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Cover: A Southern Rockhopper Penguin *Eudyptes chrysocome* stands on Tussock Grass on Westpoint Island. Painted in poster colors, this artwork is a reproduction of a photograph by Phillip Colla. Thanks to the photographer for the original image. © Pooja Patil.

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ARTICLE

Two new species of bush frogs (Anura: Rhacophoridae: *Raorchestes*) from Meghalaya, northeastern India

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Abstract: The genus *Raorchestes* Biju et al., 2010 represents one of the most diverse lineages within the family Rhacophoridae, with its members characterized by small size, absence of vomerine teeth, direct development, and distinctive digital discs with circum-marginal grooves. Despite its location in the Indo-Burma biodiversity hotspot, the amphibian diversity of Meghalaya remains underexplored. In this study, we describe two new species, *Raorchestes jakoid* sp. nov. and *Raorchestes jadoh* sp. nov., from the Khasi Hills of Meghalaya, based on an integrative approach combining morphological, bioacoustic, and molecular data (16S rRNA). Additionally, we provide new records and supplementary descriptions for three species: *R. kempiae*, *R. garo*, and *R. asakgrensis*, thereby improving our understanding of their intraspecific variation and distribution. Phylogenetic analyses confirm the placement of the new species within the *Raorchestes parvulus* species complex. The new species are distinguished by a suite of morphological traits, unique call structures, and genetic divergence from congeners. Notably, both new species were discovered in secondary habitats near human settlements, suggesting ecological tolerance yet raising concerns about their long-term survival amid rapid habitat loss. The elevational distribution of the species studied ranges from 235 m to 1,655 m, with a concentration between 1,000–1,600 m, highlighting patterns of elevational partitioning and habitat specialization. Our findings add to the growing evidence of high cryptic diversity in the region and underscore the urgent need for targeted herpetofaunal surveys and conservation actions in Northeast India.

Keywords: 16SrRNA, acoustic, biodiversity, conservation, endemism, Indo-Burma biodiversity hotspot, morphology, *parvulus* complex, systematics, taxonomy.

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Competing interests: The authors declare no competing interests.

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Author contributions: HW—conceptualization, paper writing, collection of specimens, field study and data gathering; JP—paper writing and phylogenetic analysis; HTL—provided morphological data; MD—laboratory work and paper writing.

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INTRODUCTION

The genus *Raorchestes* Biju et al., 2010 is one of the most diverse in the family Rhacophoridae (Vijayakumar et al. 2014), currently comprising 80 recognized species (Biju & Bossuyt 2009; Frost 2025). The distribution of *Raorchestes* spans a wide geographical range, from southern and northeastern India to Nepal, extending through Myanmar, Thailand, Laos, and southern China, reaching Vietnam, Cambodia, and western Malaysia (Frost 2025). These small frogs are characterized by their unique morphological traits, including an adult snout-vent length between 15–45 mm and the absence of vomerine teeth. Notably, all documented species undergo direct development, with eggs hatching directly into froglets, bypassing the free-swimming tadpole stage. Additionally, the genus is distinguished by the expanded tips at its fingers, and toes, each ending in discs with circum-marginal grooves (Biju et al. 2010; Seshadri et al. 2012; Wu et al. 2021).

Meghalaya, a state in northeastern India, lies within the Indo-Burma biodiversity hotspot, a region renowned for its remarkable species richness and high levels of endemism (Myers et al. 2000). Despite its ecological significance, much of Meghalaya's amphibian diversity remains underexplored, with many species still awaiting formal description. Recent studies describing new amphibian taxa points to the rich and underexplored amphibian diversity of Meghalaya (Mathew & Sen 2007, 2009, 2010a, 2010b; Das et al. 2010; Mahony et al. 2011, 2013, 2018; Purkayastha & Matsui 2012; Kamei et al. 2013; Saikia et al. 2023; Naveen et al. 2024, 2025).

Among the Rhacophoridae of Meghalaya, species within the genus *Raorchestes* are unique in exhibiting direct development. In contrast, all other rhacophorid genera recorded from the region (e.g., *Rhacophorus*, *Polypedates*, *Kurixalus*, & *Chirixalus*) undergo an indirect development cycle, with a prominent free-swimming aquatic tadpole stage following hatching. Additionally, members of the genus *Raorchestes* possess rudimentary toe webbing. In comparison, species of other rhacophorid genera exhibit moderate to extensive toe webbing. Based on morphology, bioacoustic and genetics (16S rRNA), herein, two new species of *Raorchestes* belonging to the *Raorchestes parvulus* species complex were described (Garg et al. 2021) along with additional data on the newly described *R. asakgrensis* Naveen, Chandramouli, Babu, Ryndongsngi, Karunakaran & Kumara 2024, and of redescribed *R. garo* (Boulenger, 1919), and *R. kempiae* (Boulenger, 1919) from the subtropical forests of Meghalaya. Naveen et al. (2025) synonymised two nominal taxa *Philautus namdaphaensis* Sarkar & Sanyal, 1985 and *P. manipurensis* Mathew & Sen, 2009 under *R. kempiae*. These newly described and redescribed species significantly enhance the known diversity within the genus, offering fresh insights into the biogeography of *Raorchestes,* and contributing to the broader understanding of amphibian diversity in this ecologically rich but understudied region.

MATERIALS AND METHODS

Field sampling

Fieldwork was carried out in different parts of Meghalaya where specimens were observed and collected (Figure 1), including Mawpat, South West Khasi Hills (25.359° N, 91.255° E, elevation 1,355 m) for ADBUHW0154, Mawsynram, East Khasi Hills (25.296° N, 91.585° E, elevation 1,445 m) for ADBUHW0141, Lawbah, East Khasi Hills (25.247° N, 91.580° E, elevation 815 m) for ADBUHW0143, ADBUHW0145, and ADBUHW0144, Langtor, Eastern West Khasi Hills (25.533° N, 91.586° E, elevation 1,655 m) for ADBUHW0124 and ADBUHW0123, Laittyra, East Khasi Hills (25.222° N, 91.742° E, elevation 755 m) for ADBUHW0052, Mawiong Nongkhlaw, Eastern West Khasi Hills (25.690° N, 91.641° E, elevation 875 m) for ADBUHW0049, Umdein, West Khasi Hills (25.637° N, 91.047° E, elevation 445 m) for ADBUHW0119, Lailad, Nongkhyllem, Ribhoi (25.897° N, 91.775° E, elevation 235 m) for ADBUHW0116, and Tura, West Garo Hills (25.519° N, 90.210° E, elevation 375 m) for ADBUHW0169, and ADBUHW0170 between 2022 and 2024.

The research was conducted under the permission of the Principal Chief Conservator of Forests, Wildlife and Chief Wildlife Warden, Meghalaya (Memo. No. FWC/Research/115/2790–2796, Memo. No. FWC/Research/115/1653–1661 & Memo. No. FWC/Research/115/1134–1142). The study used randomized walks (Lambert 1984) and visual encounter surveys (Crump & Scott 1994) on different sites. The frogs were located and recorded by paying attention to the male frogs' calls. The frogs were photo-documented using Canon EOS M50 Mark II. Collected frogs were euthanized using lignocaine (2%), preserved in 10% formaldehyde solution, and deposited in the Assam Don Bosco University.

Morphological Study

The measurements were made using a vernier calliper to the nearest 0.01 mm. Different morphometric

characters and descriptions were considered following Watters et al. (2016). The morphological characters include: head width (HW); snout-vent length (SVL); tibia length (TL); interorbital distance (IOD); head length (HL); eye diameter (ED); internarial distance (IND); eye–nostril distance (EN); snout length (SL); snout–nostril length (NS); foot length (FL); tympanum diameter (TD); thigh length (THL); hand length (HAL); forearm length (FLL); upper eyelid width (UEW); tarsus length (TSL); mandible to eye distance (MBE); upper arm length (UAL); horizontal tympanic annulus diameter (TAD); mandible–nostril distance (MN); hindlimb–length (HLL); lower arm length (LAL); body width (BW); snout–urostyle length (SUL); finger I length (Fin1L); finger II length (Fin2L); finger III length (Fin3L); finger IV length (Fin4L); finger I disk width (Fin1DW); finger II disk width (Fin2DW); finger III disk width (Fin3DW); finger IV disk width (Fin4DW); finger IV width (Fin4W); toe I length (Toe1L); toe II length (Toe2L); toe III length (Toe3L); toe IV length (Toe4L); toe V length (Toe5L); and toe IV disk width (Toe4DW). For morphological comparison, we used raw measurements. We compared these measurements with the members of *Raorchestes parvulus* complex (Garg et al. 2021; Naveen et al. 2024, 2025): *Raorchestes kempiae*, and *Raorchestes garo*.

Bioacoustics recording and analyses

The calls were captured in real–time using BOYA BY–DMR7 unidirectional handheld microphones (WAV format, 24–bit) and SONY ICD–PX470 stereo digital voice recorders (MP3 format, 256 kbps) between 1600 h and 2300 h. The distance between the recording equipment and the calling males was maintained at 30–150 cm, except few which are present at the top of big trees, with recording levels adjusted before each session (Prasad et al. 2020). The acoustic properties of the different species were analyzed using Raven Pro 1.6. For calls, we analyzed the temporal variables like the number of notes per call, note duration, duration of the silent interval between notes, call duration, duration of the silent intervals between the calls, and call repetition rate. The spectral variables include the dominant frequency. Descriptive statistics like mean, standard deviation, range, and coefficient of variance were computed using Microsoft Excel 2010.

Genetic study: Genomic DNA isolation from 10 samples of *Raorchestes* spp. (ADBUHW0049, ADBUHW0052, ADBUHW0116, ADBUHW0124, ADBUHW0141, ADBUHW0143, ADBUHW0145, ADBUHW0154, ADBUHW0169, ADBUHW0170) was done using Phenol: Chloroform: Isoamyl alcohol method, followed by 0.8% agarose gel electrophoresis, and visualized under UV light using Biorad Gel Imazer Gel Documentation Unit. The 16S rRNA gene were amplified using gene- primers pair AH-16S_S 5'- CGC CTG TTT ACC AAA AAC ATC GCC T-3' and AH-16S_R 5'- TGC GCT GTT ATC CCY RGG GTA ACT-3' following Caranza & Arnold (2006). Comparative genetic data from members of *Raorchestes parvulus* group were download from GenBank and were used in construction of phylogenetic tree (Table 2). Sequence alignment was done using MUSCLE (Edgar 2004) in MEGA7 (Tamura & Nei 1993; Kumar et al. 2016) with default parameter settings (max 2072 bp). Maximum likelihood (ML) phylogenetic tree was reconstructed using unpartitioned dataset in IQ-TREE (Nguyen et al. 2015) with the substitution model TIM2+F+R2 selected based on the BIC scores by Model Finder (Kalyaanamoorthy et al. 2017). The ML analysis was run with an ultrafast bootstrap option (Minh et al. 2013) for 1,000 iterations to assess clade support. The uncorrected pairwise p-distance was calculated in MEGA7 (Kumar et al. 2016) with pairwise deletions of missing data and gaps.

RESULTS

Based on 16S rRNA data generated, the species studied were seen to be members of the *Raorchestes parvulus* species group (Garg et al. 2021; Image 1; Supplement Table 1). The specimens ADBUHW0049 (PQ492285), ADBUHW0052 (PQ492286), and ADBUHW0145 (PQ492281) were seen to form a sister clade with *R. kempiae* differing by an uncorrected p-distance of 0.000–0.006 (0.6%). Specimens, ADBUHW0141 (PQ492279) and ADBUHW0154 (PQ492282) were seen to form a sister taxon *to R. garo*, differing by an uncorrected p-distance of 0.000.

ADBUHW0116 (PQ492287), ADBUHW0169 (PQ492283), and ADBUHW0170 (PQ492284) were seen to be sister taxa to *R. asakgrensis*, differing from each other with an uncorrected p-distance of 0.000–0.015 (0.15%).

Furthermore, specimen ADBUHW0124 (PQ492288) was seen to be sister taxon to *R. shillongensis*, differing by an uncorrected p-distance of 0.034 (3.4%), and ADBUHW0143 (PQ492280) was seen to be sister to *R. rezakhani*, differing by an uncorrected p-distance of 0.058 (5.8%) to 0.061 (6.1%).

Systematics

***Raorchestes kempiae* (Boulenger, 1919)**

(Images 2 & 3; Tables 1 & 3)

Referred materials

ADBUHW0049, adult male collected from Mawiong Nongkhlaw, Eastern West Khasi Hills, Meghalaya, India (25.690° N, 91.641° E, elevation 875 m on 30 August 2023 at around 1845 h by Holiness Warjri and Rijessing Warjri.

ADBUHW0052 adult male collected from Laittyra, East Khasi Hills, Meghalaya, India 25.222° N, 91.742° E, elevation 755 m) on 7 August 2023 at around 1930 h by Holiness Warjri and Rijessing Warjri.

ADBUHW0145, adult male collected from Lawbah, East Khasi Hills, Meghalaya, India (25.247° N, 91.580° E, elevation 815 m) on 6 August 2024 at around 1750 h by Holiness Warjri and Rijessing Warjri.

Diagnostic characters

The species is allocated to the genus *Raorchestes* because of small size (adult SVL ranging from 15–45 mm) and absence of vomerine teeth; a large, transparent gular pouch visible during calls; in males, tips of all fingers and toes expanded into discs with circum-marginal grooves (Biju et al. 2010; Wu et al. 2021). *Raorchestes kempiae* is characterised by: webbing formula (I 1–2 II 2–1 III 1–3.5 IV 3–2 V); inner palmar tubercle absent and outer palmar tubercle with round shape; tibio-tarsal articulation reaching the eye when hindlimb is stretched alongside body (whereas Boulenger (1919) mentioned of tibio-tarsal articulation reaching the anterior border of an eye); nuptial pad present; inner metatarsal tubercle oval (IMT/Toe4L 0.09 mm long), outer metatarsal tubercle absent; upper part of body with small warts.

Color in life (Image 2)

Dorsal color beige, with or without an hour glass shaped marking; finger discs and toe discs greyish; dorsal surface of the hindlimb and forelimb with more or less dark crossbars; supratympanic fold dark brown; iris light golden; ventral surface creamy white with many white spots.

