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Caption: Lowland Tapir Tapirus terrestris (Medium—watercolours on watercolour paper) © Aakanksha Komanduri.

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The first record of Medog Gliding Frog *Rhacophorus translineatus* Wu, 1977 (Anura: Rhacophoridae) from Chhukha District, Bhutan

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Abstract: *Rhacophorus* is a genus of tree frogs in the family Rhacophoridae commonly referred to as parachuting or gliding frogs, distinguished by extensive digital webbing. A rare species, *Rhacophorus translineatus* Wu, 1977, was recorded for the first time in Bhutan. Information on morphological characters, geographical distribution, habitat and natural history notes is provided.

Keywords: Conservation status, distribution range, habitat, morphological characters, morphology, tree frongs.

Rhacophoridae is a large group of arboreal frogs containing 430 recognized species in 20 genera (Frost 2020). Of these, *Rhacophorus* Kuhl & Van Hassalt, 1822 contains 44 species distributed across southern India to Bhutan and eastern Xizang (China) east and south to Hunan, Hainan, Yunnan & Guangxi, through Myanmar, Thailand, Laos, Cambodia, Vietnam to Sumatra, Borneo, Sulawesi (Indonesia), and the Philippines (Frost 2020; AmphibiaWeb 2020).

In Bhutan, the Rhacophoridae are represented by four species: two from the genus *Polypedates* and two *Rhacophorus* species (Wangyal 2014; Das et al. 2016; Tshewang & Letro 2018; Koirala et al. 2019). *Rhacophorus smaragdinus* (Blyth, 1852) formerly *Rhacophorus maximus*, was reported from Zhemgang (Wangyal 2014) and Jigme Dorji National Park (Koirala et al. 2016). In 2016, Rhacophorus bipunctatus Ahl, 1927 was reported from Royal Manas National Park (Das et al. 2016). Currently, the anuran fauna of Bhutan is represented by 83 recognized species distributed among seven genera (Das et al. 2016; Nidup et al. 2016; Tshewang & Letro 2018; Koirala et al. 2019; Wangyal 2013, 2014; Tenzin & Wangyal 2019; Wangyal & Gurung 2017; Wangyal et at. 2020). These earlier studies did not provide evidential records of R. translineatus from Bhutan. R. translineatus was first described by Wu (Fei et al. 1977) and its type locality given as "Motuo, Xizang (= Tibet), China" was provided by Li et al. (2011). More than two decades after its first discovery in China in 1977, Bordoloi et al. (2002), and Borah & Bordoloi (2004) reported R. translineatus from Dihang Dibang Biosphere Reserve, a new record for India.

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The distribution range of *R. translineatus* is restricted to Medog county in Xizang (Tibet) autonomous region, China (Jiang & Lau 2004), and the Indian state of Arunachal Pradesh (Saikia et al. 2017; Roy et al. 2018). Currently, 14 species of *Rhacophorus* are known to occur in countries neighboring India (Frost 2017), and nine are recorded from China (Pan et al. 2017). Here we present

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Editor: Anonymity requested.

First record of Rhacophorus translineatus from Chhukha District, Bhutan

the first record of *R. translineatus* from Bhutan.

MATERIALS AND METHODS Study area

Gedu Territorial Forest Division covers entire Chhukha district (Figure 1) which lies within the 26.716– 27.3°N and 89.250–89.816°E. It borders with Samtse to the west, Ha to the north-west, Paro & Thimphu to the north, and Dagana to the east. Towards the south, it borders with India. It covers an area of approximately 1,879.77 km². The Chhukha district has an altitudinal range between 200 to 4,400 m and forest cover about 89.26% with corresponding vegetation types of tropical forest, sub-tropical forest, warm broadleaved forest, cool broadleaved forest, mixed conifer, and alpine meadows (RFMD 2017) that harbor rich repositories of biodiversity. Annual precipitation ranges from 750 mm in the north to 4,000 mm in the south (WCSD 2018).

The tropical and subtropical zone of the Chhukha experiences a hot summer with moderate to high rainfall, whereas in the warm temperate and cool temperate zones at higher altitudes, the climatic conditions are characterized by warm summers and cold winters. The higher region of the park is covered by perennial snow; a home of glacial rivers which serves as an important source of water for household use, agriculture and hydropower generation in the downstream valleys.

