

Two New *Philautus* (Anura: Ranidae: Rhacophorinae) from Ponmudi Hill in the Western Ghats of India

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Two new species of Shrubfrog, *Philautus bobingeri* sp. nov. and *Philautus graminirupes* sp. nov., are described from Ponmudi Hill in the Western Ghats. *Philautus bobingeri* is related to *P. glandulosus* but displays a number of clear-cut characters that make it easily distinguishable. *Philautus graminirupes* has previously been confused with *Philautus signatus*, but this species is confined to localities north of the Palghat Gap. *Philautus bobingeri* is a true canopy species, whereas *P. graminirupes* is exclusively found on herbaceous plants close to the ground. The microhabitat preference of both species is directly related to their choice of oviposition-site, because *P. bobingeri* eggs were found about 4 m high on a tree trunk, whereas *P. graminirupes* usually deposits its eggs in rock crevices or at the base of grass clumps close to the ground.

THE genus *Philautus* constitutes a group of rhacophorines (Ranidae) that is characterized by direct-development, that is, the attainment of the adult morphology without going through a free-living larval phase (Bossuyt and Dubois, 2001; Callery et al., 2001). The recognized diversity of species in this genus on the Indian subcontinent has increased considerably in recent years (Biju, 2001; Meegaskumbura et al., 2002), but there is still a major gap in the information on distribution patterns across biogeographic regions (Inger et al., 1987; Bossuyt, 2002). For example, because of the lack of data on species ranges in the Western Ghats of India, many *Philautus* there have been confused with species that are restricted to a small geographic area within India, or even outside India, such as Sri Lanka (e.g., Inger et al., 1984; Dutta, 1997; Das and Dutta, 1998) or Java (Krishnamurthy and Sakuntala, 1993).

The Agasthyamala Hill range (formerly Ashambu Hills; approximately between 8°25' to 8°53'N and 77°08' to 77°35'E) extends over two states of southern India. This area has some of the best remaining tropical moist forests in the Western Ghats (Nair, 1991) and is considered one of the centers of floral endemism and biodiversity in this region (Mill, 1995). Ponmudi is a relatively degraded moist forest track that partly covers the northern periphery of Ashambu Hill range in Kerala. The anuran survey of this region was started by two British naturalists, R. H. Beddome during the late 1800s (Günther, 1876; Boulenger, 1882) and followed by H. S. Ferguson in the early 20th century (Ferguson, 1904). Much later, Ponmudi was systematically investigated under the leadership of Robert F. Inger in 1982 (Inger et al., 1984, 1987), and this

team reported 23 species of anurans, five of them belonging to the genus *Philautus*.

During our ongoing survey of the Western Ghats anurans, we found quite a large number of undescribed *Philautus* from the Ashambu Hill range. Herein, we describe two new species from Ponmudi Hill, *Philautus bobingeri* sp. nov. and *Philautus graminirupes* sp. nov., that have formerly been confused with species that are confined to Sri Lanka (*Philautus femoralis*) and localities north of the Palghat Gap (*Philautus signatus*), respectively.

MATERIALS AND METHODS

Measurements and terminology follow Bossuyt and Dubois (2001). The following measurements were taken, to the nearest 0.1 mm, using a digital slide-caliper (SVL, HL, and TL) or a binocular microscope with a micrometer ocular. SVL (snout-vent length), HW (head width, at the angle of the jaws), HL (head length, from rear of mandible to tip of snout), MN (distance from rear of mandible to nostril), MFE (distance from rear of mandible to anterior orbital border of eye), MBE (distance from rear of mandible to posterior orbital border of eye), SL (snout length, from tip of snout to anterior orbital border of eye), EL (eye length, horizontal distance between bony orbital borders of eye), IUE (inter upper eyelid width, the shortest distance between the upper eyelids), UEW (maximum upper eyelid width), IN (distance between internal border of nostrils), IFE (internal front of eyes, shortest distance between anterior orbital border of eyes), IBE (internal back of eyes, shortest distance between posterior orbital border of eyes), NS (distance from nostril to tip of snout), EN (distance from nostril to anterior or-

