



frog leg

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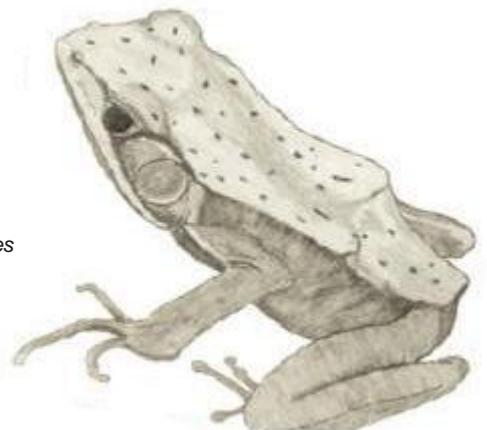
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Clinotarsus curtipes



A new site record of *Nasikabatrachus sahyadrensis* Biju and Bossuyt, 2003 from Thrissur Forest Division, Western Ghats, and notes on the tadpoles

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Recent anural studies in the forests of Western Ghats have discovered quite a few species new to science. The discovery of the monotypic

frog *Nasikabatrachus sahyadrensis* (Biju & Bossuyt 2003) is considered a link between archaebatrachians and neobatrachians. The type of

N. sahyadrensis was obtained from a degraded forest near a cardamom plantation at Kattappana, Idukki District, Kerala part of the Western Ghats (09°45'N & 77°05'E). Subsequent studies and observations provide more insight into the distribution of *N. sahyadrensis* from the Western Ghats. It has been later reported from Sankaran Kudi in the Anamalai, Tamil Nadu, Kothamangalam in Ernakulam District and Erumely in Kottayam District, Kerala (Dutta et al. 2004), Silent Valley National Park, Palakkad



Image 1. New site record of *Nasikabatrachus sahyadrensis* from Thrissur Forest Division (marked in red)



Image 2. Calling *Nasikabatrachus sahyadrensis*, seen in the burrow.

Photo by Jobin K.M.

District, Kerala (Das 2006), Karuvarakundu, Malappuram District, Kerala (Radhakrishnan et al. 2007) and from Karian Shola, Anamalai Tiger Reserve, Tamil Nadu (Raj et al. 2011). *N. sahyadrensis* has been reported from the north and south of the Palghat Gap of the Western Ghats.

During the course of our inventorying of the herpetofaunal diversity in the Thrissur forests, the first author heard the call of *N. sahyadrensis* on 4 June 2011. The call was heard from different locations within the forests. It was noticed that the frog's calls were more towards the area near the stream. Upon hearing the call we specifically searched for the

Table 1: Morphometry of tadpoles of *Nasikabatrachus sahyadrensis* from Thrissur Forest Division

Specimen No.	SVL (mm)	IOD (mm)	IND (mm)	END (mm)	TL (mm)	WM (mm)	IMTTL	IMTTW
11 June 2011 (Stage 1)								
Tadpole 1	12.83	2.29	1.15	1.87	19.61	5.85	-- --	-- --
Tadpole 2	12.02	2.09	1.18	1.85	18.23	5.07	-- --	-- --
4 September 2011 (Stage 2)								
Tadpole 3	29.5	5.38	2.48	3.6	37.17	14.52	-- --	-- --
Tadpole 4	28.68	5.44	2.58	3.7	45.29	15.43	-- --	-- --
Tadpole 5	30.47	5.53	2.41	3.6	48.53	15.19	-- --	-- --
Tadpole 6	27.5	5.82	1.75	3.75	31.08	14.98	2.63	0.32
29 September 2011 (Stage 3)								
Tadpole 7	31.17	6.23	1.72	4.18	34.77	13.89	2.78	0.53
Tadpole 8	32.85	6.12	1.78	3.97	42.93	15.14	2.77	0.49
Tadpole 9	32.07	6.24	2.02	4.09	33.8	13.93	3.03	0.51
Tadpole 10	29.08	6.27	2.2	4.12	24.79	12.27	3.03	0.53

SVL (snout-vent length), IOD (inter-orbital distance), IND (inter-nasal distance), END (eye-to-nostril distance), TL (Tail length), WM (width of tadpole mouth), IMTTL (Inner metatarsal tubercle length), IMTTW (Inner metatarsal tubercle width)



