

First report of *Megophrys pachyproctus* Huang, 1981 (Anura: Megophryidae) from Talle Valley Wildlife Sanctuary, Arunachal Pradesh, India

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Abstract

The endemic Asian megophryid genus *Megophrys* is represented by a total of 77 species of which 14 are reported to occur in India. Due to its close proximity to China, Arunachal Pradesh- the easternmost state of India- is believed to harbor many species of amphibians endemic to China. One such *Megophrys* species endemic to China, *Megophrys pachyproctus*, is reported herein this paper as the first record for India, based on a single specimen collected from Talle Valley Wildlife Sanctuary in Ziro Valley of Arunachal Pradesh.

Keywords: Arunachal Pradesh, New country record, North-East India, Talle Valley Wildlife Sanctuary, Ziro Valley

Introduction

Political boundaries mean nothing for animal migrations and distributions, while geographical features act as one of the important factors for them. Arunachal Pradesh- the easternmost state of India- due to its close proximity with Xizang Province of China and sharing similar topological features, has a high chance of harbouring many species of amphibians distributed in China, especially Xizang. In recent decades, a few Chinese frog species have been reported from India (Ao *et al.*, 2003; Borah *et al.*, 2013; Sarania *et al.*, 2015), while a few Indian frogs (described from Arunachal Pradesh) were reported from Xizang, China (Li *et al.*, 2016; Liang *et al.*, 2017); however, such findings are far less than what the geographical similarities suggest.

The endemic Asian anuran family Megophryidae extends from Pakistan in the west to the Philippines in the east and the Greater Sunda Islands in the south and made up of 5 genera [*Leptobranchella*, *Leptobranchium*, *Megophrys*, *Oreolalax* and *Scutigera*] (Frost, 2018). Of these, the genus *Oreolalax* is not represented in India, while the rest are found in the country. The genus *Megophrys* is the most dominant among the genera of Megophryidae with 77 species, out of which 14 species are found in India (Frost, 2018).

In 2017, a megophryid frog specimen was collected from Talle Valley Wildlife Sanctuary (TWS), in the Apatani Plateau of Arunachal Pradesh, with a strikingly brown-yellow coloured dorsum with scattered crimson coloured tubercles and a typical protruded posterior which is known to be a specific character of an endemic Chinese *Megophrys* species, *M. pachyproctus*.

Megophrys pachyproctus closely resembles *M. minor*; however, substantial differences exist between the two. The presence of vomerine ridge and protruded posterior end (in males) that appears like an arc-shaped swelling in *M. pachyproctus* (absent in *M. minor*) separate this species from the later (Huang *et al.*, 1998) [comparative differences in Table 1].

Previously, Smith (1935) reported *M. minor* from the Lohit Valley of Arunachal Pradesh. Although, this report was overlooked for many decades, due to which, *M. minor* was not considered in the faunal list of India, Mahony *et al.*, (2013) included this species in the Indian faunal list based on Smith (1935), with a remark that proper study of the specimen or fresh collection is warranted for detailed comparison with *M. minor sensu stricto*. This raises a question, if the specimen collected from TWS could be *M. minor*? A detailed perusal of Smith (1935) report rest to

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Table 1. Morphological comparatives of *Megophrys* species found in Arunachal Pradesh, India

Features	<i>M. pachyproctus</i>	<i>M. anrae</i>	<i>M. major</i>	<i>M. minor</i>	<i>M. robusta</i>	<i>M. vegrandis</i>
SVL (in mm)	35.3-37.8 (M); 35.8- 46.9 (F)	39.1-45.0 (M); 48.9 (F)	65.5-77.0 (M) 80.0- 94.0 (M)	32.2-40.5 (M); 42.0-48.2 (F)	54.0-82.55 (M); 93.35-114.0 (F)	27.5-30.6 (M) Female not known
Head	Almost equal	Longer	Wider	Almost equal	Wider	Equal
Tympanum	Oval, distinct	Distinct	Small	Round, large	Distinct	Circular
Vomerine ridge	Swollen, with teeth	Weakly raised; circular	Vomerine teeth vertical	Ridge not visible; teeth absent	With 2 rows of teeth	Absent
Skin (Dorsum)	X- shaped ridge	Weak V-shaped ridge with an inverted V-shaped ridge below	Hour-glass mark	Hour-glass mark	V-shaped ridge	Weak V-shaped ridge with an inverted V-shaped ridge below
Upper eyelid with horn-like tubercle	Absent	Present	Absent	Absent	Absent	Absent
Cloaca	Projecting in male	Not projecting	Not projecting	Not projecting	Not projecting	Not projecting
TTA	Ant. eye corner	-	Snout tip/ beyond	Eye & snout tip	Eye/ eye- nostril	-
Colour (Dorsum)	Brown-yellow	Light greyish- brown	Olive green/ brown green	Yellow olive/ dark olive	Light brown/ dark grey/ orange-red	Olive-brown