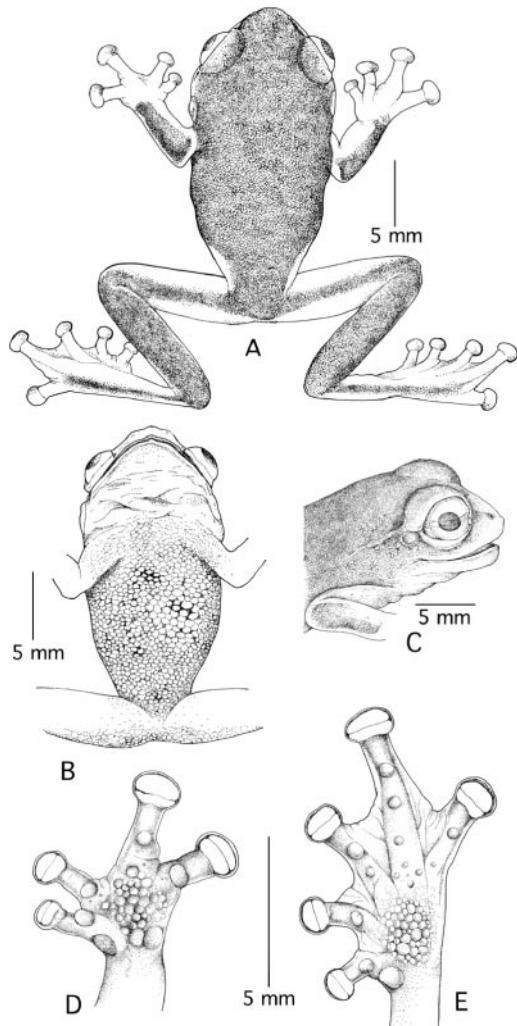


Fig. 1. Holotype of *Philautus bobingeri*, (A) Dorsal view; (B) ventral view; (C) lateral view of head; (D) ventral view of hand; (E) ventral view of foot.

bital border of eye), TYD (largest tympanum diameter), TYE (distance from posterior orbital border of eye to tympanum), FLL (forelimb length, from elbow to base of outer palmar tubercle), HAL (hand length, from base of outer palmar tubercle to tip of third finger), TFL (third finger length, from base of first subarticular tubercle), FD_{I-IV} (disc width on finger I–IV), FW_{I-IV} (width of finger I–IV, at base of disc), TD_{I-V} (disc width on toe I–V), TW_{I-V} (width of toe I–V, at base of disc), TL (tibia length), TW (maximum tibia width), FL (femur length), FOL (foot length, from base of inner metatarsal tubercle to tip of fourth toe), FTL (length of fourth toe, from base of first subarticular tubercle to tip of fourth toe), TFOL (dis-

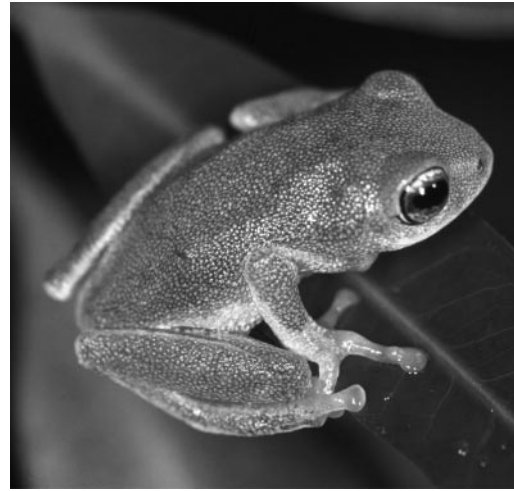


Fig. 2. Dorsolateral view of *Philautus bobingeri*, holotype in life.

tance from heel to tip of fourth toe), IMT (inner metatarsal tubercle length), and ITL (inner toe length). Drawings of the holotype were made using a stereomicroscope with a drawing tube. Abbreviations for institutes are listed elsewhere (Bossuyt and Dubois, 2001). The new species were compared with all valid species currently recognized in the genus *Philautus* (Bossuyt and Dubois, 2001; D. F. Frost, Amphibian species of the world: an online reference V3.0, [khttp://research.amnh.org/herpetology/amphibia/index.html](http://research.amnh.org/herpetology/amphibia/index.html) [American Museum of Natural History, 22 August 2004]) and especially with the name-bearing types of all Western Ghats and Sri Lankan species.

Philautus bobingeri sp. nov.

Figures 1, 2, 3; Table 1

Holotype.—Bombay Natural History Society, BNHS 4272, an adult male (SVL 21.3 mm) collected by S. D. Biju on 1 September 1997 at an altitude of 1030 m above sea level, from Ponnudi Hills near “upper sanatorium” (approximately 8°45’N, 77°08’E) in Thiruvananthapuram District, Kerala, India.

Paratypes.—Three adult males collected along with the holotype, BNHS 4273–4274 and Tropical Botanic Garden and Research Institute, TBGRI 2002.0055, and two adult females, BNHS 4275 (collected along with the holotype) and Field Museum of Natural History, Chicago, FMNH 218114 (collected by Robert F. Inger and Bradley Shaffer on May 1982 from Ponnudi Hills).