Image 3. The distribution map of *Nasikabatrachus sahyadrensis* with the present sightings (marked in red)

species and we later observed the call came from underground burrows and from small fissures or gaps seen between rocks and soil in the rocky areas. The burrows were covered with litter, and the frogs were spotted from a few of the burrows after careful removal of the litter. We photographed (Image, 2, 5) a single individual of *N. sahyadrensis* from a moist deciduous forest patch

of Pattikkad Range, Thirissur Forest Division, Thirissur District, Kerala (Image 1, 4) on the day of the first sighting at around 19.00hrs. Geographical location of the present observations is between 10o 34'20.7" N latitude and 76o 18'33.4" E longitude, at an altitude of 65.5m. Pattikkad range is located south of the Palghat Gap in the Western Ghats. The frogs were heard very close

to a seasonal stream. Subsequent detailed search for the *N. sahyadrensis*, was also rewarding. The authors who were familiar with the call of the *N. sahyadrensis* heard at least four different males calling within an area of 5m radius with the observer at the centre. During surveys, we noticed that calling individuals stopped calling as soon as the observer approached the 'caller'. The call of male *N. sahyadrensis* was also recorded using a SONY IC recorder ICD-PX720 during the recent discovery ([Audio 1](#)).

We continued the exploration in the nearby area in the next few days and heard more *N. sahyadrensis* from other locations within the Pattikkad Forest Range. On 9 June 2011 we were at Peechi- Vazhani Wildlife Sanctuary, which is contiguous to the Pattikkad Forest Range. The *N. sahyadrensis* were heard at this location too. Once again, the frog's calls were heard near a seasonal forest stream.

No amplexing or breeding pairs of *N. sahyadrensis* could be sighted from these areas during any of the visits to both the areas; this could be because breeding might have occurred before 4 June 2011. Southwest monsoon in this area had started at the beginning of last week of May 2011.



Image 4. Habitat of tadpoles of *Nasikabatrachus sahyadrensis*

On 11 June 2011 we again monitored the area from where *N. sahyadrensis* were heard and seen on 4 June 2011. This was quite rewarding as we located tadpoles of the *N. sahyadrensis* from these locations on that day. Tadpoles were found in the fast flowing seasonal streams near to area of observation, resisting the water current. Tadpoles were collected from the stream for further analysis. These collected tadpoles were staged on the basis of date of collection and metamorphic development observed in general. The collected tadpoles were deposited in the Kerala Agricultural University Natural History Museum, after properly fixing in 10%

formalin. The Morphometry of tadpoles were taken using a Mitutoyo Digimatic Caliper (to the nearest 0.1mm).

Photo by Jobin K.M.

The measurements tally with that given by Dutta et al. (2004). Standard measurements were taken for a few tadpoles. The morphological parameters taken include: SVL (snoutvent length), IOD (inter-orbital distance), IND (inter-nasal distance), END (eye-to-nostril distance), TL (Tail length), WM (width of tadpole mouth), IMTTL (Inner metatarsal tubercle length), IMMTW (Inner metatarsal tubercle width) after Dutta et al. (2004). The morphometry of the tadpoles is given in Table 1. Tadpoles of the *N. sahyadrensis* have ventrally placed oral disc (Image 6), flat body, large white head, dorsally placed eyes and nostrils, reduced tail fin, sinistral spiracle, keratinized beaks with

Photo by Jobin K.M.



Image 5. Female *Nasikabatrachus sahyadrensis* sighted at Pattikkad in Thrissur Forest Division

with teeth rows, the funnelshaped cloacal tube and flaplike extensions ventrally on the tailfin from the cloaca. They were seen hung or attached to the stones and rocks in fast flowing streams.

During the day, the tadpoles spent time submerged in the water and they came out by dusk. As it gets darker, more and more tadpoles would emerge from the water. The emergence of the tadpoles from underneath the water and their subsequent crawling movement through the

Photo by Jobin K.M.

