adult males, and BNHS 4556, an adult female, from Kalpetta; BNHS 4553 and BNHS 4554, two adult males, from Sulthanbathery; BNHS 4555, an adult male, from Mananthavady; BNHS 4550, an adult male, from Mettupalayam (Table 2).

Diagnosis: Philautus wynaadensis can be distinguished from known congeners by the following combination of characters: (1) medium adult size (SVL 25.7 ± 1.5 mm, $N = 7$, male; SVL 27.2 mm, $N = 1$, female); (2) body rather slender; (3) snout subelliptical in ventral view; (4) upper two-thirds of tympanum dark black; (5) dorsum with spinular projections.

Philautus wynaadensis can be confused with *P. amboli* sp. nov. and *P. kani* sp. nov. (see both those species for comparisons).

Description of the neotype: A detailed description of the neotype was published in Bossuyt & Dubois (2001).

Variation: Measurements of eight specimens including the neotype are given in Table 2. This species shows some colour variation, even within the same population, from uniform grey to brownish or reddish grey. BNHS 4556 (Fig. 64A): dorsum grey–brown, a dark-brown band from the half portion of upper eyelid to vent, snout grey–brown, upper two-thirds of tympanum dark black, upper half of iris light brownish, lower half dark brownish; lateral side light brownish, either side of snout including loreal and tympanic regions dark-brownish black, limbs light brown with dark cross bands; ventral side light creamy white with dark spots; BNHS 4554 (Fig. 64B): dorsum reddish brown with a faint 'X' marking, loreal and tympanic regions light grey, upper two-thirds of tympanum dark black, limbs light-reddish brown with faint cross bands; ventral side uniform white with faint minute spots; BNHS 4552 (Fig. 64C): uniform grey dorsum with faint cross bands on limbs.

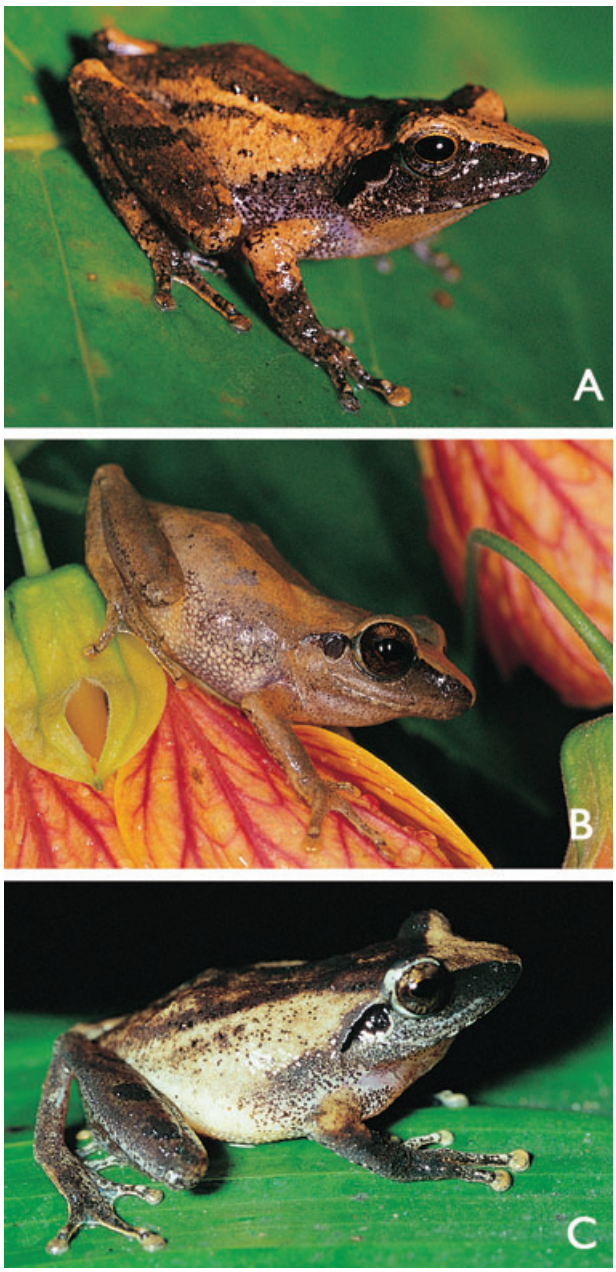

Figure 64. *Philautus wynaadensis*: A, specimen (BNHS 4556) from Kalpetta; B, specimen (BNHS 4554) from Sulthanbathery; C, specimen (BNHS 4552) from Kalpetta.