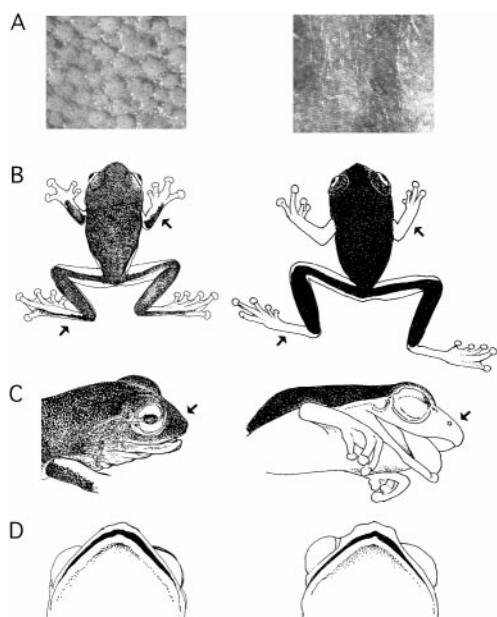


Fig. 3. Comparison of *Philautus bobingeri* (left) with *Philautus glandulosus* (right): (A) dorsal skin texture; (B) dorsal view, showing coloration on forelimb and hind limb; (C) lateral view of head, showing coloration of loreal and tympanic region; (D) snout shape.

Diagnosis.—*Philautus bobingeri* can be distinguished from all species in the genus by the combination of the following characters: (1) rather flat body; (2) head wider than long (HW 9.2–9.4 mm vs HL 8.4–8.9 mm); (3) snout length shorter than horizontal diameter of eye (SL 3.0–3.4 mm vs EL 3.5–4.1 mm); (4) snout in dorsal view oval; (5) canthus rostralis indistinct; (6) vertical loreal region (7) oval finger tips; (8) presence of nuptial pad on the first finger of males; (9) fourth toe webbing reaches beyond the distal subarticular tubercle on outer side; (10) uniformly granular dorsum; (11) dorsally uniform leaf green in life, turning to greyish-blue in spirit; (12) anterior and posterior surfaces of thighs light red to dark flesh red in life, turning grayish to white in preservation.

Because of the overall green coloration, *P. bobingeri* could be confused with three other green species from the Western Ghats, *Philautus beddomii*, *Philautus chalazodes*, and *P. glandulosus* and one species from Sri Lanka, *P. femoralis*. However *P. bobingeri* is distinct from *P. beddomii* and *P. chalazodes* by the granular dorsum, the red coloration of the posterior margin of the thighs, and the golden brown iris. *Philautus femoralis* has been shown to be a member of the Sri Lankan radiation and is not closely related

to the green *Philautus* species of the Western Ghats (Meegaskumbura et al., 2002). *Philautus bobingeri* might represent the closest relative of *P. glandulosus*, which it resembles closely in overall morphology and coloration. However, the new species differs from *P. glandulosus* (comparison with different populations of the latter from Madikeri, Karnataka State, and Mananthavady, Kerala State) by a number of clear-cut characters, the most obvious being shown in Figure 3: uniformly granular dorsum (vs shagreened in *P. glandulosus*, Fig. 3A); oval finger tips (vs rounded, Fig. 3B); dorsal surface of forearm and loreal region green (vs yellow, Fig. 3B,C); anterior and posterior surface of thighs red (vs yellow); and oval snout (vs almost pointed, Fig. 3D).

Description of the holotype.—All measurements in millimeters. A relatively small *Philautus* (SVL 21.3), body flat; head wider than long (HW 9.3, HL 8.2, MN 6.6, MFE 5.3, MBE 2.9); outline of snout in dorsal view oval and in profile rounded (Figs. 1A–C, 2), slightly protruding, snout length (SL 3.0) shorter than the horizontal diameter of the eye (EL 3.5); canthus rostralis indistinct, loreal region vertically flat; interorbital area slightly convex, longer (IUE 4.0) than upper eyelid (UEW 1.6), longer than internasal distance (IN 2.5); distance between anterior margins of eyes (IFE 5.2) 1.7 times in distance between posterior margins of eyes (IBE 9.0); nostrils rounded, without flap of skin, closer to tip of snout (NS 1.0) than to front of eye (EN 1.4); pupil oval, horizontal; tympanum (TYD 0.8) rather indistinct, rounded, 4.3 times in eye diameter (Fig. 1C), larger than tympanum-eye diameter (TYE 0.4); vomerine teeth absent; tongue large (5.1 × 4.0), cordate, shallowly emarginate, lobes acute, granular; lingual papilla absent; supratympanic fold rather indistinct.

Forelimb (FLL 4.9) shorter than hand (HAL 5.5, TFL 3.0); relative length of fingers: I < IV < III; tips of fingers with oval disks (FD_I = 1.0, FW_I = 0.5, FD_{II} = 1.3, FW_{II} = 0.6, FD_{III} = 1.7, FW_{III} = 0.6, FD_{IV} = 1.7, FW_{IV} = 0.8), with distinct circummarginal grooves; all fingers with dermal fringe on both edges; webbing absent; subarticular tubercles prominent, rounded, single, III2 weakly developed, IV2 absent; prepollex rather indistinct, oval; double palmar tubercle (one small and one large), oval, distinct; supernumerary tubercles prominently present on all fingers, and especially on the palm (Fig. 1D).