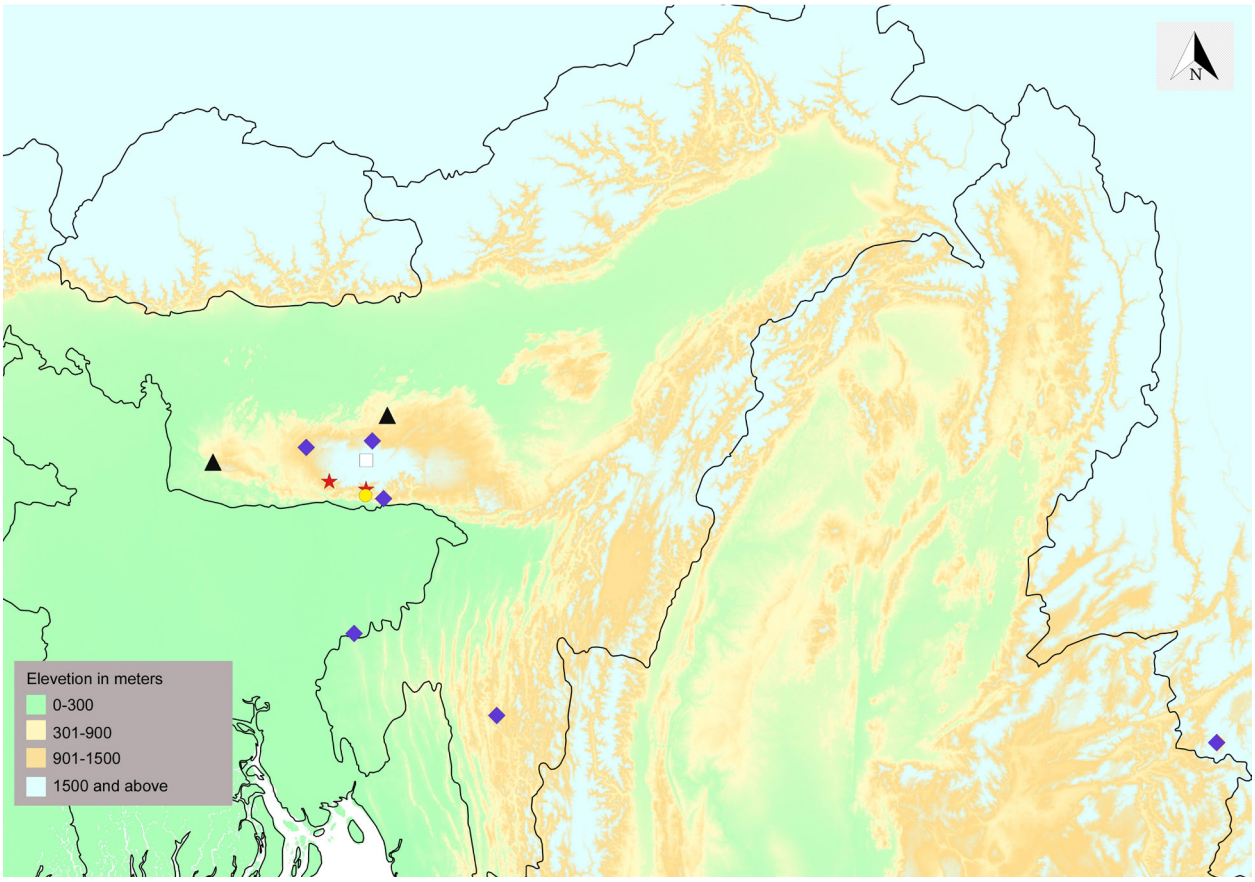

Figure 1. An elevation map showing distribution of *Raorchestes garo* (red star), *Raorchestes jakoid* sp. nov. (yellow circle), *Raorchestes jadoh* sp. nov. (white square), *Raorchestes asakgrensis* (black triangle), and *Raorchestes* cf. *kempiae* (blue diamond).

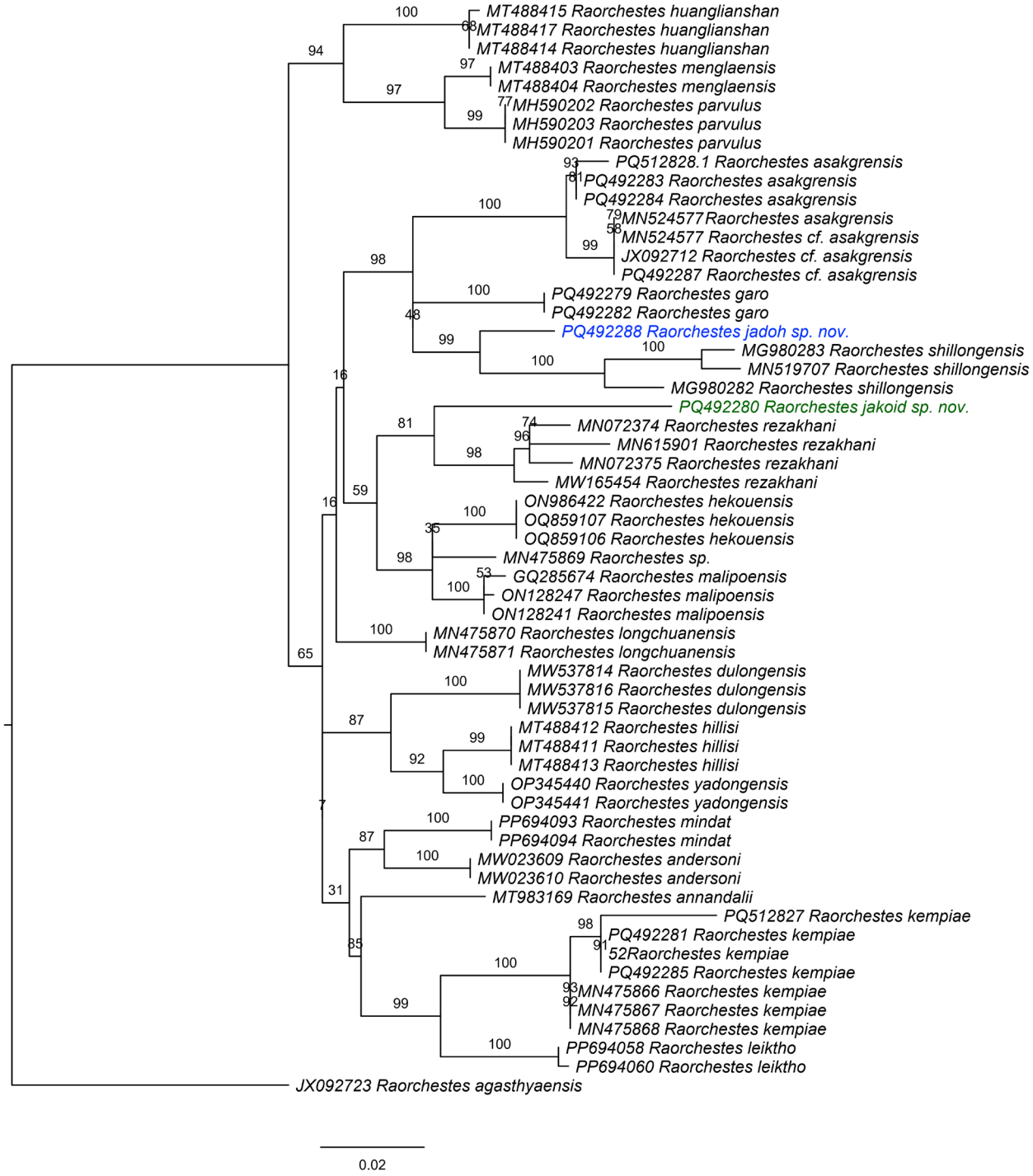

Image 1. Maximum likelihood phylogeny of frogs in the genus *Raorchestes*; numbers at nodes represent bootstrap support (Preceding the species name is NCBI accession number).

Advertisement calls: (Image 3; Table 3)

Ten advertisement calls were analyzed from two individuals having SVL of 23.6 and 24.4 mm. The calling position from the ground was observed to be 20–400 cm. When recording, calling males were sitting on trees and grasses near human settlements and calls were recorded between 1625 h and 1800 h on 7 August 2023. The ambient air temperature was 26°C and the relative humidity was 99%.

The advertisement call had a mean duration of 0.37

Image 2. Live image of *Raorchestes kempiae* from Meghalaya, India.: A—Lawbah, East Khasi Hills | B—Mawiong, Eastern West Khasi Hills | C—Laittyra, East Khasi Hills. © Holiness Warjri.

± 0.05 seconds, with a mean inter−call interval of 1.32 ± 0.11 seconds, and an average call repetition rate of 2.73 ± 0.33 calls per minute. Each call contained an average of 2.0 ± 0.0 notes, with a note duration of 0.12 ± 0.008 seconds and a mean inter-note interval of 0.06 ± 0.007 seconds. The mean dominant frequency of the call was 2.73 ± 0.03 kHz, ranging 2.72−2.81 kHz, with a coefficient of variation of 1.09.

***Raorchestes garo* (Boulenger, 1919)**
(Images 3 & 4; Tables 1 & 3)

Referred materials

ADBUHW0154 adult male collected from Mawpat, South West Khasi Hills, Meghalaya, India (25.359^0 N, 91.255^0 E, elevation 1,355 m) on 17 July 2024 at around 1830 h by Holiness Warjri and Rijessing Warjri.

ADBUHW0141 adult male collected from Mawsynram, East Khasi Hills, Meghalaya, India (25.296^0 N, 91.585^0 E, elevation 1,445 m) on 6 July 2024 at around 1910 h by Holiness Warjri and Rijessing Warjri.

Diagnostic characters: *Raorchestes garo* is characterised by small body size (maximum SVL 22.7 mm), vomerine teeth absent, males possess a transparent gular pouch which is visible when calling, and tips of all fingers and toes expanded into discs with circum-marginal grooves. Tympanum may be distinct or hidden. Boulenger (1919) and Naveen et al. (2024) mentioned of distinct tympanum, whereas the specimens reported in this study (ADBUHW0141 and ADBUHW0154) have a indistinct tympanum; webbing between fingers absent; relative finger lengths: I < II < IV < III, relative toe lengths: I < II < III < V < IV; webbing formula for toe is: I 1−1 II 1−1 III 3−3 IV 3−2.5 V; inner palmar tubercle absent and outer palmar tubercle present with round shape; tibiotarsal articulation reaching the posterior border of an eye when hindlimb is stretched alongside body (whereas Boulenger (1919) mentioned tibio-tarsal articulation reaching the anterior border of an eye); nuptial pad present and whitish in color; inner metatarsal tubercle oval (IMT/Toe4L 0.07 mm long), outer metatarsal tubercle absent; dark brown

Table 1. Morphometric data of *Raorchestes garo, R. jakoid* sp. nov., *R. jadoh* sp. nov., *R. asakgrensis*, and *R. kempiae* from Meghalaya, India.

	ADBUHW0154	ADBUHW0141	ADBUHW0143	ADBUHW0144	ADBUHW0123	ADBUHW0124	ADBUHW0169	ADBUHW0170	ADBUHW0116	ADBUHW0049	ADBUHW0052	ADBUHW0145
Species	*R. garo*		*R. jakoid* sp. nov.		*R. jadoh* sp. nov.		*R. asakgrensis*			*R. kempiae*		
SVL	22.47	22.75	18.47	21.6	14.01	13.68	21.57	23.35	18.08	22.96	24.4	23.62
SUL	21.41	18.11	16.5	20.13	13.24	13	20.52	22.93	16.41	21.64	23.07	22.1
BW	7.21	7.11	7.4	7.51	7.2	7.33	8.53	10.38	7.35	8.59	9.1	9.7
HW	5.79	7.67	7.05	7.52	6.02	5.43	8.35	9.21	6.42	8.87	8.56	8.8
HL	3.95	5.34	5.2	6.11	4.01	3.91	6.54	7.68	5.26	7.13	8.97	7.22
IOD	2.18	2.68	2.19	1.7	2.12	2.1	2.21	2.05	2.13	2.61	2.33	2.79
IND	2.8	1.52	2.12	2.1	1.97	1.85	1.84	2.01	1.98	2.67	3.15	1.89
UEW	1.51	1.81	1.63	1.75	1.51	1.46	1.94	2	1.52	2.06	1.74	1.78
ED	1.68	2.51	1.79	1.8	1.71	1.69	2.24	2.6	1.82	3.21	2.77	2.64
EN	1.71	2.61	1.7	1.89	1.71	1.69	2.24	2.94	1.6	2.48	2	2.53
SL	2.9	3.41	2.4	2.45	2.9	2.87	3.24	4.32	2.78	3.64	4	3.41
NS	0.91	1.41	1.45	1.28	0.9	0.89	1.99	1.71	2.6	1.86	2.01	1.61
TD	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct
TAD	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct
MBE	1.31	1.31	1.07	1.45	1.21	1.25	1.74	2.17	1.04	2.42	2.04	1.41
MN	3.06	3.58	4.41	5.45	2.91	3.01	4.63	4.88	4.27	5.69	5.05	6.01
FLL	3.49	4.79	4.22	4.29	3.42	3.41	3.72	4.92	4.12	5.33	5.15	5.73
UAL	4.12	4.41	3.09	3.33	4.15	4.11	3.8	3.73	3.08	3.96	3.49	3.25
LAL	7.11	9.11	11.45	12	7.11	7.15	14.33	4.66	11.29	11.04	10.87	10.01
HAL	4.45	5.65	4.85	4.91	4.61	4.5	5.68	6.09	4.78	7.37	7.87	7.19
HLL	19.05	24.01	23.5	23.16	18.61	19.02	32.03	34.97	23.5	33.77	36.47	31.21
THL	6.75	9.19	7.75	8.16	6.75	6.7	11.51	10.8	8.07	12.11	10.71	11.1
TL	7.16	10.11	8.4	10.62	8.11	7.1	11.49	12.91	8.43	11.58	12.23	14.23
TSL	4.08	6.61	3.69	5.49	4.09	4.02	7.49	6.73	3.88	6.53	6.52	5.98
FL	6.04	8.11	7.35	8.11	6.05	6.03	8.58	9.47	7.36	9.38	8.91	9.53
Fin1L	1.61	4.25	2.93	3.18	1.43	1.66	2.45	2.1	2.25	3.12	4.33	3.01
Fin2L	2.1	5.35	3.55	4.11	2	2.11	3.19	3.92	3.65	4.69	5.23	4.15
Fin3L	4.14	6.41	5.35	6.45	4.12	4.15	5.87	6.1	5.3	7.51	7.4	6.94
Fin4L	3.61	5.99	4.28	4.5	4.62	3.59	4.63	5.2	4.22	5.48	6.45	5.73

Table 1. cont.

	ADBUHW0154	ADBUHW0141	ADBUHW0143	ADBUHW0144	ADBUHW0123	ADBUHW0124	ADBUHW0169	ADBUHW0170	ADBUHW0116	ADBUHW0049	ADBUHW0052	ADBUHW0145
Species	*R. garo*		*R. jakoid* sp. nov.		*R. jadoh* sp. nov.		*R. asakgrensis*			*R. kempiae*		
Fin1DW	0.33	0.46	0.32	0.44	0.33	0.39	0.36	0.44	0.49	0.53	0.61	0.45
Fin2DW	0.61	0.86	0.86	0.89	0.62	0.65	0.81	0.82	0.85	0.93	1.12	0.91
Fin3DW	1.19	0.97	1.2	1.61	1.36	1.29	1.25	1.25	1.14	1.42	1.48	1.45
Fin4DW	0.81	0.88	0.92	0.99	0.99	0.68	0.87	0.84	0.9	1.44	1.48	1.16
Fin4W	0.25	0.56	0.59	0.91	0.21	0.25	0.72	0.87	0.58	0.6	1	0.58
Toe1L	1.31	2.99	2.4	2.91	1.21	1.26	2.3	3.65	2.41	3.29	2.85	3.59
Toe2L	3.39	2.11	3.45	2.48	3.18	2.42	3.1	2.97	2.4	5.55	4.97	4.22
Toe3L	5.19	5.2	5.6	6.78	6	6.11	6.33	6.7	5.49	7.27	6.68	5.99
Toe4L	6.19	7.11	7.5	7.69	6.01	6.45	8.85	9.16	7.41	9.19	9.52	9.52
Toe5L	6.19	6.99	6.7	6.9	5	5.12	7.54	7.36	6.55	8.03	7.32	7.81
Toe4DW	0.87	1.2	0.98	1.03	0.83	0.86	1.12	1.4	0.94	1.41	1.4	1.29

interorbital triangle between eyes interorbital distance larger than eye horizontal diameter; upper part with small warts.