Distribution: Philautus wynaadensis is widely distributed in the Western Ghats, especially north of the Palghat Gap, with its southern limit reaching up to Periyar (South of the Palghat Gap). This species was collected from nine localities: Mananthavady, Sulthanbathery, Kalpetta, Palakkad, Parambikulam-Puliyarapadam, and Mettupalayam (NPG); and Thrissur, Meladoor, and Periyar (SPG) (Fig. 58D, Table 1). It is one of the most common *Philautus* in

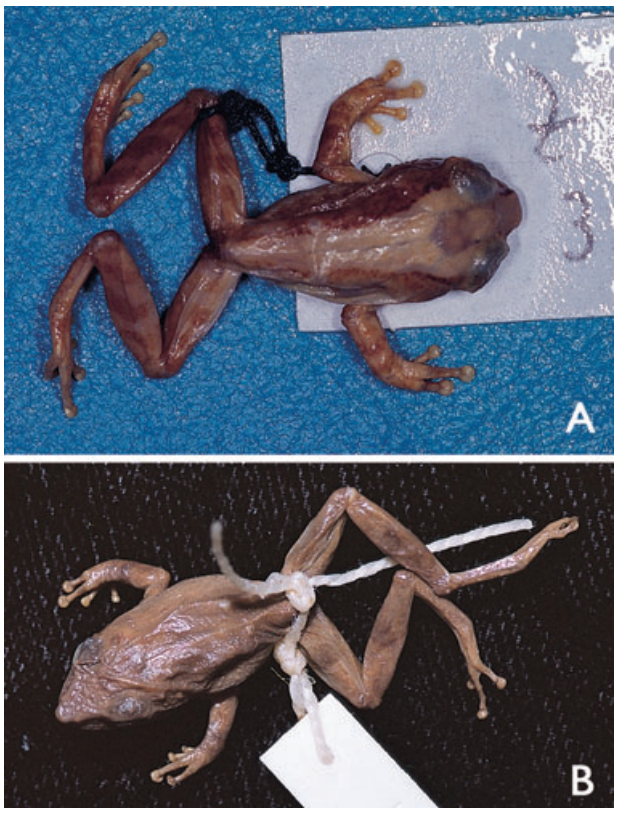

Figure 65. A, holotype (ZMB 3057) of *Ixalus leucorhinus*; B, holotype (BMNH 1947.2.6.21) of *Ixalus nasutus*.

the study region, and is dominant in wayside vegetation and urban areas.

Remarks: Philautus wynaadensis was discussed as I*xalus leucorhinus* Lichtenstein & Martens, 1856 (BMNH 72.4.17257a–d, four adult males from 'N. Canara'; BMNH 74.4.29.587 adult male, BMNH 74.4.29.495 adult female from 'Malabar') by Boulenger (1882).

DISCUSSION

Species diversity and endemism

Our recent recognition of 18 new species (Biju & Bossuyt, 2005a, b, c; Biju & Bossuyt, 2006; and in this paper) brings the total number of *Philautus* in the Western Ghats to 32 species. The discovery of so many novelties from this geographical region can be mainly attributed to our extensive field studies during the appropriate season for a whole decade. Previously, the Western Ghats anuran fauna had mainly been studied by means of local surveys. Comprehensive studies, like those that have been carried out in Sri Lanka (Manamendra-Arachchi & Pethiyagoda, 2005; Meegaskumbura & Manamendra-Arachchi, 2005), in the Malay region (Dring, 1987; Inger, 1989; Inger, Stuebing & Tan, 1995; Inger & Stuebing, 1996, 1997; Malkmus & Riede, 1996a, b; Stuebing & Wong, 2000), or in China (Hu, Fei & Ye, 1978; Yang, Su & Li, 1979; Ye & Hu, 1984; Kou, 1990; Fei 1999) were, until now, lacking. In addition to the new species, our efforts over years of systematic survey now also solve a number of longstanding problems in the identification of certain populations.