Hind limbs moderately long, heels touch with limbs folded at right angles to the body; shank four times longer (TL 11.2) than wide (TW

TABLE 1. MEASUREMENTS IN MILLIMETERS (RANGE, MEAN, AND STANDARD DEVIATION) FOR THE TYPE SPECIMENS OF *Philautus bobingeri* AND *Philautus graminirupes*. Abbreviations are defined in the text.

	<i>Philautus bobingeri</i>						<i>Philautus graminirupes</i>					
	Males (N = 4)			Females (N = 2)			Males (N = 4)			Females (N = 2)		
	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Mean	SD
SVL	21.3–24.8	23.87	1.71	23.5–26.0	24.75	1.76	21.4–22.6	22.0	0.58	27.3–29.4	28.35	1.48
HW	9.2–9.4	9.3	0.08	9.7–10.9	10.03	0.84	8.6–9.8	9.22	0.50	11.6–12.0	11.8	0.28
HL	8.2–8.9	8.05	0.29	8.7–10.1	9.04	0.98	8.3–9.4	8.95	0.46	11.4–12.0	11.7	0.85
IFE	5.2–5.6	5.32	0.18	5.2–5.7	5.45	0.35	4.0–5.0	4.72	0.48	5.3–5.5	5.4	0.14
IBE	8.9–9.1	9.00	0.08	9.0–10.0	9.05	0.70	7.4–9.2	8.3	0.88	10.2–10.4	10.25	0.07
IUE	3.2–4.0	3.55	0.34	3.2–3.4	3.03	0.41	2.6–2.9	2.72	0.15	3.5–3.7	3.6	0.14
UEW	1.6–2.3	2.00	0.29	1.8–2.2	2.00	0.28	2.1–2.7	2.42	0.25	2.6–2.9	2.75	0.21
SL	3.0–3.4	3.17	0.17	3.4–3.7	3.55	0.21	3.0–3.2	3.07	0.95	4.4	4	0
EL	3.5–4.1	3.09	0.27	3.4–3.9	4.1	0.41	3.8–4.2	3.97	0.17	4.5–4.8	4.65	0.21
TYD	0.8–0.9	0.85	0.05	0.9–1.0	0.95	0.07	1.0–1.4	1.2	0.16	1.2–1.4	1.3	0.14
FLL	4.9–5.9	5.42	0.42	5.2–5.5	5.35	0.21	5.0–5.4	5.17	0.17	6.5–6.6	6.55	0.07
HAL	5.5–6.8	6.32	0.57	6.7–7.5	7.01	0.56	5.7–7.0	6.47	0.55	6.2–6.4	6.3	0.14
TFL	3.0–3.9	3.6	0.40	3.8–4.0	3.09	0.41	3.0–4.2	3.75	0.52	4.5–4.9	4.7	0.28
TL	11.0–11.9	11.42	0.40	11.8–13.2	12.05	0.98	10.5–11.7	11.35	0.56	14.8–15	14.9	0.14
FOL	9.2–10.0	9.8	0.4	9.2–10.0	9.8	0.4	8.2–9.3	8.85	0.46	11.2–11.9	11.55	0.49
FTL	4.3–5.2	4.87	0.40	4.3–5.2	4.87	0.40	3.3–5.1	4.32	0.75	4.9–5.7	5.3	0.56
IMT	0.8–1.2	1.0	0.16	0.8–1.2	1.0	0.16	0.7–1.1	0.95	0.17	1.2–1.3	1.25	0.07
ITL	1.8–2.0	1.85	2.0	1.8–2.0	1.85	0.1	1.8–2.0	1.92	0.15	2.4–2.4	2.4	0

2.8), shorter than thigh (FL 12.0), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 9.2); distance from heel to tip of toe IV (TFOL 15.1) about 3.5 times longer than toe IV (FTL 4.3); relative length of toes when opposed: I < II < III < V < IV; tip of toes with disks, rather wide compared to toe width (TD_I = 1.0, TW_I = 0.5; TD_{II} = 1.2, TW_{II} = 0.5; TD_{III} = 1.5, TW_{III} = 0.6; TD_{IV} = 1.8, TW_{IV} = 0.7; TD_V = 1.6, TW_V = 0.8), with a distinct circummarginal groove; webbing moderate (Fig. 1E); small dermal fringe along toe V, from tip to second subarticular tubercle; subarticular tubercles rather distinct, rounded, simple, III2, IV3, and V2 weakly developed; inner metatarsal tubercle rather distinct (IMT 0.8), oval, more than two times in length of toe I (ITL 1.8); outer metatarsal tubercle absent; supernumerary tubercles present on all toes, and especially on feet (Fig. 1E).

Skin of snout, between eyes, upper eyelids, side of head, back and flanks uniformly granular (Figs. 1A, 2, 3A-left); dorsal part of forelimbs and hind limbs shagreened to granular; throat smooth to shagreened, belly and ventral part of thighs granular (Fig. 1B).