Color in life (Image 4)

Dorsal color beige, with a faint) (shaped marking; finger discs and toe discs greyish; dorsal surface of the hindlimb and forelimb with more or less dark crossbars; supratympanic fold dark brown; crotch with distinct black patches; iris golden brown; ventral surface creamy white with many white spots.

Advertisement calls: (Image 3; Table 3)

A total of 10 advertisement calls were analysed from 2 individuals having SVL of 22.5 and 22.8 mm. The calling position from the ground is observed to be between 50–500 cm. The calling males were observed and recorded between 1830 h and 2125 h on 17 July 2024 with most calls originating from bushes in dense forest areas and near human settlements. The ambient air temperature during the recordings was 24°C, with a relative humidity of 89 %. The advertisement calls analyzed had a mean duration of 0.03 ± 0.005 seconds, with a mean inter-call interval of 2.26 ± 0.18 seconds, and an average call repetition rate of 35.28 ± 6.15 calls per minute. Each call consisted of a single note, meaning the note duration was identical to the call duration, and the inter-note interval matched the inter-call interval. The mean dominant frequency of the call was 2.93 ± 0.04 kHz, with a frequency range of 2.91–3.00 kHz. The coefficient of variation was 1.35.

***Raorchestes asakgrensis* Naveen, Chandramouli & Babu, 2024**

(Images 3 & 5; Tables 1 & 3)

Referred materials

ADBUHW0170 adult male collected from Tura, West Garo Hills, Meghalaya, India (25.519^0 N, 90.210^0 E, elevation 375 m) on 22 July 2024 at around 1830 h by Holiness Warjri and Rijessing Warjri.

Two adult males, ADBUHW0169 and ADBUHW0116 were collected. ADBUHW0169 was collected from the same locality and had the same information as the holotype, and ADBUHW0116 was collected from Lailad, Nongkhyllem, Ribhoi (25.897^{0}N, 91.775^{0}E, elevation 235 m) on 27 April 2024 at around 1800 h by Holiness Warjri and Ibankershisha Dkhar.

Diagnostic characters

Raorchestes asakgrensis is characterised by: very

Table 2. GenBank accession of 16s rRNA gene for species used to construct maximum likelihood phylogenetic tree.

Species	Locality	Voucher specimen	GenBank accession No
Raorchestes andersoni	Medog, Tibet, China	KIZ 014104	MW023610
Raorchestes andersoni	Medog, Tibet, China	KIZ YPX16167	MW023609
Raorchestes annandalii	Nepal	CDZMTU419	MT983169
Raorchestes asakgrensis	Tura, West Garo Hills, Meghalaya	ADBUHW0169	PQ492283
Raorchestes asakgrensis	Tura, West Garo Hills, Meghalaya	ADBUHW0170	PQ492284
Raorchestes asakgrensis	Lailad, Nongkhyllem, Ribhoi, Meghalaya	ADBUHW0116	PQ492287
Raorchestes asakgrensis	Nongkhyllem, Meghalaya	ZSIS-M7	MN524577
Raorchestes asakgrensis.	NA	CESF420	JX092712.1
Raorchestes asakgrensis.	Asakgre Community Reserve, Garo Hills, Meghalaya, India	SACON VA 805	PQ512828
Raorchestes cf. *parvulus*	Gunung Jerai, Kedah, Malaysia	LSUHC 10473	MH590203
Raorchestes cf. *parvulus*	Pulau Langkawi, Kedah, Malaysia	LSUHC 7596	MH590202
Raorchestes cf. *parvulus*	Gunung Stong, Kelantan, Malaysia	LSUHC 11118	MH590201
Raorchestes dulongensis	Qinlangdang Village, Yunnan, China	KIZ 035125	MW537815
Raorchestes dulongensis	Qinlangdang Village, Yunnan, China	KIZ 035082	MW537814
Raorchestes dulongensis	Qinlangdang Village, Yunnan, China	KIZ 035126	MW537816
Raorchestes garo	Mawpat, South West Khasi Hills, Meghalaya	ADBUHW0154	PQ492282
Raorchestes garo	Mawsynram, East Khasi Hills, Meghalaya	ADBUHW0141	PQ492279
Raorchestes garo	Daribokgre Community Reserve, East Garo Hills, Meghalaya, India	SACON VA 809	PQ585812
Raorchestes hekouensis	Hekou, Yunnan, China	GXNU YU000536	OQ859106
Raorchestes hekouensis	Hekou, Yunnan, China	GXNU YU000537	OQ859107
Raorchestes hekouensis	Hekou, Yunnan, China	GXNU YU000160	ON986422
Raorchestes hillisi	Xiding, Yunnan, China	MT488411	MT488411
Raorchestes hillisi	Xiding, Yunnan, China	CIB 116329	MT488412
Raorchestes hillisi	Xiding, Yunnan, China	CIB 116330	MT488413
Raorchestes huanglianshan	Mt. Huanglian, Lvchun, Yunnan, China	CIB 116365	MT488414
Raorchestes huanglianshan	Mt. Huanglian, Lvchun, Yunnan, China	CIB 116353	MT488415
Raorchestes huanglianshan	Mt. Huanglian, Lvchun, Yunnan, China	CIB 116354	MT488417
Raorchestes jadoh sp. nov.	Langtor, Eastern West Khasi Hills, Meghalaya	ADBUHW0124	PQ492288
Raorchestes jakoid sp. nov.	Lawbah, East Khasi Hills, Meghalaya	ADBUHW0143	PQ492280
Raorchestes kempiae	Mikadogre Community Reserve	SACON VA 806	PQ512827
Raorchestes kempiae	Mawiong Nongkhlaw, Eastern West Khasi Hills, Meghalaya	ADBUHW0049	PQ492285
Raorchestes kempiae	Laittyra, East Khasi Hills, Meghalaya	ADBUHW0052	PQ492286
Raorchestes kempiae	Lawbah, East Khasi Hills, Meghalaya	ADBUHW0145	PQ492281
Raorchestes kempiae	Cangyuan, Yunnan, China	KIZ 015855	MN475866
Raorchestes kempiae	Cangyuan, Yunnan, China	KIZ 015856	MN475867
Raorchestes kempiae	Cangyuan, Yunnan, China	KIZ 015857	MN475868
Raorchestes leiktho	Near Leiktho, Hp-an District, Kayin State, Myanmar	SMF 106284	PP694058
Raorchestes leiktho	Near Leiktho, Hp-an District, Kayin State, Myanmar	SMF 106234	PP694060
Raorchestes longchuanensis	Gongdong, Longchuan county, Yunnan, China	KIZ 048492	MN475871
Raorchestes longchuanensis	Gongdong, Longchuan county, Yunnan, China	KIZ 048468	MN475870
Raorchestes malipoensis	Malipo, Yunnan, China	SWFU 3110	ON128247
Raorchestes malipoensis	Malipo, Yunnan, China	SWFU 3111	ON128241
Raorchestes malipoensis	Pac Ban, Tuyen Quan, Vietnam	ROM30288	GQ285674
Raorchestes menglaensis	Zhushihe, Mengla, Yunnan, China	CIB 116338	MT488403
Raorchestes menglaensis	Zhushihe, Mengla, Yunnan, China	CIB 116340	MT488404
Raorchestes mindat	Ovatmataung National Park, Kanpetlet township, Mindat District, Chin State, Myanmar	CAS 234782	PP694093
Raorchestes mindat	Ovatmataung National Park, Kanpetlet township, Mindat District, Chin State, Myanmar	CAS 234783	PP694094
Raorchestes rezakhani	Maulovibazar, Bangladesh	JnUZool-A0319	MN072374
Raorchestes rezakhani	Maulovibazar, Bangladesh	JnUZool-A0419	MN072375
Raorchestes rezakhani	Maulovibazar, Bangladesh	JnUZool-A0619	MN615901
Raorchestes rezakhani	Bangladesh	A0619	MW165454
Raorchestes shillongensis	Shilong, meghalaya, India	ZSIS-M1	MN519707
Raorchestes shillongensis	Malki forest, Shilong, meghalaya, India	R2	MG980283
Raorchestes shillongensis	Risa forest, Shilong, meghalaya, India	R1	MG980282
Raorchestes sp.	Tam Dao, Vinh Phu, Vietnam	ROM30298	MN475869
Raorchestes yadongensis	Yadong, Xizang, China	YBU 21222	OP345440
Raorchestes yadongensis	Yadong, Xizang, China	YBU 21223	OP345441
Nasutixalus jerdonii	Meriema, Nagaland, India	SDBDU 2007.060	KU170003

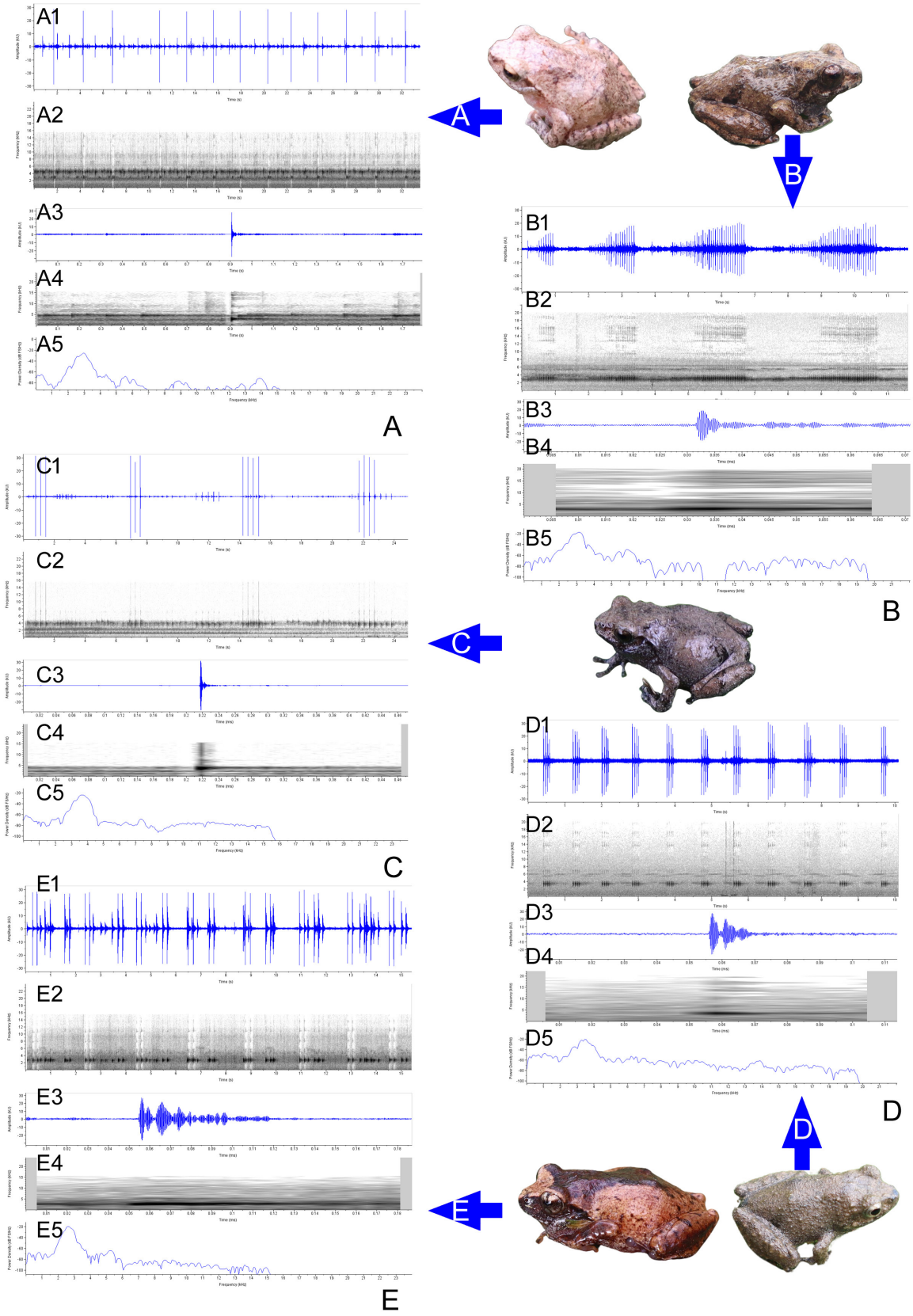

Image 3. Advertisement calls: 1—Oscillogram of call | 2—Spectrogram of call | 3—Oscillogram of single note | 4—Spectrogram of single note | 5—Power spectrum (Window type-Blackman, 3dB Filter Bandwith-150 Hz)] of A—*Raorchestes garo* | B—*Raorchestes jakoid* sp. nov. | C—*Raorchestes jadoh* sp. nov. | D—*Raorchestes asakgrensis* | E—*Raorchestes kempiae* from Meghalaya, India.