Most *Philautus* species of the Western Ghats can be identified by their life colour pattern, but this can rapidly fade during preservation. Therefore, many of the characteristic patterns are not visible in preserved animals, and this has increased the difficulties for comprehensive taxonomic studies without new field observations. This situation has also resulted in several *Philautus* species from Sri Lanka and the Western Ghats of India being regarded as conspecifics. Boulenger (1882) first recognized two species of Sri Lankan *Philautus* from the Western Ghats (*I. leucorhinus* and *I. variabilis*), and several authors subsequently included these names in their work (e.g. Rao, 1937; Inger & Dutta, 1986; Sekar, 1995; Dutta, 1997; Krishnamurthy & Hussain, 2000). Later, more species originally described from Sri Lanka were added to the Western Ghats checklist, such as *P. nasutus* (e.g. Pillai, 1986; Pillai & Pattabiraman, 1990; Ravichandran & Pillai, 1990; Dutta, 1997), *P. temporalis*, and *P. femoralis* (e.g. Inger *et al.*, 1984; Inger & Dutta, 1986; Dutta, 1997; Daniels, 2005). Additionally, Krishnamurthy & Sakuntala (1993) reported two species from the Western Ghats that where originally described from Java. The presence of Sri Lankan species in the Western Ghats has been reported in many of the recent compilations of ecological and biogeographical work (e.g. Inger *et al.*, 1987; Daniels, 1992; Patil & Kanamadi, 1997; Kadadevaru & Kanamadi, 2001; Padhye & Dahanukar, 2005). However, recent molecular work (Bossuyt *et al.*, 2004) suggested that India and Sri Lanka may have less species in common than was originally thought. During the whole course of our study, we paid special attention to the aforementioned species, and could not find evidence of any of the Sri Lankan species occurring in the Western Ghats. This confirms that faunal exchange between Sri Lanka and the Western Ghats has been limited, and suggests that the two countries may not share a single *Philautus* species.

Biogeography

Bossuyt (2002) and Bossuyt *et al.* (2004) hypothesized that the influence of the discontinuity of the Western Ghats at the Palghat Gap may have played a role in

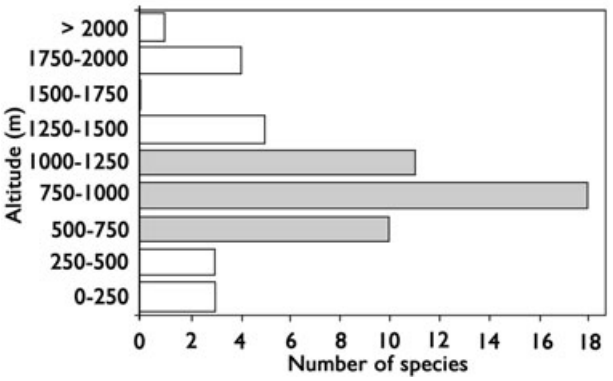

Figure 66. Number of species (*x* axis) found at different altitudes (*y* axis) throughout the Western Ghats. This figure illustrates that *Philautus* species are most abundant between 500 and 1250 m a.s.l.

the divergence of the anuran fauna. Our data here indicate that only four species, *P. akroparallagi* sp. nov., *P. anili*, *P. ponmudi* and *P. wynaadensis*, occur on both sides of the Palghat Gap. This area has been shown to constitute a barrier for gene flow in elephants (Vidya *et al.*, 2005), and it was suggested that this was caused by prehistoric vicariant events related to the gap itself (i.e. non-anthropogenic). DNA analyses of more populations and multiple unlinked loci will be necessary to study phylogeographic structure, and to understand the role of the Palghat gap in shaping the distribution of these four *Philautus* species.