Color of holotype in life.—Dorsum uniform leaf green without any markings (Figs. 1A, 2), lateral sides red without any markings, loreal and tympanic region leaf green (Fig. 2); iris golden brown with dark brown spots encircled by a thin bluish-black ring, pupil black; lower arm leaf green (Figs. 1A, 2, 3B-left), upper arm yellowish, hand yellow-red (Fig. 2), finger tips light red; femur with a leaf green line extending from dorsum to knee, anterior and posterior margins red without any markings, tibia almost completely leaf green, tarsus with an extremely thin leaf green line (Fig. 1A); forelimbs and hind limbs without cross bands; ventrally white or slightly light yellow, throat, and hands and feet light yellow.

Color of holotype in alcohol.—Dorsum uniform grayish-blue, lateral sides white, without markings; dorsal surface of upper arms and hands white; anterior and posterior surface of thighs grayish-white; ventrally uniform white to light yellow without any markings.

Male secondary sexual characters.—Nuptial pad present (Fig. 1D), smooth; median subgular vocal sac present, a pair of openings situated at the base of lower jaw.

Female secondary sexual characters.—Oviduct of paratype BNHS 4275 zigzag; ovary large, creamy white.

Reproductive mode.—During July 1999, we observed a pair of *P. bobingeri* in axillary amplexus and located a clutch of 24 eggs on an Acacia tree trunk at about 4 m height at the type locality. The eggs were nonpigmented white and protected by a dense jelly layer, measuring 3.9 ± 0.4 mm ($N = 24$) in diameter. Hatched froglets (18 days after discovery) were morphologically similar to the adults.

Variation.—Measurements (range, mean, and standard deviation) of the type series are given in Table 1.

Etymology.—The species is named after Robert F. Inger (Field Museum of Natural History, Chicago) in appreciation of his contribution to Asian amphibian taxonomy and his constant encouragement to the first author right from 1994.

Distribution and natural history.—*Philautus bobingeri* is known only from the type locality in Ponmudi, south of the Palghat Gap. The holotype and four paratypes were collected from phylloides, about 5 m high in an Acacia tree (*Acacia auriculiformis*), near disturbed evergreen forest patches. The fifth paratype, FMNH 218114, was collected from the leaves of “1–3 meter tall shrubs” (Inger et al., 1984). All were collected during rainy nights around 2000 h.

Philautus graminirupes sp. nov.

Figures 4, 5; Table 1

Holotype.—BNHS 4264, an adult male (SVL 22.6 mm) collected by S. D. Biju on 7 July 2000 at an altitude of 1020 m above sea level, at “upper sanatorium” Ponmudi Hill, (approximately 8°45'N, 77°08'E), in Thiruvananthapuram District, Kerala, India.

Paratypes.—Three adult males collected along with the holotype, BNHS 4265, BNHS 4266 and TBGRI 2002.0055, and two adult females, BNHS 4267 (collected along with the holotype) and FMNH 218118 (collected by Robert F. Inger and Bradley Shaffer on May 1982 from Ponmudi Hills).

Diagnosis.—*Philautus graminirupes* can be distinguished from all other members of the genus by the combination of the following characters: (1) small male adult size; (2) snout in dorsal

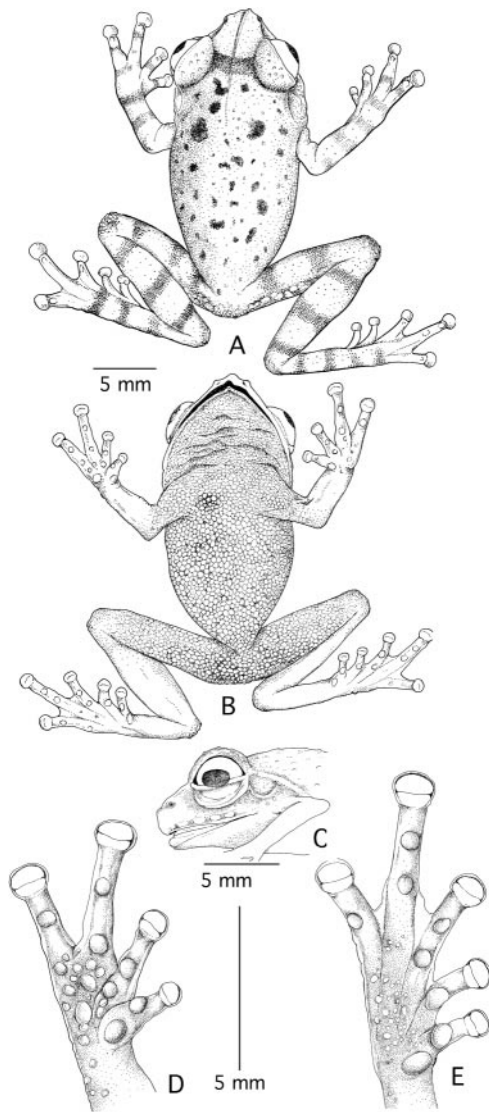


Fig. 4. Holotype of *Philautus graminirupes*, (A) Dorsal view; (B) ventral view; (C) lateral view of head; (D) ventral view of hand; (E) ventral view of foot.

view pointed; (3) snout shorter than horizontal diameter of eye (SL 3.0–3.2 mm, EL 3.8–4.2 mm); (4) canthus rostralis sharp; (5) posterior surface of thighs chocolate brown, vermiculated with bluish-green.