doubt about the later specimen being *M. minor*, as in *M. minor* the first finger is half the length of the second and toes have rudiments of web. As both these characters are missing in the specimen from TWS, Arunachal Pradesh and agrees fully with the morphological description (Huang *et al.*, 1998) and diagnostic characters (Fei *et al.*, 2012; Fei and Ye, 2016) of *Megophrys pachyproctus*, our specimen represents the first report of this species from India.

The *Megophrys* population of Arunachal Pradesh was previously known to be divided into 5 species, viz. *M. anrae*, *M. major*, *M. minor*, *M. robusta* and *M. vegrandis* (Frost, 2018). A thorough examination of the specimen from TWS was compared with all the known *Megophrys* species of the State before finally being identified as *Megophrys pachyproctus*. Comparative table showing the differences between these 6 species are provided in Table 1.

Orlov *et al.*, (2002) had reported *Megophrys pachyproctus* from Vietnam although, considerable doubts about the proper identity of this species has been raised since then (Fei and Ye, 2016; Frost, 2018).

Material and Methods

A single male specimen (V/A/NERC/ZSI/1352), collected by Bikramjit Sinha from Pange, Talle Valley Wildlife Sanctuary (TWS), Ziro Valley, Arunachal Pradesh on 17th June, 2017 [27.547681 N; 93.897555 E"; alt. 1855 m asl] and deposited in the National Zoological Collection of Zoological Survey of India, Shillong (ZSIS).

The specimen was fixed in 5% formalin solution after taking photographs in live condition. All measurements (in millimeters) were done with a Mitutoyo™ digital caliper. The measurements taken are as per the parameters used in measuring the types of *Megophrys pachyproctus*. These are SVL (Snout Vent length), HL (Head Length), HW (Head Width), INS (inter-narial distance), EHD (Eye Horizontal Diameter), SL (Snout Length), TD (Tympanum Diameter), IOS (Minimum distance between the upper eyelids), UEW (maximum width of the upper eyelid), FAHL (forearm and hand length), FAW (width of forearm), HAL (Hand length), TLL (Total Leg Length), TBL (Tibia Length), TFL (Length of tarsus and foot), FOL (Foot Length). TTA (Tibio-tarsal

articulation) of the specimen is also noted. Dissection of the specimen was carried out to ascertain the sex. GPS coordinates were recorded using GARMIN Oregon 550. The specimen was collected during 19:00 to 21:00 hrs.

PAST 3.2 (Hammer *et al.*, 2001) was used for multivariate Principal Component Analysis (PCA). A total of 13 morphometric characters were used (Table 3). The data for the PCA of similar sized *Megophrys* of Arunachal Pradesh, *M. anacrae*, *M. pachyproctus* and *M. vegrandis* was taken from Hunag *et al.*, (1998) and Mahony *et al.*, (2013). The reason for limiting the PCA to 13 parameters is due the limited morphometric parameters available for the type series of *M. pachyproctus* (Hunag *et al.*, 1998). *M. major* and *M. robusta* being much larger frogs; while due to lack of morphometric data of *M. minor*, were ignored for the PCA. However, considerable differences (see Introduction and Table 1) exist between *M. minor* and *M. pachyproctus* to be confused with respect to their proper identifications.

Following literature was consulted for relevant characters and photographs of the species: Hunag *et al.*, (1998), Fei *et al.*, (2012) and Fei and Ye (2016).