Consistent with the lack of shared species between the mainland and Sri Lanka, local endemism within the Western Ghats is generally extremely high in *Philautus*. Our study suggests that 15 species are known only from their type locality and its vicinity. It has been proposed that the restricted distribution patterns of amphibians are related to the isolated hilly areas of the regions, which provide a potential arena for allopatric isolation (Inger *et al.*, 1987). Our study indicates that most species are predominantly found between 500 and 1250 m a.s.l. (Fig. 66). As a consequence, any geographical gap that is lower may constitute a potential barrier to dispersal. The altitudinal preference of most species thus indicates that the oceanic barrier between the Western Ghats and Sri Lanka is indeed irrelevant to dispersal between these two landmasses.

Genetic investigations have significantly contributed to our knowledge on the origin of the Western Ghats amphibians (Gower *et al.*, 2002; Biju & Bossuyt, 2003; Bossuyt *et al.*, 2004; Roelants, Jiang & Bossuyt, 2004). This study provides the necessary framework for initiating biogeographical and evolutionary studies within the Western Ghats.

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REFERENCES

Annandale N. 1919. The fauna of certain small streams in the Bombay presidency. *Records of Indian Museum* **16:** 109–161.

Biju SD. 2001. A synopsis to the frog fauna of the Western Ghats, India. *Indian Society for Conservation Biology-Occasional Publication* **1:** 1–24.

Biju SD. 2003. Reproductive mode in the shrub frog *Philautus glandulosus* (Jerdon, 1853) (Anura: Rhacophoridae). *Current Science* **84:** 283–284.

Biju SD, Bossuyt F. 2003. New frog family from India reveals an ancient biogeographical link with *the Seychelles*. *Nature* **425:** 711–714.

Biju SD, Bossuyt F. 2005a. A new species of frog (Ranidae, Rhacophorinae, *Philautus*) from the rainforest canopy in the Western Ghats, India. *Current Science* **88:** 175–178.

Biju SD, Bossuyt F. 2005b. Two new *Philautus* (Anura: Ranidae, Rhacophorinae) from Ponmudi Hills in the Western Ghats of India. *Copeia* **2005:** 29–37.

Biju SD, Bossuyt F. 2005c. A new species of *Philautus* (Anura: Ranidae, Rhacophorinae) from Ponmudi Hill in the Western Ghats. *Journal of Herpetology* **39:** 349–353.

Biju SD, Bossuyt F. 2006. Two new *Philautus* (Anura: Ranidae, Rhacophorinae) from the Western Ghats, India. *Amphibia-Reptilia* **27:** 1–9.

Bossuyt F. 2002. A new species of Philautus (Anura: Ranidae) from the Western Ghats of India. *Journal of Herpetology* **36:** 656–661.

Bossuyt F, Dubois A. 2001. A review of the frog genus *Philautus* Gistel, 1848 (Amphibia, Anura, Ranidae, Rhacophorinae). *Zeylanica* **6:** 1–112.

Bossuyt F, Roelants K, Spithoven L, Daro HM. 2001. *Philautus bombayensis* (Bombay oriental shrub-frog), Reproduction. *Herpetological Review* **32:** 34–35.

Bossuyt F, Meegaskumbura M, Beenaerts N, Gower DJ, Pethiyagoda R, Roelants K, Mannaert A, Wilkinson M, Bahir MM, Manamendra Arachchi K, Ng PKL, Schneider CJ, Oommen VO, Milinkovitch MC. 2004. Local endemism within the Western Ghats-Sri Lanka biodiversity hotspot. *Science* **306:** 479–481.

Boulenger GA. 1882. *Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum*. London: Taylor & Francis.

Boulenger GA. 1891. Description of a new species of frog obtained by Mr. H.S. Ferguson in Travancore, South India. *Journal of Bombay Natural History Society* **6:** 450.

Boulenger GA. 1906. Description of two Indian frogs. *Journal & Proceedings of Asiatic Society of Bengal, (n.s)* **2:** 385.

Daniels RJR. 1992. Geographic distribution pattern of amphibians in the Western Ghats, India. *Journal of Biogeography* **19:** 521–529.

Daniels RJR. 2005. *Amphibians of Peninsular India*. Hyderabad: Indian Academy of Science & University Press.