Philautus graminirupes differs from all previously described species of the Western Ghats in having its snout length shorter than the horizontal diameter of the eye (SL 3.07 ± 0.95 mm, EL 3.97 ± 0.17 , $N = 4$) and the posterior surface of the thighs chocolate brown, vermiculated with bluish-green. Inger et al. (1984) reported this species as *P. signatus*, but they already



Fig. 5. Dorsolateral view of *Philautus graminirupes* holotype in life.

stated that the identification was “questionable.” *Philautus graminirupes* differs from *P. signatus* in having a smaller snout–vent length (22.00 ± 0.58 mm, $N = 4$ vs 31.14 ± 2.29 mm, $N = 5$, in *P. signatus*), the snout length shorter than the horizontal diameter of the eye (SL 3.07 ± 0.95 mm, EL 3.97 ± 0.17 , $N = 4$ vs SL 5.28 ± 0.08 mm, EL 4.14 ± 0.21 , $N = 5$, in *P. signatus*), a tongue without lingual papilla (present in *P. signatus*), and the posterior surface of the thighs chocolate brown, vermiculated with bluish-green (vs grayish brown without markings in *P. signatus*).

Description of holotype.—All measurements in millimeters. A relatively small *Philautus* (SVL 22.6), body rather robust (Figs. 4A–B, 5); head wider than long (HW 9.6, HL 9.2, MN 8.1, MFE 6.3, MBE 3.5), flat above; outline of snout in dorsal view pointed (Fig. 4A–B), slightly protruding, snout length (SL 3.1) shorter than the horizontal diameter of the eye (EL 4.0; Fig. 4C); canthus rostralis sharp, loreal region acutely concave; interorbital area slightly convex, about equal to (IUE 2.8) upper eyelid (UEW 2.7), shorter than internasal distance (IN 2.3); distance between anterior margins of eyes (IFE 5.0) 1.8 times in distance between posterior margins of eyes (IBE 9.2); nostrils oval, without flap of skin, closer to tip of snout (NS 1.4) than to front of eye (EN 1.9); pupil oval, horizontal; tympanum (TYD 1.2) rather indistinct, rounded, 3.3 times in eye diameter, 1.7 times distance from tympanum to eye (TYE 0.7); vomerine

teeth absent; tongue large (6.9×4.4), cordate, deeply emarginate, lobes acute, smooth, lingual papilla absent; supratympanic fold prominent, from back of eye to shoulder (Figs. 4C, 5).

Forelimb (FLL 5.0) shorter than hand (HAL 7.0, TFL 4.2); relative length of fingers: $I < II < IV < III$; tips of fingers with well-developed disks ($FD_I = 0.8$, $FW_I = 0.4$; $FD_{II} = 1.0$, $FW_{II} = 0.6$; $FD_{III} = 1.3$, $FW_{III} = 0.6$; $FD_{IV} = 1.2$, $FW_{IV} = 0.7$) with a distinct circummarginal groove; all fingers with a dermal fringe on the edges; webbing on fingers absent; subarticular tubercles prominent, rounded, single, all present; prepollex rather distinct, oval; single palmar tubercle, oval, distinct; supernumerary tubercles prominently present (Fig. 4D).

Hind limbs moderately long, heels touch with limbs folded at right angles to the body; shank 4.8 times longer (TL 11.6) than wide (TW 2.4), shorter than thigh (FL 12.8), longer than distance from base of inner metatarsal tubercle to tip of toe IV (FOL 9.3); distance from heel to tip of toe IV (TFOL 15.4) about three times longer than toe IV (FTL 5.1); relative length of toes: $I < II < III < V < IV$; tips of toes with disks, rather wide compared to toe width ($TD_I = 0.8$, $TW_I = 0.6$; $TD_{II} = 0.9$, $TW_{II} = 0.5$; $TD_{III} = 1.1$, $TW_{III} = 0.6$; $TD_{IV} = 1.2$, $TW_{IV} = 0.5$; $TD_V = 1.2$, $TW_V = 0.6$), with a distinct circummarginal groove; webbing reduced (Fig. 4E); small dermal fringe along toe V; subarticular tubercles rather prominent, rounded, simple, IV3 and V2 absent; inner metatarsal tubercle rather distinct (IMT 1.1), oval, about two times in length of toe I (ITL 2.0); outer metatarsal tubercle absent; weakly developed supernumerary tubercles present on all toes (Fig. 4E).