Methods

A single individual female of R. translineatus was observed by the first author in Gurung Dara, a hill district inhabited by the Gurung ethnic group in Chhukha district, Bhutan. Photographs were taken of the live specimen using a Canon EOS 80D digital camera, and locality data were collected using GPS (Garmin eTrex). The collected frog was euthanized humanely by using recommended dose of (1.0 g/L) of maximum strength Orajel (Cecala et al. 2007) and fully sedated specimen was put to death by placing it in a 40% ethyl alcohol bath for 30 minutes. The specimen was fixed using 10% formalin and preserved in 75% ethanol. Beside the snout-vent length (SVL), which was made with a flexible ruler to the nearest 1 mm, all other measurements of morphological characters were made with a digital slide caliper to the nearest 0.01mm. Since there is no standard system in the country to assign e-voucher number series; specimen was designated with



Figure 1. Map of study area. Phuntsholing geog, Chhukha district, Bhutan.

field collection number and deposited by first author to Gedu Forest Division for future reference.

Terminology for morphological characters followed Li et al. (2011) and Watters et al. (2016). Abbreviations are as follows: SVL: Snout-vent length- measured from tip of snout to vent, HL: Head length-distance from the posterior jaws to the tip of the snout, HW: Head width-maximum distance between angle of jaws, IN: Internarial distance between inner margins of nostrils, IOD: Interorbital distance-minimum distance between upper eyelids, SL: Snout length- measured from anterior border of eye to tip of snout, ED: Eye diameterhorizontally from anterior to posterior corners of eye, UWE: Width of eyelid- greatest width of upper eyelid margin, TD: Tympanum diameter-greatest horizontal width of the tympanum, AGL: Axilla to Groin lengthmeasured from posterior base of forelimb to anterior base of hindlimb, DNE: nostril-eye length- measured from nostril to eye, THL: Thigh length- distance from vent to knee, TIL: Tibia length- distance from knee to foot, LAL: Lower arm length- distance from the elbow to the tip of Finger III, UAL: Upper arm length-measured from the axilla to the elbow, FAL: Forearm length- from the flexed elbow to the base of the outer palmar tubercle, HAL: Hind limb length- from vent to tip of longest toe, FLL: Forelimb length- measured from axilla to tip of disk of finger III, FL: Foot length- measured from proximal end of inner metatarsal tubercle to tip of toe IV, HTL: TRL- Tarsus length; Hand length- base of outer palmer tubercle to tip of finger III.

RESULTS

Specimen examined: Field collection No (GFD. AMP.20.001), *R. translineatus* (Figure 2) an adult female collected on 9 July 2020, at 2230 h from Gurung Dara (26.972°N and 89.452°E), WGS84, elevation 1,727 m) in Phuntsholing geog (geog= sub district), Gedu Territorial Forest Division, Chhukha district, Bhutan.

Morphology and measurements

Currently reported *R. translineatus* was compared with morphological characters of *R. translineatus* presented in literatures (Table 1). Dorsally light brown in colour (Image 1); very fine granules on dorsum with 11 narrow transverse dark brown line from snout to vent (Image 2A); head flat, longer than broad; tympanum distinct; eye large, pupil is horizontally oval (Image 2B); tip of the snout is pointed, protruding forward; ventrally whitish with series of markings; second, third, and fourth fingers near full webbed, toes fully webbed (Image 2C); ventrolaterally marked with a series of white spots; hind



Image 1. *Rhacophorus translineatus* recorded from Gurung Dara, Gedu Forest Division, Chhukha Bhutan.

Table 1. Comparison of morphological characters of currently studied *R. translineatus* with the Holotype (CIB 73II0031), type locality: Motuo, Xizang (= Tibet), China. Data taken from (Li et al. 2011). "–" indicates data unavailable.

Characters (in mm)	Currently studied <i>R.</i> <i>translineatus</i> Field collection No: GFD. AMP.20.001	<i>R. translineatus</i> Holotype: CIB 73110031
SVL	66.50	54.68
HL	22.10	18.10
HW	1 8.35	16.38
IND	6.08	5.04
IOD	7.01	5.57
SL	9.89	9.75
ED	6.10	5.57
UWE	5.40	-
TD	2.95	1.97
AGL	35.56	-
DNE	5.20	4.46
THL	33.50	23.54
TIL	36.07	26.68
LAL	32.81	26.28
UAL	15.50	-
FAL	14.03	-
HLL	116.50	-
FLL	48.31	-
FL	28.71	25.61
HTL	18.78	18.11
TRL	18.22	-

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Image 2. Rhacophorus translineatus recorded from Chuuka district: A—Dorsal view of live specimen | B—Lateral view of live specimen | C— Ventral view of preserved specimen | D—Lateral view of preserved specimen. © Sonam Lhendup.

limbs are slender (Image 2D).