Das I, Dutta SK. 1998. Checklist of amphibians of India, with English common names. *Hamadryad* **23:** 63–68.

Dring JCM. 1987. Bornean treefrogs of the genus *Philautus* (Rhacophoridae). *Amphibia-Reptilia* **8:** 19–47.

Dutta SK. 1997. *Amphibians of India and Sri Lanka. (checklist and bibliography)*. Bhubaneswar: Odyssey Publishing House.

Fei L. 1999. *Atlas of amphibians of China*. Yunan, China: Publishing House for Science and Technological Literature.

Gower DJ, Kupfer A, Oommen VO, Himstedt W, Nussbaum RA, Loader PS, Presswell B, Müller H, Krishna SB, Boistel R, Wilkinson M. 2002. A molecular phylogeny of ichthyophiid caecilians (Amphibia: Gymnophiona: Ichthyophiidae): out of India or out of South East Asia? *Proceedings of Royal Society London Biology* **269:** 1563–1569.

Gururaja KV, Aravind NA, Ali S, Ramachandra TV, Velavan TP, Krishnakumar V, Aggarwal RK. 2007a. A new frog species from the central Western Ghats of India, and its phylogenetic position. *Zoological Science* **24:** 525–534.

Gururaja KV, Dinesh KP, Palot MJ, Radhakrishnan C, Ramachandra TV. 2007b. A new species of *Philautus* Gistel (Amphibia: Anura: Rhacophoridae) from southern Western Ghats, India. *Zootaxa* **1621:** 1–16.

Günther A. 1876. Third report on collections of Indian reptiles obtained by the British Museum. *Proceedings of Zoological Society* **1875:** 567–577.

Hooker JD, Thomson T. 1855. *Flora India*. London: W Pamplin.

Hu S-Q, Fei L, Ye C-Y. 1978. Three new amphibian species of frog Borneo. *Malayan Nature Journal* **42:** 229–243.

Inger RF. 1989. Four new species of frog from Borneo. *Malayan Nature Journal* **42:** 229–243.

Inger RF, Dutta SK. 1986. An overview of the fauna of India. *Journal of Bombay Natural History Society* **83:** 135–146.

Inger RF, Stuebing RB. 1996. Two new species of frogs from southern Sarawak. *Raffles Bulletin of Zoology* **44:** 543–549.

Inger RF, Stuebing RB. 1997. *A field guide to the frog fauna of Borneo*. Sabah: Science and Technology Unit.

Inger RF, Shaffer HB, Koshy M, Bakde R. 1984. A report on a collection of amphibians and reptiles from the Ponmudi, Kerala, South India. *Journal of Bombay Natural History Society* **81:** 551–570.

Inger RF, Shaffer HB, Koshy M, Bakde R. 1987. Ecological structure of a herpetological assemblage in South India. *Amphibia-Reptilia* **81:** 551–570.

Inger RF, Stuebing RB, Tan F-L. 1995. New species and new records of anurans from Borneo. *Raffles Bulletin of Zoology* **43:** 115–131.

Jerdon TC. 1853. Catalogue of reptiles inhabiting the Peninsula of India (continued from p. 479). *Journal of Asiatic Society of Bengal* **1870:** 1486–1488.

Kadadevaru GG, Kanamadi RD. 2001. Vocal interactions, territoriality and fighting behaviour of the rhacophorid frog, *Philautus variabilis* (Günther, 1858). *Current Science* **80:** 1486–1488.

Kou Z-T. 1990. A new species of genus *Philautus* (Amphibia: Rhacophoridae) from Yunnan, China. In: Zhao E, ed. *From water onto land*. Beijing: China Forestry Press, 210–212.

Krishnamurthy SV, Hussain SA. 2000. Amphibian fauna of Kudremukh National Park, Western Ghats, India. *Journal of Bombay Natural History Society* **97:** 436–439.

Krishnamurthy SV, Sakuntala K. 1993. Amphibian fauna of Sringeri taluk (Chickamagalure District: Karnataka). *Journal of Indian Institute of Science* **73:** 443–452.