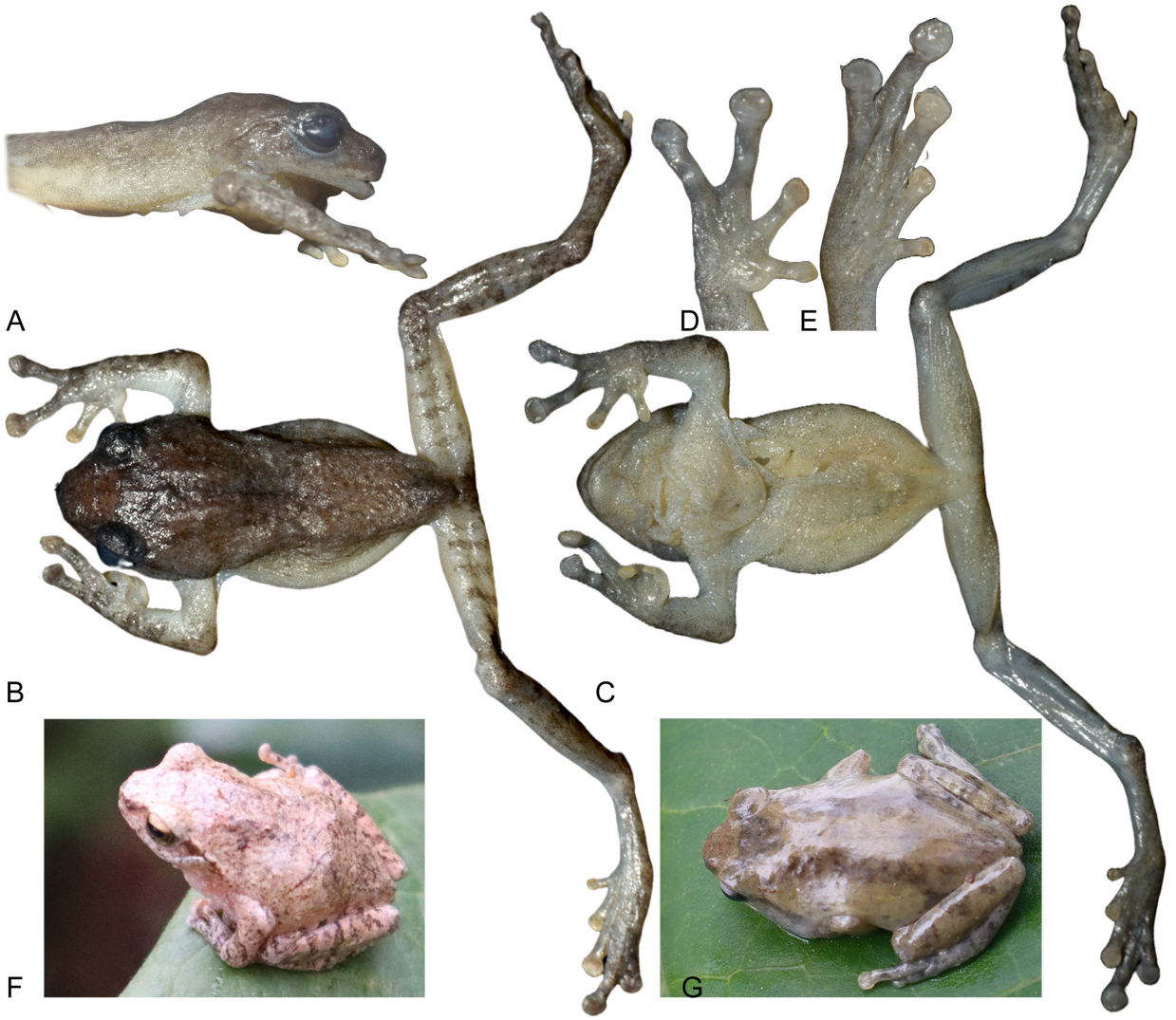

Image 4. *Raorchestes garo* from Meghalaya, India: A—Lateral aspect | B—Dorsal aspect | C—Ventral aspect | D—Manus | E—Pes | F&G—Live specimens. © Holiness Warjri.

small body size with maximum SVL of 23.35 mm; head wider than long; tympanum may be distinct or hidden. Rudimentary webbing between toes present, webbing formulaI I 1–2 II 2–2 III 2–3.5 IV 3.3–2 V; relative finger lengths: I < II < IV < III, relative toe lengths: I < II < III < V < IV; inner palmar tubercle absent and outer palmar tubercle present with round shape; tibio-tarsal articulation reaches anterior border of an eye when hindlimb is stretched alongside of body; nuptial pad distinct; inner metatarsal tubercle oval (IMT/Toe4L 0.08 mm long), outer metatarsal tubercle absent; interorbital distance larger than eye horizontal diameter.

Color in life (Image 5)

Dorsal color light to dark brown, with no cross bars on the body; finger discs and toe discs light orange and greyish; dorsal surface of the hindlimb and forelimb with more or less dark crossbars; supratympanic fold black; iris light brown.

Advertisement calls: (Image 3; Table 3)

Fifteen advertisement calls were analyzed from three individuals having SVLs of 18.1, 21.6, and 23.4 mm. The calling position from the ground is observed to be 50–900 cm. The calling males were observed and recorded from trees and grasses near human settlements between 1745 h and 2100 h on 12 August 2023. The ambient air temperature was 28°C and the relative humidity was 99%.

The advertisement call had a mean duration of 0.24 ± 0.02 seconds, with a mean inter–call interval of 0.62 ± 0.09 seconds and an average call repetition rate of 4.17

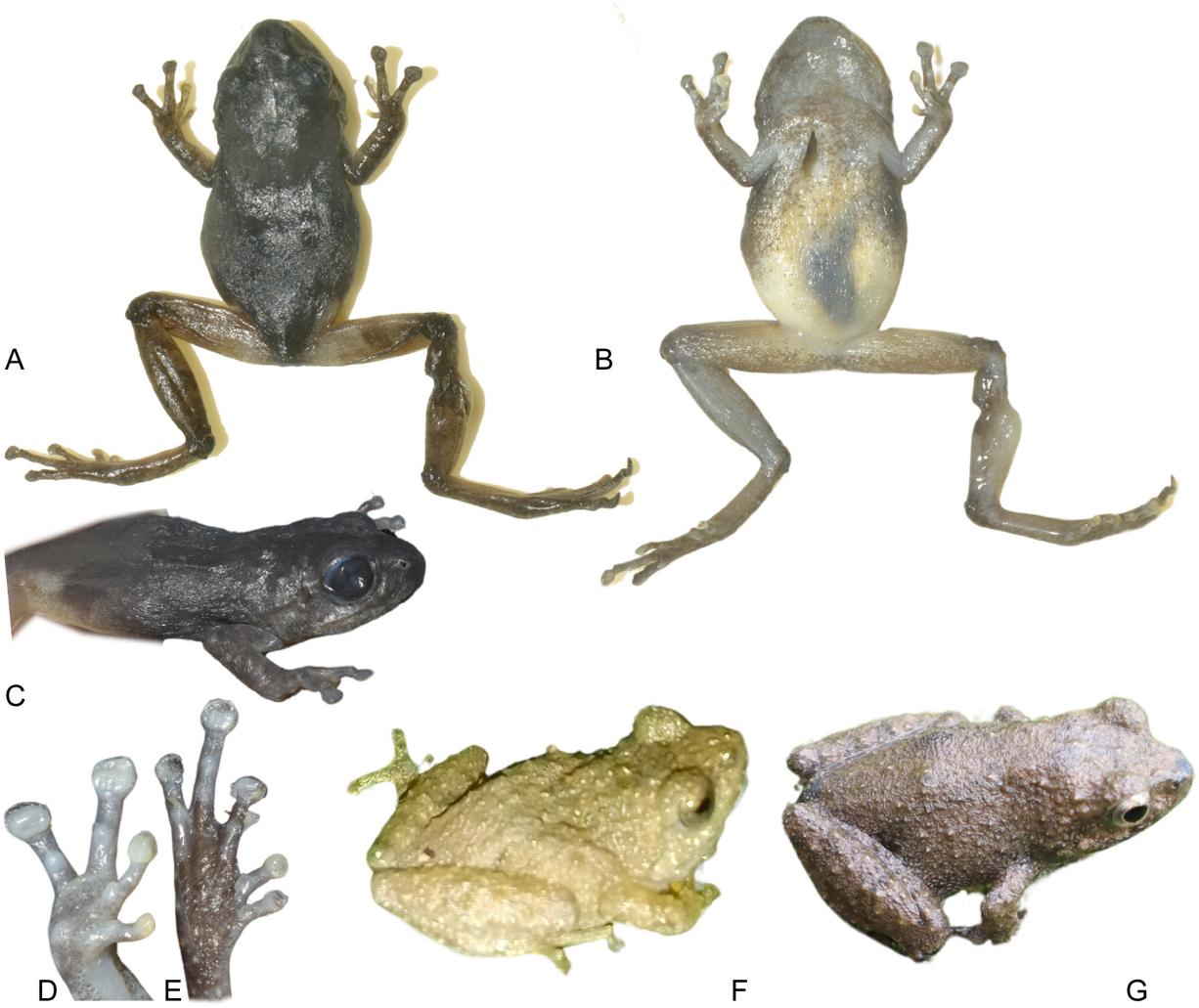

Image 5. *Raorchestes asakgrensis* from Meghalaya, India: A—Dorsal aspect | B—Ventral aspect | C—Lateral aspect | D—Manus | E—Pes | F&G—Live specimens. © Holiness Warjri.

± 0.40 calls per minute. Each call contained an average of 4.0 ± 0.0 notes, with a mean note duration of 0.02 ± 0.003 seconds and a mean inter-note interval of 0.03 ± 0.003 seconds. The call's mean dominant frequency was 3.39 ± 0.04 kHz, ranging 3.36–3.45 kHz, with a coefficient of variation of 0.

***Raorchestes jakoid* sp. nov.**

(Image 3 & 6; Table 1, 3 & 4)

urn:lsid:zoobank.org:act:3240A3E3-FF1C-428C-86D0-E6712B4645CC

Holotype

ADBUHW0143 adult male collected from Lawbah, East Khasi Hills, Meghalaya, India (25.247^0 N, 91.580^0 E, elevation 815 m) on 6 July 2024 at around 1800 h by Holiness Warjri and Rijessing Warjri.

Paratype

ADBUHW0144 an adult male, other data same as holotype.

Etymology

The specific epithet 'jakoid' is derived from the Khasi word for "frog" (jakoid), used by the indigenous Khasi people of Meghalaya, northeastern India. The name is treated as a noun in apposition. This nomenclature honours the rich linguistic and cultural heritage of the Khasi community, and emphasizes the importance of local traditional knowledge in the discovery, and conservation of biodiversity in the Khasi Hills.

Diagnostic characters

While the developmental mode of the newly described species, *Raorchestes jakoid* sp. nov., remains

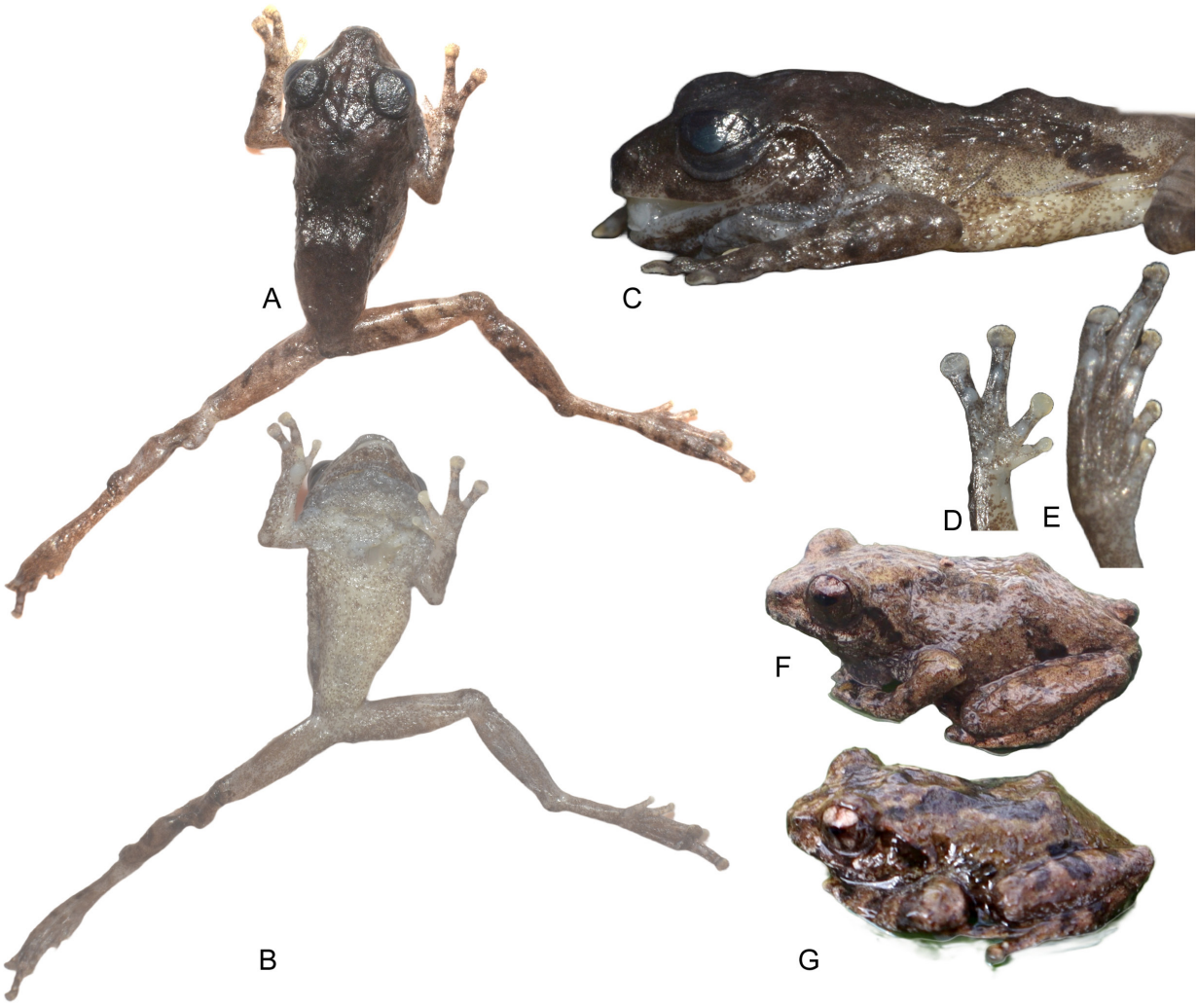

Image 6. *Raorchestes jakoid* sp. nov. from Meghalaya, India [Holotype (ADBUHW0143)]: A—Dorsal aspect | B—Ventral aspect | C—Lateral aspect | D—Manus | E—Pes | F&G—Live specimens. © Holiness Warjri.

uncertain, its placement within the genus *Raorchestes* is supported by the following combination of characteristics: small body size, vomerine teeth absent, male possesses transparent gular pouch which is visible when calling, and tips of all fingers & toes expanded into discs with circum-marginal grooves. The new species is distinguished from relevant congeners by phylogenetic position, by call analysis based on parameters like dominant frequency, call duration, inter-call interval, call repetition rate, number of note, note duration, and inter-note interval, and by the combination of the following morphological characteristics: small body size with SVL of 18.47–21.6 mm; head wider than long; tympanum indistinct, supratympanic fold distinct; tongue pyriform, and notched posteriorly; webbing between fingers absent; rudimentary webbing between toes present; relative finger lengths: I < II < IV < III, relative toe lengths: I < II < III < V < IV; inner palmar tubercle absent and outer palmar tubercle present with round shape; tibiotarsal articulation reaching posterior border of an eye when hindlimb is stretched alongside of body; nuptial pad distinctly whitish in colour; inner metatarsal tubercle oval (IMT/Toe4L 0.07 long), outer metatarsal tubercle absent; body surface slightly rough and has")(" shaped marking; interorbital distance larger than eye horizontal diameter; upper parts with very small warts.

Description of the holotype

(Measurement in mm, Table 1) ADBUHW0143 adult male. Body size is small (SVL 18.47). Head is wider than long (HW/HL 1.36); top of the head is relatively flat; snout is slightly rounded and longer than eye diameter

(SL/ED 1.34); tympanum indistinct; supratympanic fold distinct; canthus rostralis rounded; internarial distance smaller than interorbital distance (IOD/IND 1.03); nostril is positioned slightly closer to the tip of the snout than to the front corner of the eyes (EN/NS 1.17); tongue pyriform and notched posteriorly; vomerine teeth absent; eye diameter small (ED 1.79) and a large external single subgular vocal sac present.

Forelimbs robust; lower arm is longer than the upper arm (LAL/UAL 3.71). Relative finger lengths: I < II < IV < III; tips of all four fingers expanded into discs in which the disc size is I<II<IV<III; webbing between fingers absent; circum-marginal grooves present; outer metacarpal tubercle distinct and rounded; inner metacarpal tubercle indistinct; no webbing between fingers; small nuptial pad present on the dorsal side of the first finger, whitish.

Hindlimb long (23.5); tibia length is longer than foot length (TL/FL 1.14); relative toe lengths: I < II < III < V < IV; tips of toes with discs and smaller than finger discs; rudimentary webbing between toes present (I 1−1 II 1−2.5 III 2−3 IV 3−1 V); inner metatarsal tubercle oval; outer metatarsal tubercle absent; tibio-tarsal articulation reaching the posterior border of an eye when hindlimb is stretched alongside body.