Skin of snout and between eyes shagreened with a few granular tubercles, between the eyes a horny ridge from the snout to the middle of the body (Figs. 4A, 5); upper eyelids granular, side of head shagreened, back shagreened to granular; flanks granular; dorsal part of forelimbs shagreened with a few granular projections; tarsus shagreened; throat and chest slightly granular; belly and ventral part of thighs with granular skin (Fig. 4B).

Color of holotype in life.—Dorsum grayish brown with various amounts of irregular black (Figs. 4A, 5) 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 3–5 narrow light bands; iris silvery-brown with dark brown horizontal bands, pupil black; forelimbs and hind limbs light grayish-brown with brownish-black cross-bands, fingers and

toes with dark cross-bands, anterior surface of thighs vermiculated with brown-yellow, tinted with bluish-green, posterior surface of thighs light chocolate brown, vermiculated with bluish green; ventrally light gray with dark brown specks of variable size, forming a vermiculated belly; feet and hands light gray with dark brownish-black margins.

Color in alcohol.—The grayish-yellow dorsum has turned to light brown, black patches have become dark gray, loreal and tympanic region light brown, abdominal region dark brown, vermiculated with light gray; forelimbs gray-brown, hind limbs light brown with dark brown cross-bands, posterior surface of thighs light brown vermiculated; ventrally uniform gray with dark brown irregular spots, united into patches on throat.

Secondary male sexual characters.—Nuptial spines absent; median subgular vocal sac present; a pair of oval-shaped openings present at the base of lower jaw.

Secondary female sexual characters.—Oviduct of paratype BNHS 4267 zigzag; ovary large, creamy white.

Variation.—Measurements (in millimeters) of the type series are given in Table 1. The dorsal coloration of BNHS 4265 is darker brown, BNHS 4266 has less markings, and TBGRI 2002.0052 has a discontinuous cross-marking on the back. In captivity, the color changes from light grayish-brown to dark brown.

Etymology.—The species name is derived from two Latin words *graminis*, meaning grass and *nirupes*, meaning rock, referring to the rocky grassland habitat of this species.

Distribution and natural history.—*Philautus graminirupes* is known only from the type locality Ponnudi, south of the Palghat Gap. 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- and fern-covered rock in grassland. All were collected at around 2000 h after heavy rain.

Breeding was observed at the type locality. The amplexus is axillary and 38 eggs were laid at the base of a grass clump, about 10 m away from a perennial stream. Two more clutches, containing 32 and 30 eggs, respectively, were located within a radius of 5 m, one in a rock crevice and another at the base of a grass clump.

The eggs were nonpigmented white and protected by a dense jelly layer. Eggs are large and measure 4.9 ± 0.5 mm ($N = 38$) in diameter. The eggs underwent direct development and hatching of froglets took place after 24 days.

DISCUSSION

In Peninsular India, the highest frog diversity can be found in the Western Ghats or Sahyadri Hills, a chain of mountains, which runs parallel to the west coast of India over a distance of 1600 km. This mountain range begins as low hills in the northwest state of Gujarat, then passes southward through Maharashtra, Goa, Karnataka, and Kerala before ending abruptly in Mahendragiri Hills in Tamil Nadu at the southern tip of India. This range has a significant, about 30 km wide valley (approximately between $10^{\circ}35'N$ and $10^{\circ}50'N$), known as the Palghat Gap, which divides the Western Ghats in two main units. The new species are currently known only from the type locality, south of Palghat Gap. In contrast, *P. glandulosus*, which is a potential close relative of *P. bobingeri*, is currently known only from localities north of the Palghat Gap, and *P. signatus*, which has been confused with *P. graminirupes*, is also confined to the northern side of this gap. These observations add evidence to the hypothesis that the Palghat Gap may constitute an important barrier to faunal dispersal in the Western Ghats (Bossuyt et al., 2004).

COMPARATIVE MATERIAL

Philautus adspersus (BMNH 1947.2.6.23); *Philautus annandalii* (BMNH 1947.2.26.58); *Philautus beddomii* (BMNH 1947.2.26.59–66, NMW 22884); *Philautus bombayensis* (ZSIC 18287, SDB 40175, SDB 4091); *Philautus cavirostris* (BMNH 1947.2.7.83); *Philautus chalazodes* (BMNH 1947.2.6.35, SDB 430–434); *Philautus charius* (MNHN 1999.5597, SDB 4210–13, SDB 44974498); *Philautus dubius* (BMNH 1947.2.7.86); *Philautus femoralis* (BMNH 1947.2.26.89–90, *P. "femoralis"* FMNH 218111, 218112, 218113); *Philautus fergusonianus* (BMNH 1947.2.27.61); *Philautus flaviventris* (BMNH 1947.2.26.98); *Philautus glandulosus* (BMNH 1947.2.27.22, SDB 40239, SDB 6339); *Philautus griet* (KBIN 1919–1922, 1926, SDB 465); *Philautus hypomelas* (BMNH 1947.2.7.47–57); *Philautus jerdonii* (BMNH 1947.2.7.84); *Philautus leucorhinus* (ZMB 3057); *Philautus luteolus* (BNHS 4191–92, SDB 106, SDB 615, SDB 1089, SDB 6337); *Philautus microtympanum* (BMNH 1947.2.8.48); *Philautus nanus* (BMNH