Kuramoto M, Joshy SH. 2003. Two new species of the genus *Philautus* (Anura: Rhacophoridae) from the Western Ghats, Southwestern India. *Current Herpetology* **22:** 51–60.

Maddison DR, Maddison WP. 2000. *MacClade: analysis of phylogeny and character evolution*. In: version 4.0 edn. Sunderland, Massachusetts: Sinauer Associates.

Malkmus R, Riede K. 1996a. Die Baumfrösche der Gattung *Philautus* vom Mount Kinabalu. Teil I. Überblick und die *aurifasciatus*-Gruppe mit Beschreibung einer neuen Art (*Philautus saueri* n. sp. *Sauria* **18:** 27–37.

Malkmus R, Riede K. 1996b. Die Baumfrösche der Gattung *Philautus* vom Mount Kinabalu. Teil II. Die vermiculatus-Gruppe mit Beschreibung einer neuen Unterart (*Philautus aurantium gunungensis* n. ssp.) und die *hosei*-Gruppe. *Sauria* **18:** 21–28.

Manamendra-Arachchi K, Pethiyagoda R. 2005. The Sri Lankan shrub-frog of the genus *Philautus* Gistel, 1848 (Ranidae: Rhacophorinae), with description of 21 new species. In: Yeo DCJ, Ng PKL, Pethiyagoda R, eds. *Contributions to biodiversity exploration and research in Sri Lanka*. Singapore: The Raffles Bulletin of Zoology, Supplement No. 12, 163–303.

Meegaskumbura M, Manamendra-Arachchi K. 2005. Description of eight new species of shrub frogs (Ranidae: Rhacophorinae: *Philautus*) from Sri Lanka. In: Yeo DCJ, Ng PKL, Pethiyagoda R, eds. *Contributions to biodiversity exploration and research in Sri Lanka*. Singapore: The Raffles Bulletin of Zoology, Supplement No. 12, 305–338.

Padhye A, Dahanukar N. 2005. Amphibian diversity and distribution in Tamhini, northern Western Ghats, India. *Current Science* **88:** 1496–1501.

Patil NS, Kanamadi RD. 1997. Direct development in the Rhacophorid frog, *Philautus variabilis* (Günther). *Current Science* **73:** 697–671.

Pillai RS. 1986. Amphibian fauna of Silent Valley, Kerala. *Records of Zoological Survey India* **84:** 229–242.

Pillai RS, Pattabiraman R. 1990. Amphibians from Sabarigiri forest, Western Ghats, Kerala, including a new species of *Micrixalus*. *Records of Zoological Survey India* **86:** 383–390.

Posada D, Crandall KA. 1998. Modeltest: testing the model of DNA substitution. *Bioinformatics* **14:** 817–818.

Rao CRN. 1937. On some new forms of Batrachia from S. India. *Proceedings of Indian Academy of Science, Biology* **6:** 387–427.

Ravichandran MS, Pillai RS. 1990. On a collection of frogs and toads from Periyar Wildlife Sanctuary. *Records of Zoological Survey India* **87:** 121–126.

Roelants K, Jiang J, Bossuyt F. 2004. Endemic ranid (Amphibia: Anura) genera in southern mountain ranges of the Indian subcontinent represent ancient frog lineages: evidence from molecular data. *Molecular Phylogenetics and Evolution* **31:** 730–740.

Roelants K, Gower DJ, Wilkinson M, Loader SP, Biju SD, Guillaume K, Moriau L, Bossuyt F. 2007. Global patterns of diversification in the history of modern amphibians. *Proceedings of the National Academy of Scienceof the United States of America* **104:** 887–892.

Ronquist F, Huelsenbeck JP. 2003. MrBayes 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* **19:** 1572–1574.

Sambrook J, Fritsch EF, Maniatis T. 1989. *Molecular cloning: a laboratory manual*. New York: ColdSpring Harbor Laboratory Press, Cold Spring Harbor.

Sekar AG. 1995. On the morphology, advertisement call and habitat of the bush frog, *Philautus leucorhinus* Lichtenstain and Martens, 1856. *Journal of Bombay Natural History Society* **92:** 22–25.