Dorsum is rough with small warts while the ventral regions are granular, the dorsal surface of the head, forelimb, and hindlimb are covered with very small granules. On the ventral side of digits rounded subarticular tubercles having different sizes are present. Relative size of 0.15 (third subarticular tubercles of Fin 3/Fin 3L) is recorded. Surfaces of hands and toes are granular.

Color in life (Image 6)

Dorsal colour light brown, with a black ")(" shaped marking; finger discs and toe discs light orange and greyish; dorsal surface of the hindlimb and forelimb with more or less dark crossbars; supratympanic fold black; iris light brown. The groin is dark and has less visible bands on the upper part of the thigh.

Advertisement calls (Image 3, Table 3)

The calls of two individuals having SVL of 18.5 and 21.6 mm were observed and recorded from small bushes at 1820−2040 h on 6 July 2024. The calling position from the ground is observed to be 100−350 cm. The ambient air temperature was 27°C and the relative humidity was 89%.

The advertisement call had a mean duration of 1.37 ± 0.93 seconds, with a mean inter-call interval of 1.17 ± 0.19 seconds, and an average call repetition rate of 1.07 ± 0.64 calls per minute. Each call contained an average of 17.0 ± 13.31 notes, with the mean note duration being 0.03 ± 0.003 seconds and the mean inter−note interval at 0.04 ± 0.005 seconds. The call's mean dominant frequency was 3.19 ± 0.0 kHz, with a coefficient of variation of 0.

Comparison (see Table 4)

Raorchestes jakoid sp. nov. differs from *R. andersoni* (Ahl, 1927) by 1) tympanum indistinct vs. tympanum distinct in *R. andersoni*; 2) rudimentary webbing between the toes vs. feebly webbed in *R. andersoni*; 3) inner palmar tubercle absent vs. present in *R. andersoni*; 4) outer palmar tubercle present vs. absent in *R. andersoni.*

Raorchestes jakoid sp. nov. differs from *R. annandalii* (Boulenger, 1906) by 1) tympanum indistinct vs. tympanum just distinguishable in *R. annandalii*; 2) rudimentary webbing between the toes vs. webbed at the base of the toe in *R. annandalii*; 3) tibiotarsal articulation reaches the posterior border of the eye vs. the eye in *R. annandalii*; 4) dorsum with small warts vs. smooth in *R. annandalii*; 5) inner palmar tubercle absent vs. present *R. annandalii*; 6) outer palmar tubercle present vs. absent *R. annandalii.*

Raorchestes jakoid sp. nov. differs from *R. dulongensis* Wu, Liu, Gao, Wang, Li, Zhou, Yuan & Che 2021 by 1) SVL of 18.47−21.6 mm vs. 15.0−19.0 mm in *R. dulongensis*; 2) tympanum indistinct vs. tympanum distinct in *R. dulongensis*; 3) nuptial pad present vs. absent in *R. dulongensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. dulongensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. dulongensis*; 6) inner palmar tubercle absent vs. present in *R. dulongensis.*

Raorchestes jakoid sp. nov. differs from *R. hekouensis* Du, Xu, Liu & Yu, 2024 by 1) SVL of 18.47−21.6 mm vs. 16.1–17.5 mm in *R. hekouensis*; 2) tympanum indistinct vs. distinct in *R. hekouensis*; 3) inner palmar tubercle absent vs. present in *R. hekouensis*; 4) outer palmar tubercle present vs. absent in *R. hekouensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. hekouensis.*

Raorchestes jakoid sp. nov. differs from *R. hillisi* Jiang Ren, Guo, Wang & Li 2020 by 1) SVL of 18.47−21.6 mm vs. 15.9−17.7 mm in *R. hillisi*; 2) tympanum indistinct vs. tympanum distinct in *R. hillisi*; 2) webbing formula of I 1−1 II 1−2.5 III 2−3 IV 3−1 V vs. I 1−1 II 1−2.5 III 1−2.5 IV 2.5−1 V of *R. hillisi*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the eye in *R. hillisi*; 4) outer palmar present vs. absent in *R. hillisi.*

Raorchestes jakoid sp. nov. differs from *R. huanglianshan* Jiang, Wang, Ren, and Li 2020 by 1) SVL of

18.47–21.6 mm vs. 17.0–19.6 mm in *R. huanglianshan*; 2) tympanum indistinct vs. distinct in *R. huanglianshan*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the eye in *R. huanglianshan*; 4) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 1–1 II 1–2 III 1–2 IV 2–1 V of *R. huanglianshan*.

Raorchestes jakoid sp. nov. differs from *R. longchuanensis* Yang & Li 1978 by 1) SVL of 18.47–21.6 mm vs. 21.4–23.9 mm in *R. longchuanensis*; 2) tympanum indistinct vs. tympanum distinct in *R. longchuanensis*; 3) inner palmar tubercle absent vs. present in *R. longchuanensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<III ≈ V<IV in *R. longchuanensis.*

Raorchestes jakoid sp. nov. differs from *R. malipoensis* Huang, Liu, Du, Bernstein, Liu, Yang, Yu & Wu 2023 by 1) SVL of 18.47–21.6 mm vs. 14.6–17.7mm in *R. malipoensis*; 2) tympanum indistinct vs. distinct and small in *R. malipoensis*; 3) outer palmar tubercle present vs. absent in *R. malipoensis*; 4) inner metatarsal tubercle oval vs. round in *R. malipoensis*; 5) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. malipoensis*; 6) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. malipoensis*; 7) nuptial pad present vs. absent in *R. malipoensis*; 8) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 2–2 II 2–2 III 2–3 IV 3–2 V of *R. malipoensis*.

Raorchestes jakoid sp. nov. differs from *R. meglaensis* (Kou, 1990) by 1) SVL of 18.47–21.6 mm vs. 16.6–21.6 mm in *R. meglaensis*; 2) inner palmar tubercle absent vs. present in *R. meglaensis*; 3) outer metatarsal tubercle absent vs. present in *R. meglaensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. meglaensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. meglaensis*; 6) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 1–1 II 1–2 III 1–2.5 IV 2.5–1 V of *R. meglaensis.*

Raorchestes jakoid sp. nov. differs from *R. parvulus* (Boulenger, 1893) by 1) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 2–2 II 1.5–3.25 III 2–3.5 IV 3.25–2 V of *R. parvulus*; 2) inner metatarsal tubercle oval vs. small in *R. parvulus*; 3) nuptial pad present vs. absent in *R. parvulus*; 5) inner palmar tubercle absent vs. present in *R. parvulus.*

Raorchestes jakoid sp. nov. differs from *R. rezakhani* Al-Razi, Maria & Muzaffar, 2020 by 1) SVL of 18.47–21.6 mm vs. 18.85–20.90 mm in *R. rezakhani*; 2) supratympanic fold distinct vs. weakly distinct in *R. rezakhani*; 3) nuptial pad present vs. absent in *R. rezakhani*; 4) outer palmar tubercle present vs. absent in *R. rezakhani*; 5) inner metatarsal tubercle present vs. absent in *R. rezakhani*; 5) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. rezakhani*; 6) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 2–2 II 1.75–2 III 1.5–3 IV 2.75–2 V of *R. rezakhani*.

Raorchestes jakoid sp. nov. differs from *R. yadongensis* Zhang, Shu, Liu, Dong & Guo 2022 by 1) SVL of 18.47–21.6 mm vs. 17.8–24.1 mm in *R. yadongensis*; 2) tympanum indistinct vs. distinct in *R. yadongensis*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the snout in *R. yadongensis.*

Raorchestes jakoid sp. nov. differs from *R. mindat* Köhler, Dost, Than, Ohler, Thammachoti Charunrochana, Chuaynkern, Chuaynkern, and Geiss, 2025 by 1) SVL of 18.47–21.6 mm vs. 16.75–18.36 mm in *R. mindat*; 2) inner palmar tubercle absent vs. present in *R. mindat*; 3) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. II 2–3.5 III 2+–3.5 IV 3.25–2 V of *R. mindat.*

Raorchestes jakoid sp. nov. differs from *R. leiktho* Köhler, Dost, Than, Ohler, Thammachoti Charunrochana, Chuaynkern, Chuaynkern, and Geiss, 2025 by 1) SVL of 18.47–21.6 mm vs. 15.72–15.80 mm in *R. leiktho*; 2) supratympanic fold distinct vs. indistinct in *R. leiktho*; 3) inner palmar tubercle absent vs. present in *R. leiktho*; 4) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. III 2–3.5 IV 3.33–2 V of *R. leiktho.*

Furthermore, the new species differs from members of *R. parvulus* species complex, and other bush frogs of Meghalaya as follows:

Raorchestes jakoid sp. nov. differs from *R. garo* by 1) tympanum indistinct vs. tympanum distinct in *R. garo*; 2) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 1–1 II 1–1 III 3–3 IV 3–2.5 V of *R. garo*; 3) dorsum with small warts vs. smooth in *R. garo.*

Raorchestes jakoid sp. nov. differs from *R. kempiae* by 1) SVL of 18.47–21.6 mm vs. 22.96–24.4 mm in *R. kempiae*; 2) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 1–2 II 2–1 III 1.1–3.5 IV 3–2 V in *R. kempiae*.

Raorchestes jakoid sp. nov. differs from *R. shillongensis* (Pillai and Chanda, 1973) by 1) SVL of 18.47–21.6 mm vs. SVL of 10–20 mm of *R. shillongensis*; 2) inner metatarsal tubercle present and oval vs. indistinct in *R. shillongensis*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the tympanic region *R*. shillongensis.

Raorchestes jakoid sp. nov. differs from *R. asakgrensis* by 1) SVL of 18.47–21.6 mm vs. SVL of 18.0–23.35 mm of R. *asakgrensis*; 2) tympanum indistinct vs. distinct in *R. asakgrensis*; 3) webbing formula of I 1–1 II 1–2.5 III 2–3 IV 3–1 V vs. I 1–2 II 2–2 III 2–3.5 IV 3.33–2 V in *R. asakgrensis*

***Raorchestes jadoh* sp. nov.**

(Image 3 & 7; Table 1, 3 & 4)

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Holotype

ADBUHW0124 adult male collected from Langtor, eastern West Khasi Hills, Meghalaya, India (25.533° N, 91.586° E, elevation 1655 m) on 10 May 2024 at around 19:00 h by Holiness Warjri and Rijessing Warjri.

Paratype

ADBUHW0123 an adult male, other data same as holotype.

Etymology

The specific epithet 'jadoh' is derived from the name of a traditional rice and meat dish that is integral to the cuisine and cultural identity of the Khasi people of Meghalaya, northeastern India. The name is used here as a noun in apposition. This naming celebrates Khasi heritage and underscores the connection between local biodiversity and indigenous cultural practices.

Diagnostic characters

While the developmental mode of the newly described species, *Raorchestes jadoh* sp. nov., remains uncertain, its placement within the genus *Raorchestes* is supported by the following combination of characteristics: small body size, vomerine teeth absent, male possess transparent gular pouch which is visible when calling, and tips of all fingers and toes expanded into discs with circum-marginal grooves. The new species is distinguished from relevant congeners by phylogenetic position, by call analysis based on

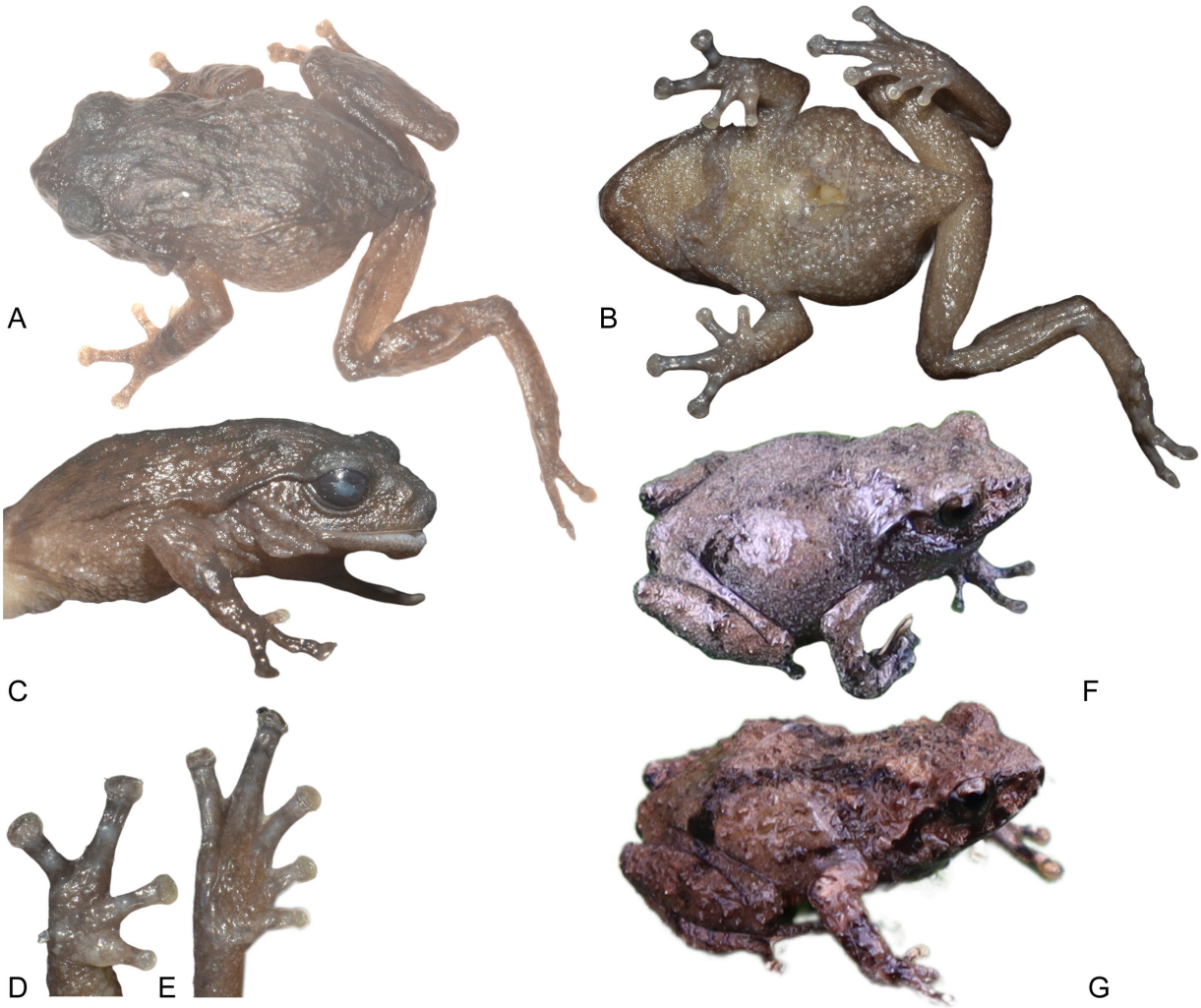

Image 7. *Raorchestes jadoh* sp. nov. from Meghalaya, India [Holotype (ADBUHW0124)]: A—Dorsal aspect | B—Ventral aspect | C—Lateral aspect | D—Manus | E—Pes | F&G—Live specimens. © Holiness Warjri.

the parameters dominant frequency, call duration, inter-call interval, call repetition rate, number of note, note duration, and inter-note interval, and by the combination of the following morphological characters: very small body size with SVL of 13.68–14.01 mm; head wider than long; tympanum indistinct, supratympanic fold distinct; tongue pyriform and notched posteriorly, webbing between fingers absent; rudimentary webbing between toes present; relative finger lengths: I < II < IV < III, relative toe lengths: I < II < III < V < IV; inner palmar tubercle absent and outer palmar tubercle present with round shape; tibiotarsal articulation reaching posterior border of an eye when hindlimb is stretched alongside of body; nuptial pad present; inner metatarsal tubercle round (IMT/Toe4L 0.08 mm long), outer metatarsal tubercle absent; interorbital distance larger than eye horizontal diameter; upper part with small warts and six fairly distinct warts on the body towards the posterior of the eyes.