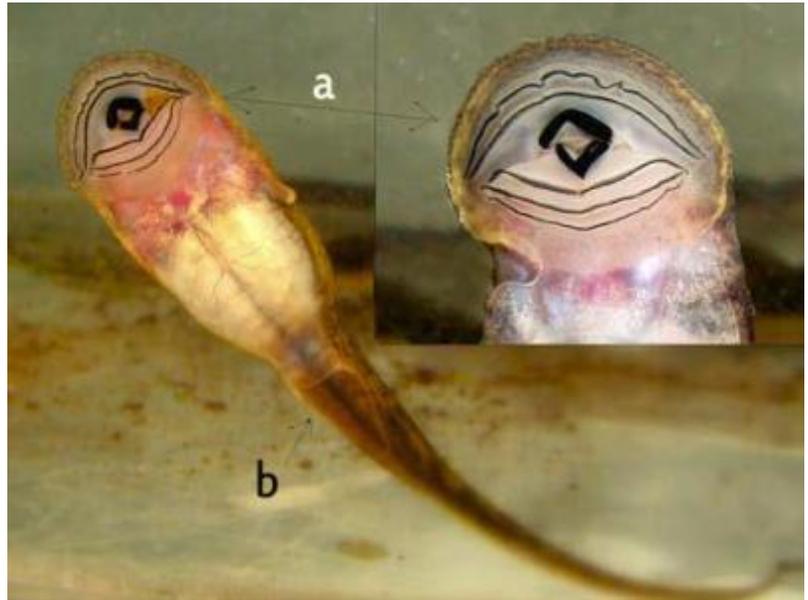


Image 6. *Nasikabatrachus sahyadrensis* tadpole showing (a) the Oral disc and (b) the funnel-shaped cloacal tube with a flap-like extension

Image 7. Tadpole attached to a rock within the stream



Photo by Jobin K.M.



Image 8. Tadpole with limbs

slimy rocky surface is a remarkable sight to watch ([video clip 1](#)). The tadpoles were found feeding primarily on the algal growth on the wet rocky surface. We could estimate about 150 to 200 tadpoles at this site.

The tadpoles with formed legs were sighted at these locations on 4 September 2011, about 86 days after the first set of tadpoles were seen. They were found clinging on to the rock surfaces in the high torrent stream. The morphometry of the tadpoles sighted and measured on 4 September 2011 is also given in Table 1. Tadpoles nearing metamorphosis with all four limbs were seen on 29 September 2011 (Image 8), about 111 days after

the first set of tadpoles were seen. On that day morphometric measurements were taken for four more tadpoles (Table 1). On subsequent field observations on 9 October 2011 (121 days) a well developed froglet was sighted (Image 9). The froglet was found outside the stream. The present observation once again reiterates the unique behaviour of this frog, which comes out of the burrow only during the peak of southwest monsoon for a few weeks to breed.

The earlier published records of *N. sahyadrensis* are from an altitude between 600 to 1000m above sea level (Biju & Bossuyt 2003, Dutta et al. 2004, Radhakrishnan et al. 2007, Raj et al. 2011) and

the present observation of this frog from an altitude of 65m is of interest (Image 3).

The present record signifies the conservation value of Peechi-Vazhani Wildlife Sanctuary, which is also an Important Bird Area (Islam & Rahmani 2004). The call of the *N. sahyadrensis* could be used as a useful tool to survey and monitor the population of this frog during the monsoon season across the Western Ghats. The present observations give further insight into the breeding biology of this less known species of a living fossil frog.

REFERENCES

Biju, S.D., & F., Bossuyt (2005b) Two new *Philautus* (Anura: Ranidae: Rhacophorinae) from Ponmudi Hill in the Western Ghats of India. *Copeia* 1: 29-37.

Das, A.S. (2006). Record of *Nasikabatrachus* from the Northern Western Ghats. *Zoos Print Journal* 21(9): 2410.

Dutta, S.K., Vasudevan, K., Chaitra, M. S., Shanker, K.

Jurassic frogs and the evolution of amphibian endemism in the Western Ghats. *Current Science* 211-216.

Islam, M.Z. & Rahmani, A.R. (2004). Important Bird Areas in India. Priority sites for conservation. Indian Bird Conservation Network: Bombay Natural History Society, BirdLife International. Pp. xviii + 1133.