Stuebing RB, Wong A. 2000. A new species of frog, *Philautus erythrophthalmus* (Rhacophoridae) from southwestern Sabah, Malaysis. *Raffels Bulletin of Zoology* **48:** 293–296.

Swofford DL. 2002. *PAUP*: phylogenetic analysis using parsimony (*and other methods), version 4.0 edn*. Sunderland, Massachusetts: Sinauer Associates.

Thompson JD, Gibson TJ, Plewniak F, Jeanmougin F, Higgins DG. 1997. The ClustalX Windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Research* **25:** 4876–4882.

Vidya TNC, Fernando P, Melinck DJ, Sukumar R. 2005. Population differentiation within and among Asian elephant (*Elephas maximus*) populations in southern India. *Heredity* **94:** 71–80.

Yang D-T, Su C-Y, Li S-M. 1979. New species and new subspecies of amphibians and reptiles from Gaoligong Shan. Yunnan. *Acta Zootaxonomica Sinica* **4:** 185–188.

Ye C, Hu S. 1984. A new species of *Philautus* (Anura: Rhacophoridae) from Xizang autonomous region. *Acta Herpetologica Sinica* **3:** 67–69.

APPENDIX

TAXA INCLUDED IN THE PHYLOGENETIC ANALYSES, WITH CORRESPONDING SEQUENCE SOURCE (SPECIMEN VOUCHER OR REFERENCE)

Taxa	Country	Voucher
Polypedates cruciger	Sri Lanka	VUB 0125
Polypedates maculatus	India: WG	VUB 0003
Polypedates sp.	India: WG	VUB 0308
Rhacophorus malabaricus	India: WG	VUB 0001
'Rhacophorus' variabilis	India: WG	KBIN 1918
***Philautus akroparallagi* sp. nov.**	India: WG	BNHS 4562
***Philautus akroparallagi* sp. nov.**	India: WG	BNHS 4392
***Philautus amboli* sp. nov.**	India: WG	BNHS 4399
Philautus anili	India: WG	BNHS 4570
Philautus anili	India: WG	BNHS 4404
Philautus beddomii	India: WG	BNHS 4412
Philautus beddomii	India: WG	BNHS 4407
Philautus bobingeri	India: WG	BNHS 4273
Philautus bombayensis	India: WG	BNHS 4418
Philautus charius	India: WG	BNHS 4422
Philautus charius	India: WG	BNHS 4420
***Philautus chotta* sp. nov.**	India: WG	BNHS 4429
***Philautus coonoorensis* sp. nov.**	India: WG	BNHS 4446

APPENDIX *Continued*

Taxa	Country	Voucher
***Philautus chlorosomma* sp. nov.**	India: WG	BNHS 4426
***Philautus chromasynchysi* sp. nov.**	India: WG	BNHS 4433
Philautus dubois	India: WG	BNHS 5285
Philautus glandulosus	India: WG	SDB 40239
Philautus glandulosus	India: WG	BNHS 4453
Philautus graminirupes	India: WG	BNHS 4266
Philautus griet	India: WG	BNHS 4455
***Philautus jayarami* sp. nov.**	India: WG	SDB 1379
***Philautus kaikatti* sp. nov.**	India: WG	BNHS 4557
***Philautus kani* sp. nov.**	India: WG	BNHS 4472
***Philautus marki* sp. nov.**	India:WG	BNHS 4537
Philautus luteolus	India:WG	BNHS 4478
***Philautus munnarensis* sp. nov.**	India:WG	BNHS 4481
Philautus nerostagona	India:WG	BNHS 4244
Philautus ponmudi	India:WG	BNHS 4257
Philautus ponmudi	India:WG	SDB 047
Philautus signatus	India:WG	BNHS 4489
***Philautus sushili* sp. nov.**	India:WG	BNHS 4544
Philautus tinniens	India:WG	BNHS 4548
Philautus travancoricus	India:WG	BNHS 4557
Philautus tuberohumerus	India:WG	BNHS 4590
Philautus wynaadensis	India:WG	BNHS 4554