Result

Diagnosis: A medium sized, brownish-yellow, male frog (SVL37.8 mm; detailed morphometrics in Table 2), head flattened, almost as long as wide; snout region concave, tip shield like, bluntly rounded, protrudes over the lower jaw. Nostril not seen on dorsal view, equally placed between eye and snout tip. Inter narial-space equals inter-orbital space, but larger than upper eyelid. Tongue rounded, slightly notched. Vomerine ridge swollen towards the posterior end; bears teeth. Pupils vertical; tympanum slightly oval and placed at a distance about equal to its diameter from the eye. Fingers without webbings; no sub-articular tubercles; relative finger lengths $3 > 4 > 2 > 1$, first finger almost equal to second. TTA reaches the anterior corner of eye; heels overlap. Toe tips rounded, third toe slightly longer than the fifth, without any webbings; no lateral fringe; no sub-articular tubercles. Inner metatarsal tubercle flattened, outer absent. Skin on dorsum rough with scattered small red warts; X-shaped ridge of small granules behind the occiput; parallel ridges dorso-laterally (Figure 1). A dark triangular mark between the eyes. Supra-tympanic fold angled obtusely, thicker near the shoulder. Posterior end of the body protrudes slightly in an arc-shaped swelling. A pair of light coloured glands

ventro-laterally in the chest region; a pair of femoral glands present, as well.



Figure 1. *Megophrys pachyproctus* from TWS, Arunachal Pradesh.

Natural History

The specimen was collected from Pange, situated on the western side of Talle Valley Wildlife Sanctuary (TWS) during the dusk hours (19:00 to 21:00 hrs) on June 17, 2017, from a damp, moist and swampy area. The frog was spotted in a bushy area and its crimson coloured granules on the dorsal and dorso-lateral side reflected the torch-light like fluorescent. It was very exciting to spot this colourful frog in the wild. The frog was mediocre in activity in that it was not that active and also not that lethargic like *Leptobrachium bompu*, another megophryid which was spotted twice in TWS by one of the authors (BJS). The whole day was raining heavily at Pange; the sky was dark with almost zero visibility. The rain intensity reduced a bit by 17:00 hrs and it was completely dark by that time.

TWS is characterized by mixed wet evergreen tropical forests. From where the specimen of *Megophrys pachyproctus* was collected, a number of associated herpetofauna were recorded like *Rhacophorus rhodopus*, *R. subansiriensis*, *R. burmanus*, *Polypedates maculatus*, *Liurana medogensis*, *Nasutixalus* sp., *Odorrana arunachalensis*, *Sphenomorphus maculatus*, *Japalura* sp., and *Ptyas nigromarginata*, including another rare megophryid frog, *Leptobrachium bompu*.

PCA: For reasons already mentioned in the material and methods section, the PCA (Figure 2) was carried out with 3 species: *M. anacrae*, *M. pachyproctus* and *M. vegrandis*.

Table 2. Morphometrics of the *Megophrys pachyproctus* (V/A/NERC/ZSI/1352) from TWS, Arunachal Pradesh, India compared with the types of *M. pachyproctus* (Hunag, 1998) [HT-Holotype, AT-Allotype, PT-Paratype]

	<i>M. pachyproctus</i>	<i>M. pachyproctus</i>	<i>M. pachyproctus</i>	<i>M. pachyproctus</i>
Sex	Male	Male	Female	Male
Reg. No	770650 (HT)	770651 (PT)	770652 (AT)	V/A/NERC/1352
SVL	35.3	36.2	35.8	37.8
HL	12.5	13	12.5	12.7
HW	12.4	12.8	12.9	12.5
SL	4.8	4.7	4.5	5.5
INS	4	4	3.9	4.5
IOS	4	4	4.3	4.0
UEW	3.5	3.8	3.2	3.72
EHD	4.9	4.8	4.7	4.7
TD	1.7	1.7	1.7	1.7
FAHL	17.9	18.4	18.7	18.7
FAW	2.7	2.5	2.4	2.8
HAL	9.9	10.1	10.4	9.7
TLL	55.5	57.8	60.0	64.2
TBL	17.1	17.8	17.8	19.7
TFL	25.6	27	27.5	29.7
FOL	16.8	17	17.4	18.3

The PCA comparing *M. pachyproctus* with similar sized *M. ancaea* and *M. vegrans* show a substantial morphological separation between these species. The blue aqua cross mark in Figure 2 represents the *M. pachyproctus* from Tale Valley Wildlife Sanctuary and as apparent showing close clustering along with *M. pachyproctus* than other *Megophrys* species. PC1 accounts for 94% variance and PC2 accounts for 4% variance (Table 3).