Description of the holotype (Measurements in mm, Table 1)

ADBUHW0124 adult male. Body size is very small (SVL 13.68). ADBUHW0124 Head is wider than long (HW/HL 1.39); top of the head is relatively flat; snout is slightly rounded; snout is longer than eye diameter (SL/ED 1.70); tympanum indistinct; supratympanic fold distinct; canthus rostralis rounded; internarial distance smaller than interorbital distance (IOD/IND 1.14); nostril is positioned slightly closer to the tip of the snout than to the front corner of the eyes (EN/NS 1.90); tongue pyriform and notched posteriorly; vomerine teeth absent; eye diameter small (ED 1.69) and a large external single subgular vocal sac present.

Forelimbs robust; lower arm is longer than the upper arm (LAL/UAL 1.74). Relative finger lengths: I < II < IV < III; tips of all four fingers expanded into discs in which the disc size is I<II<IV<III; webbing between fingers absent; circum–marginal grooves present; outer metacarpal tubercle distinct and rounded; inner metacarpal tubercle indistinct; no webbing between fingers; small nuptial pad present on the dorsal side of the first finger, whitish.

Hindlimb long (19.02); tibia length is longer than foot length (TL/FL 1.18); relative toe lengths: I < II < III < V < IV; tips of toes with discs, smaller than finger discs; rudimentary webbing between toes present (I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V); inner metatarsal tubercle round; outer metatarsal tubercle absent; tibiotarsal articulation reaching the posterior border of an eye when hindlimb is stretched alongside body.

Dorsum has small warts and six fairly distinct warts on the body towards the posterior of the eyes. At the same time, the ventral regions are granular the dorsal surface of the head, forelimb, and hindlimb are covered with very small granules; under the digits rounded subarticular tubercles having different sizes are present. Relative size of 0.10 (Third subarticular tubercles of Fin 3/Fin 3L) is recorded; surfaces of palm and sole are granular.

Color in life (Image 7)

Dorsal color light brown, with a black ")(" shaped marking; finger discs and toe discs light orange and greyish; dorsal surface of the hindlimb and forelimb with more or less dark crossbars; supratympanic fold black; iris light brown. The groin is dark and the rear part of the thigh has dark bands.

Advertisement calls: (Image 3; Table 3)

10 advertisement calls were analysed from two individuals having SVL of 13.7 and 14.0 mm. The calling males were observed and recorded from trees & bushes at 1800–2100 h on 17 July 2024. The calling position from the ground is observed to be 20–150 cm. The ambient air temperature at the time of recording was 24°C, with a relative humidity of 89%.

The advertisement call exhibited a mean duration of 0.93 ± 0.22 seconds, with a mean inter-call interval of 6.17 ± 0.54 seconds and an average call repetition rate of 1.12 ± 0.27 calls per minute. Each call contained an average of 3.5 ± 0.58 notes, with the mean note duration being 0.02 ± 0.003 seconds and the mean inter–note interval of 0.30 ± 0.01 seconds. The mean dominant frequency of the call was 3.66 ± 1.32 kHz, ranging 3.56–3.84 kHz, with a coefficient of variation of 3.63.

Comparison: (see Table 4)

Raorchestes jadoh sp. nov. differs from *R. andersoni* by 1) tympanum indistinct vs. tympanum distinct in *R. andersoni*; 2) rudimentary webbing between the toes vs. feebly webbed in *R. andersoni*; 3) inner palmar tubercle absent vs. present in *R. andersoni*; 6) outer palmar tubercle present vs. absent in *R. andersoni.*

Raorchestes jadoh sp. nov. differs from *R. annandalii* by 1) tympanum indistinct vs. tympanum just distinguishable in *R. annandalii*; 2) rudimentary webbing between the toes vs. webbed at the base of the toe in *R. annandalii*; 3) tibio-tarsal articulation reaches the posterior border of the eye vs. the eye in *R. annandalii*; 4) dorsum with small warts vs. smooth in *R. annandalii*; 5) inner palmar tubercle absent vs. present in *R. annandalii*; 6) outer palmar tubercle present vs. absent

in *R. annandalii.*

Raorchestes jadoh sp. nov. differs from *R. dulongensis* by 1) SVL of 13.68–14.01 mm vs. 15.0–19.0 mm in *R. dulongensis*; 2) tympanum indistinct vs. tympanum distinct in *R. dulongensis*; 3) nuptial pad present vs. absent in *R. dulongensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. dulongensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. dulongensis*; 6) inner palmar tubercle absent vs. present in in *R. dulongensis.*

Raorchestes jadoh sp. nov. differs from *R. hekouensis* by 1) SVL of 13.68–14.01 mm vs. 16.1–17.5 mm in *R. hekouensis*; 2) tympanum indistinct vs. distinct in *R. hekouensis*; 3) inner palmar absent vs. present in *R. hekouensis*; 4) outer palmar tubercle present vs. absent in *R. hekouensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. hekouensis*

Raorchestes jadoh sp. nov. differs from *R. hillisi* by 1) SVL of 13.68–14.01 mm vs. 15.9–17.7 mm in *R. hillisi*; 2) tympanum indistinct vs. tympanum distinct in *R. hillisi*; 2) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 1–2 II 1–2.5 III 1–2.5 IV 2.5–1 V of *R. hillisi*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the eye in *R. hillisi*; 4) outer metacarpal present vs. absent in *R. hillisi.*

Raorchestes jadoh sp. nov. differs from *R. huanglianshan* by 1) SVL of 13.68–14.01 mm vs. 17.0–19.6 mm in *R. huanglianshan*; 2) tympanum indistinct vs. distinct in *R. huanglianshan*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the eye in *R. huanglianshan*; 4) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 1–1 II 1–2 III 1–2 IV 2–1 V of *R. huanglianshan*.

Raorchestes jadoh sp. nov. differs from *R. longchuanensis* by 1) SVL of 13.68–14.01 mm vs. 21.4–23.9 mm in *R. longchuanensis*; 2) tympanum indistinct vs. tympanum distinct in *R. longchuanensis*; 3) inner palmar tubercle absent vs. present in *R. longchuanensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<III ≈ V<IV in *R. longchuanensis.*

Raorchestes jadoh sp. nov. differs from *R. malipoensis* by 1) SVL of 13.68–14.01 mm vs. 14.6–17.7mm in *R. malipoensis*; 2) tympanum indistinct vs. distinctively small in *R. malipoensis*; 3) outer palmar tubercle present vs. absent in *R. malipoensis*; 4) inner metatarsal tubercle round vs. round in *R. malipoensis*; 5) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. malipoensis*; 6) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. malipoensis*; *7)* nuptial pad present vs. absent in *R. malipoensis*; 8) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 2–2 II 2–2 III 2–3 IV 3–2 V of *R. malipoensis.*

Raorchestes jadoh sp. nov. differs from *R. meglaensis* by 1) SVL of 13.68–14.01 mm vs. 16.6–21.6 mm in *R. meglaensis*; 2) inner palmar tubercle absent vs. present in *R. meglaensis*; 3) outer metatarsal tubercle absent vs. present in *R. meglaensis*; 4) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. meglaensis*; 5) tibiotarsal articulation reaches posterior border of the eye vs. anterior of the eye in *R. meglaensis*; 6) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 1–2 II 1–2 III 1–2.5 IV 2.5–1 V of *R. meglaensis.*

Raorchestes jadoh sp. nov. differs from *R. parvulus* by 1) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 2–2 II 1.5–3.25 III 2–3.5 IV 3.25–2 V of *R. parvulus*; 2) inner metatarsal tubercle round vs. small in *R. parvulus*; 3) nuptial pad present vs. absent in *R. parvulus*; 5) inner palmar tubercle absent vs. present in *R. parvulus.*

Raorchestes jadoh sp. nov. differs from *R. rezakhani* by 1) SVL of 13.68–14.01 mm vs. 18.85–20.90 mm in *R. rezakhani*; 2) supratympanic fold distinct vs. weakly distinct in *R. rezakhani*; 3) nuptial pad present vs. absent in *R. rezakhani*; 4) outer palmar tubercle present vs. absent in *R. rezakhani*; 5) inner metatarsal tubercle present vs. absent in *R. rezakhani*; 5) relative toe length, I<II<III<V<IV vs. I<II<V<III<IV in *R. rezakhani*.

Raorchestes jadoh sp. nov. differs from *R. yadongensis* by 1) SVL of 13.68–14.01 mm vs. 17.8–24.1 mm in *R. yadongensis*; 2) tympanum indistinct vs. distinct in *R. yadongensis*; 3) tibiotarsal articulation reaches posterior border of the eye vs. the snout in *R. yadongensis.*

Raorchestes jadoh sp. nov. differs from *R. mindat* by 1) SVL of 13.68–14.01 mm vs. 16.75–18.36 mm in *R. mindat*; 2) inner palmar tubercle absent vs. present in *R. mindat*; 3) inner metatarsal tubercle oval vs. rounded in *R. mindat*; 4) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. II 2–3.5 III 2+–3.5 IV 3.25–2 V of *R. mindat.*

Raorchestes jadoh sp. nov. differs from *R. leiktho* by 1) SVL of 13.68–14.01 mm vs. 15.72–15.80 mm in *R. leiktho*; 2) supratympanic fold distinct vs. indistinct in *R. leiktho*; 3) inner palmar tubercle absent vs. present in *R. leiktho*; 4) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. III 2–3.5 IV 3.33–2 V of *R. leiktho.*

Furthermore, the new species differs from members of *R. parvulus* species complex and other bush frogs of Meghalaya as follows

Raorchestes jadoh sp. nov. differs from *R. garo* by 1) tympanum indistinct vs. tympanum distinct or hidden in *R. garo*; 2) inner metatarsal present vs. indistinct in *R. garo*; 3) webbing formula of I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V vs. I 1–1 II 1–1 III 3–3 IV 3–2.5 V in *R. garo*; 3) tibiotarsal

articulation reaches the posterior border of the eye vs. the anterior of the eye to the snout in *R. garo*; 4) dorsum with small warts vs. smooth in *R. garo.*

Raorchestes jadoh sp. nov. differs from *R. kempiae* by 1) tibiotarsal articulation which reaches the posterior border of the eyes vs. the eye to the snout in *R. kempiae*; 2) webbing formula of I 1−1 II 1−1.5 III 1−3.5 IV 3−1 V vs. I 1−2 II 2−1 III 1−3.5 IV 3−2 V in *R. kempiae*

Raorchestes jadoh sp. nov. differs from *R. shillongensis* by 1) SVL of 13.68−14.01 mm vs. SVL of 10−20 mm of *R. shillongensis*; 2) Inner metatarsal tubercle present and round vs. indistinct in *R. shillongensis*; 3) rudimentary webbing between the toe vs. indistinct rudimentary webbing present between the fourth and fifth toe in *R. shillongensis*; 4) tibiotarsal articulation reaches posterior border of the eye vs. the tympanic region *R. shillongensis.*

Raorchestes jadoh sp. nov. differs from *R. asakgrensis* by 1) SVL of 13.68−14.01 mm vs. SVL of 18.0–23.35 mm of *R. asakgrensis*; 2) tympanum indistinct vs. distinct in *R. asakgrensis*; 3) webbing formula of I 1−1 II 1−1.5 III 1−3.5 IV 3−1 V vs. I 1−2 II 2−2 III 2−3.5 IV 3.33−2 V in *R. asakgrensis*.

Raorchestes jadoh sp. nov. differs from *Raorchestes jakoid* sp. nov. by 1) SVL of 13.68−14.01 mm vs. 18.47–21.6 mm of *R. jakoid*; 2) inner metatarsal tubercle round vs. oval of *R. jakoid*; 3) upper part with small warts and six fairly distinct warts on the body towards the posterior of the eyes vs. small warts randomly distributed in *R. jakoid*; 4) webbing formula of I 1−1 II 1−1.5 III 1−3.5 IV 3−1 V vs. I 1−1 II 1−2.5 III 2−3 IV 3−1 V in *R. jakoid*; 5) call duration of 0.93 ± 0.22 seconds vs. 1.37 ± 0.93 seconds of *R. jakoid*; 6) a mean inter−call interval of 6.17 ± 0.54 seconds vs. 1.17 ± 0.19 seconds of *R. jakoid*; 7) an average call repetition rate of 1.12 ± 0.27 vs. 1.07 ± 0.64 calls per minute of *R. jakoid*; 8) 3.5 ± 0.58 notes vs. 17.0 ± 13.31 notes of *R. jakoid*; 9) note duration 0.02 ± 0.003 seconds vs. 0.03 ± 0.003 seconds of *R. jakoid*; 10) inter note interval of 0.30 ± 0.01 seconds vs. 0.04 ± 0.005 seconds of *R. jakoid*; 11) dominant frequency of 3.66 ± 1.32 kHz vs. 3.19 ± 0.0 kHz of *R. jakoid*; 12) coefficient of variation 3.63 vs. 0 of *R. jakoid.*

DISCUSSION

Prior to this study, the bush frog diversity in Meghalaya was represented by only five species: *R. kempiae*, *R. garo*, *R. annandalii*, *R. shillongensis,* and *R. asakrensis* (Frost 2025). The discovery of two new species from the *R. parvulus* species complex significantly expands the known diversity of bush frogs in this region, highlighting Meghalaya as a hotspot for amphibian speciation. These findings underscore the critical role that northeastern India plays in amphibian biodiversity within the Indo-Burma region, an area known for its complex biogeography and high endemism (Myers et al. 2000).

In this study, in addition to the new species, an additional description for *Raorchestes kempiae, Raorchestes garo*, and *Raorchestes asakgrensis* was given. In *R. kempiae*, the tibiotarsal articulation reaches the eye when the hindlimb is stretched alongside the body, whereas Boulenger (1919) previously described it as reaching the anterior border of the eye. In *R. garo*, tympanum visibility varies. While Boulenger (1919) and Naveen et al. (2024) reported a small and fairly distinct tympanum, the specimens examined in this study exhibit an indistinct tympanum. Additionally, the tibiotarsal articulation extends to the posterior border of the eye when the hindlimb is stretched alongside the body, differing from Boulenger's (1919) observation that it reaches the anterior border of the eye. Similarly, in *R. asakgrensis*, Naveen et al. (2024) documented a fairly visible tympanum, whereas the specimens analyzed in this study exhibit an indistinct tympanum. These variations in morphological characteristics contribute to a deeper understanding of intraspecific variation and potential taxonomic divergence within the genus *Raorchestes*. A recent study on *Raorchestes* of this region also revealed taxonomic inflation as two nominal taxa *Philautus namdaphaensis* and *P. manipurensis* were synonymised under *R. kempiae*, highlighting at the importance of redefining earlier-existing nominal taxa, as a prerequisite to identify new taxa (Naveen et al. 2025).