1947.2.7.78); *Philautus nasutus* (BMNH 1947.2.6.21); *Philautus pleurotaenia* (BMNH 1947.2.7.64); *Philautus signatus* (BMNH 1947.2.27.36, BMNH 1920.11.4.1–2, SDB 4001; SDB 4006, *P. "signatus"* FMNH 218123); *Philautus stictomerus* (BMNH 1947.2.8.54); *Philautus temporalis* (BMNH 1947.2.6.8–11); *Philautus tinniens* (BMNH 1947.2.6.14; SDB 523–524, SDB 40264); *Philautus travancoricus* (BMNH 1947.2.6.20; SDB 4500); *Philautus tuberochumerus* (BNHS 4193–94; SDB1101–1104); *Philautus variabilis* (BMNH 1947.2.7.87); *Philautus wynaaden-sis* (MNHN 1999. 5596; SDB 3010–11, SDB 399–4–01).

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LITERATURE CITED

- BIJU, S. D. 2001. A synopsis to the frog fauna of the Western Ghats, India. Indian Soc. Conserv. Biol. Occ. Publ. 1:1–24.
- BOSSUYT, F. 2002. A new species of *Philautus* (Anura: Ranidae) from the Western Ghats of India. J. Herpetol. 36:656–661.
- , AND A. DUBOIS. 2001. A review of the frog genus *Philautus* Gistel, 1848 (Amphibia, Anura, Ranidae, Rhacophorinae). Zeylanica 6:1–112.
- , M. MEEGASKUMBURA, N. BEENAERTS, D. J. GOWER, R. PETHIYAGODA, K. ROELANTS, A. MANNAERT, M. WILKINSON, M. M. BAHIR, K. MANAMENDRA-ARACHCHI, P. K. L. NG, C. J. SCHNEIDER, O. V. OOMEN, AND M. C. MILINKOVITICH. 2004. Local endemism within the Western Ghats—Sri Lanka biodiversity hotspot. Science 306:479–481.
- BOULENGER, G. R. 1882. Catalogue of the Batrachia Salientia s. Ecaudata in the collection of the British Museum. Taylor and Francis, London.
- CALLERY, E. M., H. FANG, AND R. P. ELINSON. 2001. Frogs without polliwogs: evolution of anuran direct development. Bioessays 23:233–241.
- DAS, I., AND S. K. DUTTA. 1998. Checklist of amphib-

- ians of India, with English common names. *Hemadryad* 23:63–68.
- DUTTA, S. K. 1997. Amphibians of India and Sri Lanka. (checklist and bibliography). Odyssey Publishing House, Bhubaneswar, India.
- FERGUSON, H. S. 1904. A list of Travancore batrachians. *J. Bombay Nat. Hist. Soc.* 15:499–509.
- GÜNTHER, A. 1876. Third report on collections of Indian reptiles obtained by the British Museum. *Proc. Zool. Soc. Lond.* 1875:567–577.
- INGER, R. F., H. B. SHAFFER, M. KOSHY, AND R. BAKDE. 1984. A report on a collection of amphibians and reptiles from the Ponnudi, Kerala, South India. *J. Bombay Nat. Hist. Soc.* 81:406–427, 551–570.
- , ———, ———, AND ———. 1987. Ecological structure of a herpetological assemblage in South India. *Amphib.-Reptilia* 8:189–202.
- KRISHNAMURTHY, S. V., AND K. SAKUNTALA. 1993. Amphibian fauna of Sringeri taluk (Chickamagalure District: Karnataka). *J. Indian Inst. Sci.* 73:443–452.
- MEEGASKUMBURA, M., F. BOSSUYT, P. PETHIYAGODA, K. MANAMENDRA-ARACHCHI, M. BAHIR, M. C. MILINKOVITICH, AND C. J. SCHNEIDER. 2002. Sri Lanka: an amphibian hot spot. *Science* 298:379.
- MILL, R. R. 1995. Regional overview: Indian subcontinent, p. 61–144. *In: Centres of plant diversity: Asia, Australasia, and the Pacific*. Vol. 2. S. D. Davis, V. H. Heywood, and A. C. Hamilton (eds.). WWF and IUCN, Cambridge.
- NAIR, S. C. 1991. The southern Western Ghats: a biodiversity conservation plan, INTACH, New Delhi, India.
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