Variation: Due to low sampling size (2 males, 1 female in Huang *et al.*, 1998; 2 males, 2 females in Fei and Ye, 2016), the SVL range of *Megophrys pachyproctus* is rather restricted. While male SVL is within the range of 35.3-36.2 mm, the female SVL is relatively broader at 35.8-46.9 mm. The male specimen from Pange, TWS has a SVL of 37.8 mm, thereby extending the male SVL range at 35.8-37.8 mm. Unlike the greyish black spots scattered in the

Table 3. Factor loading of 13 morphometric characters belonging to *M. ancaea*, *M. pachyproctus* and *M. vegrans* from Arunachal Pradesh, India and Xizang, China

	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7	PC 8	PC 9	PC 10	PC 11	PC 12	PC 13
SVL	0.70347	-0.63548	-0.23725	-0.13876	0.093002	0.036078	-0.052207	0.013966	0.023786	-0.080786	-0.061206	-0.019254	0.040883
HL	0.2276	0.023322	0.35982	0.237	-0.08937	0.20719	0.044972	-0.53331	0.10584	0.052988	-0.1495	-0.077155	-0.61834
HW	0.19965	0.071471	0.20796	0.3234	-0.28318	0.43818	0.12086	0.094633	-0.29283	0.24775	-0.29443	-0.16817	0.49935
SL	0.072255	0.091695	0.19859	0.25598	0.605	0.0035869	-0.53652	-0.26334	0.083239	-0.01131	0.15606	-0.11809	0.33588
INS	0.065199	0.034838	0.12751	-0.01307	0.2606	0.35424	-0.26733	0.55731	-0.284	0.23824	0.090094	0.29625	-0.41153
IOS	0.048948	0.086287	0.087894	0.19452	-0.18854	0.17795	-0.20962	0.41559	0.66032	-0.4316	-0.18994	-0.046889	-0.012016
UEW	0.060925	-0.027005	0.20363	-0.098613	0.30073	-0.052877	0.43946	0.23616	0.43082	0.49146	0.15734	-0.38771	-0.0046028
EHD	0.087272	0.027058	-0.049763	0.084541	-0.08215	0.16264	0.13637	-0.19981	0.37376	0.26851	0.23254	0.75859	0.22132
TD	0.058063	-0.076768	0.37782	0.25835	0.35611	-0.23764	0.49901	0.13647	-0.18244	-0.43195	-0.1383	0.29754	0.052922
HAL	0.14937	-0.13593	0.5867	-0.086675	-0.42182	-0.50373	-0.29254	0.12651	-0.042313	0.14691	0.20321	0.070994	0.067187
TBL	0.28766	0.44598	0.24596	-0.73149	0.081043	0.18221	0.038186	-0.10105	-0.0015546	-0.19294	-0.11982	0.052649	0.13033
TFL	0.44756	0.53908	-0.33024	0.23896	0.027842	-0.46239	-0.032149	0.10561	-0.011165	0.20269	-0.249	0.055756	-0.099184
FOL	0.28552	0.24107	-0.084315	0.18207	-0.15627	0.14192	0.16906	0.045677	-0.13549	-0.29329	0.77657	-0.19042	-0.03438

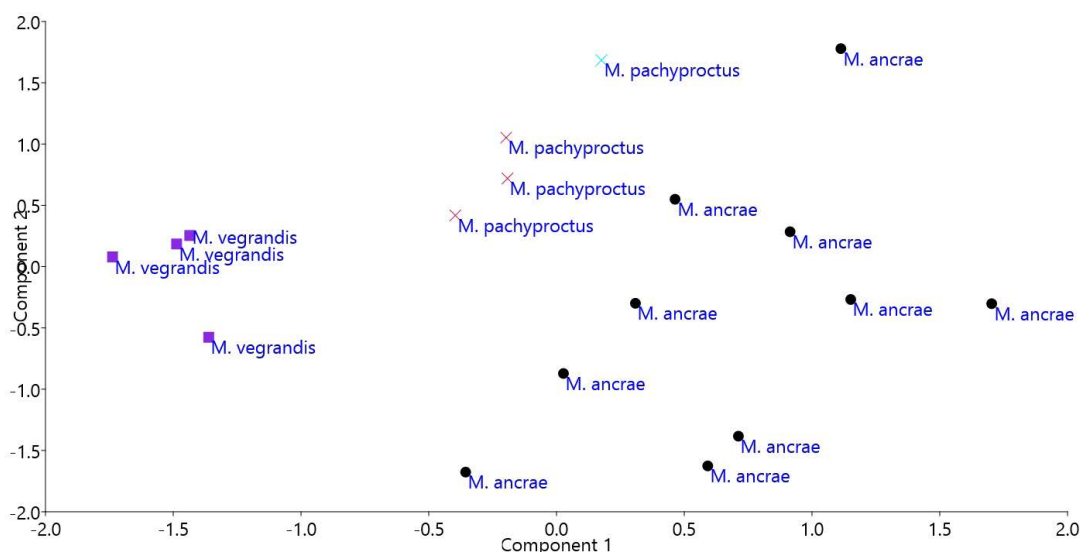


Figure 2. Principal Component Analysis scatter plot of 13 morphometric characters enlisted in Table 3 for *M. ancræ*, *M. pachyproctus* and *M. vegrandis*.