The distribution of the *Raorchestes* species across a wide range of altitudes, from 200 m (*R. asakgrensis*) to 1800 m (*R. jadoh* sp. nov.), provides valuable insights into habitat specialization and elevational partitioning within the genus. Most species diversity was concentrated between an elevation of 1,000 m and 1,600 m, a pattern observed in other amphibian taxa, where mid-elevation zones provide optimal microhabitats for species diversification (Rahbek 1995; Wu et al. 2021). This concentration of diversity at intermediate elevations is likely driven by the interaction of favourable temperature, humidity, and vegetation cover, which create stable environmental conditions necessary for the persistence of species with specific ecological requirements.

Interestingly, all new species were found in disturbed or secondary habitats near human settlements,

Table 3. Acoustic data of studied species of *Raorchestes* from Meghalaya. India.

Species	Calling position from the ground (cm)	Call Properties						
		Call Duration (s) ±SD (min–max) CV	Inter-call interval (s) ±SD (min–max) CV	Number of notes per call ±SD (min–max) CV	Note duration(s) ±SD (min–max) CV	Call Repetition Rate(calls/min) ±SD (min–max) CV	Inter-note interval(s) ±SD (min–max) CV	Dominant Frequency(kHz)±SD (min–max) CV
Raorchestes garo	50–500	0.03±0.005 (0.02–0.04) 18.2	2.26±0.18 (1.86–2.49) 7.8	1.0±0.0 (1.0–1.0) 0	0.03±0.005 (0.02–0.04) 18.2	35.28±6.15 (25.32–45.66) 17.4	2.26±0.18 (1.86–2.49) 7.8	2.93±0.04 (2.91–3) 1.35
Raorchestes asakgrensis	50–900	0.24±0.02 (0.21–0.28) 10.0	0.62±0.09 (0.5–0.8) 15.3	4.0±0.0 (4.0–4.0) 0	0.02±0.003 (0.02–0.03) 16.7	4.17±0.40 (3.6–4.9) 9.60	0.03±0.003 (0.03–0.04) 10.3	3.39±0.04(3.36–3.45) 0
Raorchestes kempiae	20–400	0.37±0.05 (0.30–0.43) 12.4	1.32±0.11 (1.16–1.46) 8.5	2.0±0.0 (2.0–2.0) 0	0.12±0.008 (0.11–0.13) 6.9	2.73±0.33 (2.32–3.31) 12.3	0.06±0.007 (0.04–0.07) 11.8	2.73±0.03(2.72–2.81) 1.09
Raorchestes jakoid **sp. nov.**	100–350	1.37±0.93 (0.55–2.81) 68.0	1.17±0.19 (0.94–1.51) 15.8	17.0±3.31 (5.0–35.0) 78.3	0.03±0.003 (0.02–0.03) 10.6	1.07±0.64 (0.36–1.81) 59.5	0.04±0.005 (0.03–0.04) 12.4	3.19±0.0
Raorchestes jadoh **sp. nov.**	20–150	0.93±0.22 (0.74–1.13) 23.6	6.17±0.54 (5.36–6.49) 8.8	3.5±0.58 (3.0–4.0) 16.5	0.02±0.003 (0.02–0.03) 12.9	1.12±0.27 (0.89–1.35) 23.6	0.30±0.01 (0.29–0.31) 13.3	3.66±1.32(3.56–3.84) 3.63

suggesting a degree of ecological tolerance. However, this apparent adaptability should not be interpreted as resilience to environmental changes, particularly in a region where habitat degradation from deforestation and agricultural expansion is accelerating. The persistence of these species in human-modified landscapes raises concerns about their long-term survival, given the growing anthropogenic pressures on Meghalaya's forests, wherein over the last 15 years there has been a 6% loss of forest cover in the West Khasi Hills District (Lyngdoh & Lyngdoh 2023).

The broad distribution of *R. asakgrensis* across disparate localities, including localities such as Tura and Lailad, Nongkhyllem, suggests that this species has a wider ecological niche than its congeners. This is in contrast to the more restricted ranges of the other species described in this study, which were confined to higher elevations. The aerial distance between populations of *R. asakgrensis* (approximately 170 km) may indicate either high dispersal ability or the existence of suitable but underexplored habitats between these regions, such as the Garbhanga Reserve Forest and adjacent areas of Assam. Similar patterns of species dispersal across fragmented landscapes have been reported in other *Raorchestes* species complexes, where geographic isolation and habitat fragmentation contribute to both speciation and range limitation (Vijayakumar et al. 2014; Wu et al. 2019).

The onset of calling activity for all species during the late dry season and the early monsoon (April–August) reflects a reproductive strategy synchronized with the arrival of rainfall, a pattern consistent with other *Raorchestes* species across their range (Biju et al. 2010; Vijayakumar et al. 2016). The behaviour of calling males, typically occupying small shrubs and bushes between 1–3 m in height, is a well-documented trait in the genus. The calls of *R. asakgrensis* were notably recorded at higher canopies (up to 9 m), particularly in Lailad, Nongkhyllem. This canopy-calling behaviour may represent a unique adaptation to its low-elevation, forested habitat, distinguishing it from its higher-elevation congeners.

Meghalaya is home to around 70 species of amphibians (including the present finding) of which around 20 (29%) species were discovered or recorded in the current millennium (since the year 2000), highlighting the importance of the study of amphibians in the landscape of Meghalaya in specific and northeastern India in general. Describing new taxa not only highlights diversity but also helps update conservation criteria. An example of the high rate of cryptic diversity is

Table 4. A comparative table of member species of *Raorchestes parvulus* species group and species of bush frogs found in northeastern India.

Character	*R. dulongensis*	*R. meglaensis*	*R. longchuanensis*	*R. parvulus*	*R. malipoensis*	*R. rezakhani*	*R. hillisi*	*R. huanglianshan*	*R. shillongensis*	*R. annandali*	*R. andersoni*	*R. garo*
SVL of male (mm)	15.0–19.0	16.6–21.6	21.4–23.9	NA	14.6-17.7	18.85–20.90	15.9–17.7	17.0–19.6	10–20	16.0	24.0	22.47–23.8
Tympanum	Distinct	Indistinct	Distinct	Hidden	Distinct	Indistinct	Distinct	Distinct	Indistinct	Just distinguish-able	Distinct	Distinct or hidden
Supratympanic fold	Distinct	NA	NA	NA	Distinct	Weakly distinct	Distinct	Distinct	Distinct	NA	NA	Distinct
Nuptial pad	Absent	Present, white	Present	Absent	Present	Absent	Present	Present	NA	NA	NA	Present
Inner palmer tubercle	Present	Present	Present	Present	Absent	Absent	Indistinct	NA	NA	Present	Present	Absent
Outer palmar tubercle	Present	Present	Present	Present	Absent	Absent	Indistinct	NA	NA	Absent	Absent	Present
Inner metatarsal tubercle	Present	Present	Present	Present	Present, round	Absent	Present, Oval		Absent	Absent	Present	Present
Outer metatarsal tubercle	Absent	Present	Absent	Absent	Absent	Absent	Absent	NA	Absent	Absent	Absent	Absent
Toe web	Rudimentary webbing between toes	Toes are partially webbed (II 1 – 2 III 1 – 21/2 IV 21/2 – 1 V)	Toes are partially webbed	Webbed at the base	Rudimentary (I 2 – 2 II 2 – 2 III 2 – 3 IV 3 – 2 V)	Moderate webbing (I2 – 2 II 1¾ – 2 III 1½ – 3 IV 2¾ – 2 V)	No web between toe I and toe II, web rudimen-tary between other toes (II 1 – 2 III 1–21/2 IV 21/2 – 1 V)	Rudimentary web on toes (II 1 – 2 III 1 – 2 – IV 2 – 1 V)	Indistinct rudiment of web present between the fourth and fifth toe	Webbed at the base	Feebly webbed	Webbed at the base (I 1–1 II 1–1 III 3–3 IV 3–2.5 V)
Relative toe length	I < II < V < III < IV	I<II<III ≈ V<IV, or I<II<III<V<IV	I<II<III ≈ V<IV	I<II< III <V<IV	I<II<V<III<IV	I < II < V < III < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III = V < IV	I < II < III < V < IV
Tibiotarsal articulation	Reaches anterior of the eye.	NA	NA	Reaches posterior border of the eye.	Reaches anterior border of the eye.	NA	Reaches the eye	Reaches the eye	Reaches the tympanic region	Reaches the eye	Reaches the eye	Reaches the posterior and above the eye
Dorsal surface	Distinct “) (”-shaped dark marking	Rough with small warts, dark butterfly-shaped spot on the back	Scattered small warts and "X" shaped markings	Curved dark band on each side of the back	X-shaped marking on the dorsal surface	“)-(“ or “) (“ shaped blackish mark on the dorsal surface	An indistinct “) (” shaped dark brown blotch on fore part of back.	An indistinct “X” shaped brown blotch on back.	"V" shaped broad light band on the back	Dorsal surface is smooth	Scattered tubercles on the dorsal surface	Dorsal surface is covered with hourglass-shaped blotch covering the head from between the eyes and the back

Table 4 cont. A comparative table of member species of *Raorchestes parvulus* species group and species of bush frogs found in northeastern India.

Character	*P. kempiae*	*R. hekouensis*	*R. yadongensis*	*R. asakgrensis*	*R. mindat*	*R. leiktho*	*R. jakoid* sp. nov.	*R. jadoh* sp. nov.
SVL of male (mm)	22.96 –24.4	16.1–17.5	17.8–24.1	18.0–23.35	16.75–18.36	15.72–15.80	18.47–21.6	13.68– 14.01
Tympanum	Hidden	Distinct	Distinct	Indistinct	Indistinct	Indistinct	Indistinct	Indistinct
Supratympanic fold	Distinct	NA	NA	Distinct	Distinct	Indistinct	Distinct	Distinct
Nuptial pad	Present	Present	Present	Present	Present	Present	Present, whitish	Present
Inner palmer tubercle	Absent	Present	NA	Absent	Present	Present	Absent	Absent
Outer palmar tubercle	Present	Indistinct	NA	Present	Present	Present	Present	Present
Inner metatarsal tubercle	Present	Present, oval	Present	Present, oval	Present, rounded	Present, oval	Present, Oval	Present, round
Outer metatarsal tubercle	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
Toe web	Webbed at the base (I 1-2 II 2-1 III 1-3.51 IV 31-2 V)	Rudimentary webbing on toes	Rudimentary webbing	Rudimentary webbing (I 1–2 II 2–2 III 2–3.5 IV 3.33–2 V)	Webbing between toes 1 and 2 vestigial, other rudimentary (II 2–3.5 III 2+–3.5 IV 3.25–2 V)	Webbing between toes 1 and 2 absent, other rudimentary (III 2–3.5 IV 3.33–2 V)	Rudimentary webbing (I 1–1 II 1–2.5 III 2–23 IV 23–1 V)	Rudimentary webbing (I 1–1 II 1–1.5 III 1–3.5 IV 3–1 V)
Relative toe length	I < II < III < V < IV	I < II < III < V < IV	I< II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV	I < II < III < V < IV
Tibiotarsal articulation	Reaches the eye or the snout	Reaches the anterior of an eye	Reaches the tip of snout.	Reaches anterior border of an eye	Reaches level of posterior margin of the eye	Reaches level of mid eye	Reaches posterior border of the eye.	Reaches posterior border of the eye.
Dorsal surface	Dorsal surface rough with granules with or without hour glass shaped marking	Distinct X-shaped dark brown marking on back		Upper parts with small wartsand with or without ") (" shaped marking.	Body surface with X-shaped markings		Body surface slightly rough with very small warts and has") (" shaped marking	Upper part with small warts and six fairly distinct warts on the body towards the posterior of the eyes. Body also has ")(" shaped marking

Cyrtodactylus khasiensis (Jerdon, 1870) which was thought to be a single species with a distribution of whole of northeastern India and adjacent Myanmar. Current studies (mostly since 2018) have pointed to the fact that *Cyrtodactylus khasiensis* is a species complex currently represented by 35 species of which 26 are endemic to India (Boruah et al. 2024). Most of these species are now found to be point endemic and loss or fragmentation of a small patch of habitat may exterminate the species as a whole (Purkayastha et al. 2020, 2021, 2022; Bohra et al. 2022; Lalremsanga et al. 2022, 2023) Thus, describing such cryptic species has a very important local as well as global conservation implications.

REFERENCES

Biju, S.D. & F. Bossuyt (2009). Systematics and phylogeny of *Philautus* Gistel, 1848 (Anura, Rhacophoridae) in the Western Ghats of India, with descriptions of 12 new species. *Zoological Journal of the Linnean Society* 155(2): 374–444.

Biju, S.D., Y. Shouche, A. Dubois, S.K. Dutta & F. Bossuyt (2010). A ground-dwelling rhacophorid frog from the highest mountain peak of the Western Ghats of India. *Current Science* 98(8): 1119–1125.

Bohra, S.C., H.T. Zonunsanga, M. Das, J. Purkayastha, L. Biakzuala & H.T. Lalremsanga (2022). Morphological and molecular phylogenetic data reveal another new species of bent-toed gecko (*Cyrtodactylus* Gray: Squamata: Gekkonidae) from Mizoram, India. *Journal of Natural History* 56(41–44): 1585–1608. https://doi.org/10.1080/00222933.2022.2119178

Boruah, B., S. Narayanan, N.A. Aravind, S. Lalronunga, V. Deepak & A. Das (2024). Description of six new species of *Cyrtodactylus* Gray (Squamata: Gekkonidae) from northeastern India. *Vertebrate Zoology* 74: 453–486. https://doi.org/10.3897/vz.74.e124752

Boulenger, G.A. (1893). Concluding report on the reptiles and batrachians obtained in Burma by Signor L. Fea dealing with the collection made in Pegu and the Karin Hills in 1887–88. *Annali del Museo civico di storia natural di Genova* 13(Series 2): 304–307.

Boulenger, G.A. (1906). Description of two new Indian frogs. *Journal of the Asiatic Society of Bengal* 2(2): 385–386.

Boulenger, G.A. (1919). Descriptions of three new batrachians from the Garo Hills, Assam. *Records of the Zoological Survey of India* 16: 207–208.

Carranza, S. & E.N. Arnold (2006). Systematics, biogeography, and evolution of *Hemidactylus* geckos (Reptilia: Gekkonidae) elucidated using mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution* 38(2): 531–545. https://doi.org/10.1016/j.ympev.2005.07.012

Crump, M.L. & N.J. Scott, Jr. (1994) Visual encounter surveys, pp. 84–92. In: Heyer, W.R., M.A. Donnelly, R.W. Mcdiarmid, L.C. Hayek & M.S. Foster (ed.). *Measuring and Monitoring Biological Diversity: Standard Methods for Amphibians*. Smithsonian Institution Press, Washington, DC, 361 pp.

Das, I., R.K.L. Tron, D. Rangad & R.N.K. Hooroo (2010). A new species of *Leptolalax* (Anura: Megophryidae) from the sacred groves of Mawphlang, Meghalaya, northeastern India. *Zootaxa* 2339: 44–56.