Distribution and natural history

Besides having its distribution in China and India, this species is currently known from Gurung Dara, Phuntsholing geog, Chhukha District, Bhutan. In Bhutan, unless otherwise stated, R. translineatus is found up to an elevation of 1,727 m. This record raises the upper elevation limit which was previously reported for the species from Motuo, Xizang (= Tibet), China as 1,200-1,500 m (Li et al. 2011) and Tiwarigaon and the Ahini Ango, Dibang River Basin, Arunachal Pradesh, India, as 920-1,480 m (Roy et al. 2018). The single individual was collected from water catchment area of Tomi River, one of the tributaries of Toorsa River which ultimately enters into the Indian state of West Bangal via Phountsholing. The frog was on farm road, situated close proximity to small seasonal freshwater pond when it was first sighted. The immediate micro-habitat was small seasonal freshwater pool surrounded by marshy, abandoned agriculture fallow land currently being used for cattle grazing by local inhabitants. The macro habitat type is characterized by forested hill represented by subtropical

broadleaved forest, mostly dominated by Nepal Alder Alnus nepalensis, Red Cedar Toona ciliata, Needle Wood Tree Schima wallichii, Chinquapin Tree Castanopsis sp., and Symplocos sp. The observed vegetation types and altitudinal gradient of specific site falls in subtropical zone of Bhutan, based on vegetation types described by Ohsawa (1978) for Bhutan.

DISCUSSION

In 2000 Das & Palden (2000) reported seven amphibians from three families: 1 megophryid, 1 bufonid, and 5 ranids, all new records for Bhutan. After a comprehensive review of the Bhutanese herpetological literature, 35 confirmed species of anurans were reported to occur in Bhutan until 2014 (Wangyal 2014). Subsequently in 2016, a species of Cascade Frog *Amolopos himalayanus* (Boulenger, 1888) was reported as first record for Bhutan by Nidup et al. (2016) from Trashigang district. In the same year two more anurans species *R. bipunctatus* and *Uperodon globulosus* (Günther, 1864) were reported by Das et al. (2016) from Royal Manas National Park as new records for Bhutan. Until 2017, Bhutan was represented by 59 species of First record of *Rhacophorus translineatus* from Chhukha District, Bhutan

amphibians (Wangyal & Gurung 2017). Subsequently, two species of amphibian viz., *Polypedates teraiensis* and *Leptobrachium bompu* Sondhi & Ohler, 2011 were added as new records for Bhutan (Tshewang & Letro 2018; Tenzin & Wangyal 2019). An addition of 22 new records by Wangyal et al. (2020) increased the amphibian checklist of Bhutan to 83 recognized species. The current record of *Rhacophorus translineatus* demonstrates that Bhutan is now home to at least 84 confirmed species of amphibian.

Historically, due to the rugged terrain, cold climatic conditions, and largely inaccessible landscape, the biological diversity of eastern Himalaya remained largely unexplored. Herpetofauna have received disproportionate scientific attention compared to large vertebrates since conservation efforts began in Bhutan. In recent decades the frequent discovery of new species and new range extensions in the eastern Himalayas demonstrates a serious need for further exploration in the region. The Himalayan foothills, the locality of currently observed R. translineatus, shares similar bio-geographic elements of the eastern Himalayan locations from where most of the Rhacophorus species including *R. translineatus* have been reported. However, altitudinal boundary extension demonstrated by currently observed R. translineatus was relatively higher than altitudinal records previously reported as, 920-1,500 m (Li et al. 2011; Roy et al. 2018). This first record of R. translineatus from Bhutan raises a total of 84 confirmed species of anurans in Bhutan. In addition, it also provides vital information on new distribution range of this species in Bhutan besides China and India.

Conservation status

The IUCN (2004) has assessed R. translineatus as a Data Deficient (DD) species in view of continuing uncertainties as to its extent of occurrence, ecological requirements, and its unknown population trend (Jiang & Lau 2004). Data Deficient species must be given high research priority as most of such species often receive disproportionate scientific attention, contributing to uncertainty in estimates of extinction risk. Currently, information on its habitat requirement is very scanty; however present study revealed that the species is adaptable to human modified landscape particularly associated with agriculture development. Although there is no adequate evidence to ascertain whether the species is facing survival threat within its present locality, but in general, amphibians are perceived to be more threatened in human dominated landscape and response rapidly to environmental change. Therefore, a

more holistic, education-focused conservation strategy combined with ecological research may be needed for more effective conservation of the amphibian fauna of Bhutan.

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