whole ventral side of the male holotype; in our specimen, the upper part is thickly scattered with greyish spots, leaving the lower half relatively clean.

Distribution Range: The type locality of *Megophrys pachyproctus* is approximately 250 km (aerial distance) North-East from Pange (TWS). With this report from India, Pange (TWS) represents the South Western limit of this species, besides providing an altitudinal distribution of this horned toad between 1530-1855 m above sea level (asl), an increase of more than 300 m.

INDIA: Pange, TWS, Arunachal Pradesh [27.547681 N; 93.897555 E”; alt. 1855 m asl].

CHINA: Gelin, Mêdong County, Xizang [29.183333 N; 95.166667 E; alt 1530 m asl]

Discussion

Despite sharing a long frontier and similar topological features with China, only a few Chinese amphibian species have been reported to occur in Northeast India (Ao *et al.*, 2003; Borah *et al.*, 2013; Sarania *et al.*, 2015). The reason could be many, like non accessibility of frontier regions, no proper surveys or even sometimes, the non

availability of translation of the original description into English for comparisons. Mahony *et al.*, (2013) expressed the difficulty amphibian taxonomists working on the bordering areas of neighbouring countries with China face, as most Chinese species were described in various Chinese languages. But the recent reports of a couple of Indian amphibians like *Theioderma moloch* (Annandale, 1912) and *Leptobrachium bompu* Sondhi and Ohler, 2011 (described from Arunachal Pradesh) from Xizang, China (Li *et al.*, 2016; Liang *et al.*, 2017) re-affirm that both Arunachal Pradesh (India) and Xizang (China) shares similar habitats and topology to support related faunal resources.

Sarkar and Ray (2006) reported 39 species of amphibians from Arunachal Pradesh, which was revised up to 63 species (Bordoloi and Borah, 2009). Over the years, there has been many new species and new range extensions into the State (Sondhi and Ohler, 2011; Kamei *et al.*, 2013; Mahony *et al.*, 2013; Saikia *et al.*, 2017a and b), including 2 new India records (Borah *et al.*, 2013; Sarania *et al.*, 2015).

The previous *Megophrys* population of Arunachal Pradesh was divided into 5 species viz. *M. ancræ* and *M. vegrandis*, which were described from the State (Mahony *et al.*, 2013); while *M. major*, *M. minor* and *M. robusta*

were known from each single reports from the State (Smith, 1935; Bordoloi and Borah, 2001; Sarkar and Ray, 2006). *M. zunhebotensis* reported by Saikia *et al.*, (2017b) reported from Arunachal Pradesh is a mistaken identification of *M. robusta*. As the SVL of the specimen reported was 66.3 mm, while the gravid female holotype of *M. zunhebotensis* was 39.0 mm and male paratype was 30.0 mm (Mathew and Sen, 2007), hence, *M. zunhebotensis* should be removed from the State's faunal records. With this current paper, *Megophrys pachyproctus* is added to the faunal list of India (Arunachal Pradesh), which increases the total *Megophrys* species in India from 14 to 15 out of the 77 species of this genus found globally (Frost, 2018).

Orlov *et al.*, (2002) included *M. pachyproctus* in the herpetofaunal checklist of Vietnam without providing any diagnostic characters, nor photograph or morphometrics. It is of great help to later workers, if, while reporting a new country record, at least proper diagnostic characters with a photograph of the specimen is provided. As considerable doubts have been raised about the proper identity of *M. pachyproctus* from Vietnam (Fei and Ye, 2016; Frost,

2018), this India record could be the only report of this species outside its type locality in China. However, Indian population of the species may be very low as only a single specimen has been recorded though the exact area has been surveyed thoroughly six times over a period of three years during 2015-2017, covering almost all the seasons. Or else, the species is very rare or elusive in nature. Even Fei and Ye (2016) suggested this species to be listed as Endangered.

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