Du, L., Y. Xu, S. Liu & G. Yu (2024). A new species of *Raorchestes* (Anura, Rhacophoridae) from Yunnan Province, China. *ZooKeys* 1192: 213–235. https://doi.org/10.3897/zookeys.1192.106013

Edgar, R.C. (2004). MUSCLE: multiple sequence alignment with high accuracy and high throughput. *Nucleic Acids Research* 32(5): 1792–1797. https://doi.org/10.1093/nar/gkh340

Frost, D.R. (2025). Amphibian Species of the World: an Online Reference Version 6.2 (20 July 2025). https://amphibiansoftheworld.amnh.org/index.php. American Museum of Natural History, New York, USA. https://doi.org/10.5531/db.vz.0001

Garg, S., R. Suyesh, S. Das, M.A. Bee & S.D. Biju (2021). An integrative approach to infer systematic relationships and define species groups in the shrub frog genus *Raorchestes*, with description of five new species from the Western Ghats, India. *PeerJ* 9(e10791): 1–78. https://doi.org/10.7717/peerj.10791

Huang, J., X.L. Liu, L. Du, J.M. Bernstein, S. Liu, Y. Yang, G. Yu & Z. Wu (2023). A new species of bush frog (Anura, Rhacophoridae, *Raorchestes*) from southeastern Yunnan, China. *ZooKeys* 1151: 47–65. https://doi.org/10.3897/zookeys.1151.95616

Jiang, K., J. Ren, J. Wang J. Guo, Z. Wang, Y. Liu, D. Jiang & J. Li (2020). Taxonomic revision of *Raorchestes menglaensis* (Kou, 1990) (Amphibia: Anura), with descriptions of two new species from Yunnan, China. *Asian Herpetological Research* 11(4): 263–281. https://doi.org/10.3897/zookeys.1151.95616

Kalyaanamoorthy, S., B.Q. Minh, T.K. Wong, A.V. Haeseler & L.S. Jermiin (2017). ModelFinder: fast model selection for accurate phylogenetic estimates. *Nature Methods* 14(6): 587–589. https://doi.org/10.1038/nmeth.4285

Kamei, R.G., D.J. Gower, M. Wilkinson & S.D. Biju (2013). Systematics of the caecilian family *Chikilidae* (Amphibia: Gymnophiona) with the description of three new species of *Chikila* from northeast India. *Zootaxa* 3666: 401–435. https://doi.org/10.11646/zootaxa.3666.4.1

Kumar, S., G. Stecher & K. Tamura (2016). MEGA7: molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution* 33(7): 1870–1874. https://doi.org/10.1093/molbev/msw054

Lalremsanga, H.T., H. Chinliansiama, S.C. Bohra, L. Biakzuala, M. Vabeiryureilai, L. Muansanga, F. Malsawmdawngliana, G.Z. Hmar, H.T. Decemson, V. Siammawii, M. Das & J. Purkayastha (2022). A new Bent-toed Gecko (*Cyrtodactylus* Gray: Squamata: Gekkonidae) from the state of Mizoram, India. *Zootaxa* 5093(4): 465–482. https://doi.org/10.11646/zootaxa.5093.4.5

Lalremsanga, H.T., Z. Colney, M. Vabeiryureilai, M. Vabeiryureilai, F. Malsawmdawngliana, S.C. Bohra, L. Biakzuala, L. Muansanga, M. Das & J. Purkayastha (2023). It's all in the name: Naming another *Cyrtodactylus* Gray (Squamata: Gekkonidae) from northern Mizoram, northeast India. *Zootaxa* 5369(4): 553–575. https://doi.org/10.11646/zootaxa.5369.4.5

Lambert, M.R.K. (1984). Amphibians and reptiles, pp. 205–227. In: *Sahara Desert. Key Environments.* Cloudsley-Thompson J.L. Pergamon Press, London, 348 pp.

Lyngdoh, E.M. & A.T.G. Lyngdoh (2023). Environmental degradation in West Khasi Hills District, Meghalaya. *International Journal of Ecology and Environmental Sciences* 49: 411–416. https://doi.org/10.55863/ijees.2023.2748

Mahony, S., S. Sengupta, R.G. Kamei & S.D. Biju (2011). A new low-altitude species of *Megophrys* Kuhl and van Hasselt (Amphibia: Megophryidae) from Assam, Northeast India. Zootaxa 3059: 36–46. https://doi.org/10.11646/zootaxa.3059.1.2

Mahony, S., E.C. Teeling & S.D. Biju (2013). Three new species of horned frogs, *Megophrys* (Amphibia: Megophryidae), from northeast India, with a resolution to the identity of *Megophrys boettgeri* populations reported from the region. *Zootaxa* 3722: 143–169. http://doi.org/10.11646/zootaxa.3722.2.2

Mahony, S., R.G. Kamei, E.C. Teeling & S.D. Biju (2018). Cryptic diversity within the *Megophrys major* species group (Amphibia: Megophryidae) of the Asian Horned Frogs: Phylogenetic perspectives and a taxonomic revision of South Asian taxa, with descriptions of four new species. *Zootaxa* 4523: 1–96. https://doi.org/10.11646/zootaxa.4523.1.1

Mathew, R. & N. Sen (2007). Description of two new species of *Xenophrys* (Amphibia: Anura: Megophryidae) from north-east India. *Cobra* 1(2): 18–28.

Mathew, R. & N. Sen (2009). Studies on little known amphibians of Northeast India. *Records of the Zoological Survey of India*. *Occasional Papers* 293: 1–64.

Mathew, R. & N. Sen (2009). Studies on caecilians (Amphibia: Gymnophiona: Ichthyophiidae) of North East India with description of three new species of *Ichthyophis* from Garo Hills, Meghalaya and additional information on *Ichthyophis garoensis* Pillai & Ravichandran, 1999. *Records of the Zoological Survey of India*. Occasional Papers 309: 1–56.

Mathew, R. & N. Sen (2010a). *Pictorial Guide to the Amphibians of Northeast India*. Records of the Zoological Survey of India, 144 pp.

Mathew, R. & N. Sen (2010b). Description of a new species of *Leptobrachium* Tschudi, 1838 (Amphibia: Anura: Megophryidae) from Meghalaya, India. *Records of the Zoological Survey of India* 109: 91–108.

Minh, B.Q., M.A.T. Nguyen & A. von Haeseler (2013). Ultrafast approximation for phylogenetic bootstrap. *Molecular Biology and Evolution* 30(5): 1188–1195. https://doi.org/10.1093/molbev/mst024

Myers, N., R.A. Mittermeier, C.G. Mittermeier, G.A.B. da Fonseca & J. Kent (2000). Biodiversity hotspots for conservation priorities. *Nature* 403(6772): 853–858. https://doi.org/10.1038/35002501

Naveen, R.S., S.R. Chandramouli, S. Babu, A.M. Ryndongsngi, P.V. Karunakaran & H.N. Kumara (2024). Rediscovery and redescription of *Ixalus garo* Boulenger, 1919, and *Ixalus kempiae* Boulenger, 1919, with a reassessment of the taxonomic status of *Raorchestes cangyuanensis* Wu, Suwannapoom, Xu, Murphy & Che, 2019, and the description of a new species from the Garo Hills of Meghalaya. *Herpetozoa* 37: 359–372. https://doi.org/10.3897/herpetozoa.37.e122825

Naveen R.S., K.P. Nath, H.T. Lalremsanga, K. Deuti, H. Decemson, L. Muansanga, M. Vabeiryureilai, F. Malsawmdawngliana, H. Warjri & J. Purkayastha (2025). A Bush Frog with multiple names: new populations of *Raorchestes kempiae* (Boulenger, 1919) and reassessment of the taxonomic status of *Philautus namdaphaensis* (Sarkar & Sanyal, 1985) and *Raorchestes manipurensis* (Mathew & Sen 2009). *Journal of Asia-Pacific Biodiversity* 18(Pre-proof): 000-000. https://doi.org/10.1016/j.japb.2025.05.003

Nguyen, L.T., H.A. Schmidt, A. von Haeseler & B.Q. Minh (2015). IQ-TREE: a fast and effective stochastic algorithm for estimating maximum-likelihood phylogenies. *Molecular Biology and Evolution* 32(1): 268–274. https://doi.org/10.1093/molbev/msu300

Pillai, R.S. & S.K. Chanda (1973). *Philautus shillongensis*, a new

frog (Ranidae) from Meghalaya, India. *Proceedings of the Indian Academy of Sciences* 78(1): 30–36.

Prasad, V.K., K.B. Gautam & S.K. Gupta (2020). Identification of anuran species diversity of the Panna Tiger Reserve, Central India, using an integrated approach. *Zootaxa* 4851(3): 450–476. https://doi.org/10.11646/zootaxa.4851.3.2

Purkayastha, J. & M. Matsui (2012). A new species of *Fejervarya* (Anura: Dicroglossidae) from Mawphlang, northeastern India. *Asian Herpetological Research* 3: 31–37. https://doi.org/10.3724/SP.J.1245.2012.00031

Purkayastha, J., H.T. Lalremsanga, B. Litho, Y.S. Rathee, S.C. Bohra, V. Mathipi, L. Biakzuala & L. Muansanga (2022). Two new *Cyrtodactylus* (Squamata, Gekkonidae) from Northeast India. *European Journal of Taxonomy* 794: 111–139. https://doi.org/10.5852/ejt.2022.794.1659

Purkayastha, J., H.T. Lalremsanga, S.C. Bohra, L. Biakzuala, H.T. Decemson, L. Muansanga, M. Vabeiryureilai, S. Chauhan & Y.S. Rathee (2021). Four new Bent-toed Geckos *Cyrtodactylus* (Gray: Squamata: Gekkonidae) from northeast India. *Zootaxa* 4980(1): 451–489. https://doi.org/10.11646/zootaxa.4980.3.2

Purkayastha, J., M. Das, S.C. Bohra, A.M. Bauer & I. Agarwal (2020). Another new *Cyrtodactylus* (Squamata: Gekkonidae) from Guwahati, Assam, India. *Zootaxa* 4732(3): 375–392. https://doi.org/10.11646/zootaxa.4732.3.2

Rahbek, C. (1995). The elevational gradient of species richness: a uniform pattern? *Ecography* 18(2): 200–205.

Saikia, B., B. Sinha, A. Shabnam & K.P. Dinesh (2023). Description of a new species of *Amolops* Cope (Anura: Ranidae) from a cave ecosystem in Meghalaya, northeast India. *Journal of Animal Diversity* 5: 36–54. https://doi.org/10.61186/JAD.5.1.36

Sarkar, A.K. & D.P. Sanyal (1985). Amphibia. *Records of the Zoological Survey of India* 82: 285–295.

Seshadri, K.S., K.V. Gururaja & N.A. Aravind (2012). A new species of *Raorchestes* (Amphibia: Anura: Rhacophoridae) from mid-elevation evergreen forests of the southern Western Ghats, India. *Zootaxa* 3410(1): 19–34. https://doi.org/10.11646/zootaxa.3410.1.2

Tamura, K. & M. Nei (1993). Estimation of the number of nucleotide substitutions in the control region of mitochondrial DNA in humans and chimpanzees. *Molecular Biology and Evolution* 10(3): 512–526. https://doi.org/10.1093/oxfordjournals.molbev.a040023

Vijayakumar, S.P., K.P. Dinesh, M.V. Prabhu & K. Shanker (2014). Lineage delimitation and description of nine new species of Bush Frogs (Anura: *Raorchestes*, Rhacophoridae) from the Western Ghats Escarpment. *Zootaxa* 3893(4): 451–488. https://doi.org/10.11646/zootaxa.3893.4.1

Vijayakumar, S.P., R.C. Menezes, A. Jayarajan & K. Shanker (2014). Glaciations, gradients, and geography: multiple drivers of diversification of Bush Frogs in the Western Ghats Escarpment. *Proceedings of the Royal Society B: Biological Sciences* 283(1836): 20161011. https://doi.org/10.1098/rspb.2016.1011

Watters, J.L., S.T. Cummings, R.L. Flanagan & C.D. Siler (2016). Review of morphometric measurements used in anuran species descriptions and recommendations for a standardized approach. *Zootaxa* 4072(4): 477–495. https://doi.org/10.11646/zootaxa.4072.4.6

Wu, Y., C. Suwannapoom, Y. Xu, J. Chen, J. Jin, H. Chen, R.W. Murphy & J. Che (2019). Description of a new species of *Raorchestes* (Anura: Rhacophoridae) from southwestern China. *Zoological Research* 40(6): 558–563. https://doi.org/10.11646/zootaxa.4941.2.5

Wu, Y., S. Liu, W. Gao, Y. Wang, Y. Li, W. Zhou, Z. Yuan & J. Che (2021). Description of a new species of Bush Frog *Raorchestes* from northwestern Yunnan, China. *Zootaxa* 4941(2): 284–300. https://doi.org/10.11646/zootaxa.4941.2.5

Supplement Table 1. Uncorrected pdistance (16s rRNA) amongst the members of *Raorchestes parvulus* species group (Preceding the species name is the GenBank accession number).

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Khasi: Ka jait jakoid *Raorchestes* Biju et al. (2020), kadei kawei na ki jait jakoid ba bun jait hapoh ka longiing Rhacophoridae, ha kaba ki dkhot jong ka ki long ki ba rit, kim don ia ki bniat vomerine, ka jingroi kam da donkam ban heh sha ki dohlun, bad ki don ki tduh kti ba iar. Ka Meghalaya, wat la ka don ha ka jaka ba bun jait ki jingthaw ba im ba ki khot ka Indo-Burma, hynrei ka jingwadbniah ia ka jingbun ki mrad ba im lang ha um bad ha ryngkew (amphibians) ka dang duna. Ha kane ka jingpule, ngin batai ia ki ar tylli ki jait jakoid kiba thymmai, kata u *Raorchestes jakoid* sp. nov. bad u *Raorchestes jadoh* sp. nov., na ki lum khasi jong ka jylla Meghalaya, ba la pynshong nongrim ha ka jing pule kaba pyniasoh lang ia ki jingtip ba iadei bad ka dur ka dar, ka sur pah, bad ki gene (16S rRNA). Nalor kata, ngi ai ki jingbatai ba thymmai naka bynta ki lai tylli kiwei pat ki jakoid kata u *R. kempiae*, u *R. garo*, bad u *R. asakgrensis*, da kaba pynjanai ia ka jingsngewthuh jong ngi shaphang jong ki. Ka jingpeit bniah ia ka jinglong jingman jong kine ki jakoid ka pynskhem ia ka jingbuh ia ki hapoh ka kynhun ba la khot ka *Raorchestes parvulus*. Ia kine ki jakoid ba thymmai la shem hajan ki jaka basah ki briew bad kane ka pyni ia ka jing lah jong ki ban im ha kino kino ki jaka, hynrei ka don ruh ka jingsngewkhia shaphang ka jingim slem jong ki hapdeng ka jingduh stet ia ka jaka shong jaka sah jong ki. La shem ia ki hapdeng ka jing jrong kaba 235m haduh 1,655 m bad kham bun hapdeng ka 1,000-1,600 m. Kine ki jinglap jong ngi ki pyni ia ka jingbun ki mrad kiba pher ha kane ka jaka bad ka donkam kyrkieh ban pynneh pynsah iaki jait mrad ba la khot ha ka phareng herpetofauana, ha ka thain shatei lammihngi jong ka ri India.

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