Radhakrishnan, C., K. C. Gopi and M. J. Palot. (2007). Extension of range

of distribution of *Nasikabatrachus sahyadrensis* Biju & Bossuyt (Amphibia: Anura: Nasikabatrachidae) along Western Ghats, with some insights into its bionomics. *Current Science* 92 (2): 213-216.

Raj, P. Deepak, V. and Vasudevan, K. (2011). Monitoring of breeding in *Nasikabatrachus sahyadrensis* (Anura: Nasikabatrachidae) in the southern Western Ghats, India. *Herpetology Notes* 4: 11-16.

Image 9. A metamorph with withdrawing tail bud



Photo by Jobin K.M.

Amphibian Fauna of Arecanut plantation in Kadatoka (Uttara Kannada) Western Ghats, Karnataka

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Introduction

The topography, climate and the geographical spread of Karnataka have created a wide range of habitats that suit a rich assemblage of herpetofauna. As far as the amphibians of Karnataka are concerned, some studies conducted include those by Hegde & Ramakrishna (2006), Ravichandran & Krishnan (2006) and Dinesh & Radhakrishnan (2007). Kadatoka is a village in the Honavar Taluka of Uttara Kannada District. Mountains cover most of this village but it also has scattered thick forests to its south and paddy fields to the west (Hegde 2009). In the present account, an attempt has been made to list out the amphibian fauna in the Arecanut plantation at Kadatoka.

Study Area:

The study was conducted mainly in an Arecanut plantation at Kadatoka Village (14022'11" N & 74027'45" E) because of its commercial and historical

importance. The village was under Durgappa Nayaka's province before Britishers. The Durgappa Nayaka's kote (Fort) covering more than 10 acres of plain land on the top of the hill used for growing paddy during monsoon has been of historical importance to the village. The general topography of this area is low lying and flat boasting of two large standing-water

Bodies on east as well as on the west of the plantation. The weather is warm almost throughout the year except for a few days (in December and January) in winter. During annual rainfall, the water body to the west is connected with the paddy fields and during the dry season (April and May) this water body dries up. The plantation consists of Arecanut, Coconut, Banana, Cocoa, Pepper, Betel, Jackfruit, Mango, Sapota, Pineapple, Tamarind, Drumstick, Soap nut and Papaya mainly on the border. Also, it consists of some flowering plants like Hibiscus, Rose, Champaka, Jasmine, Paper flower and some other wild flowers.

Image 1. *Hylarana malabarica*



Methodology:

The present paper is based on the field work carried out in different parts of the plantation during evening, specially during pre and post monsoon seasons. Visual encounter and random sampling methods were adopted for collecting amphibians. The calls heard at night were helpful in locating some species. Survey was conducted in the evening during monsoon using powerful torchlight near water bodies and in microhabitats like on the forest floor, on the rocks, among leaf litter, on moss or algae, under logs, under the soil, edge of the water bodies, among weeds and near termite mounds as explained in Daniels (1995). The frogs marked by asterisk were collected, identified, deposited and registered in the Amphibia section, ZSI, Kolkata and other samples were caught, identified and released in the field. The amphibians were identified at ZSI, Kolkata using the diagnostic characters and most of the descriptions were given based on Daniel (1963 a, b, 1967, 1975), Dutta (1997) and Das & Dutta (2006) and the taxonomy followed according to Frost (2011).



Image 2. *Duttaphrynus stomaticus*

***Duttaphrynus parietalis* (Boulenger, 1882) Ridged Toad**

Adult size: Medium to large. (SVL 85mm).

Description of the adult: Dorsal surface uniform light brown and the ventral surface marbled with brown. The skin on the upper side with numerous warts of irregular size of which those on the middle of the back are comparatively larger in size. Parotid glands are relatively large, elongate and elliptical in shape. The snout is short and blunt and the head is broad and triangular in shape. The crown bears very important ridges and the parietal ridges are obliquely directed downwards. First finger longer than the second. Tibiotarsal articulation reaching

between the eye and the tip of snout. Toes half webbed. Two moderately developed, metatarsal tubercles present.

Habits and habitat: This is a hill species and generally found in evergreen, semi evergreen as well as in moist places. Found in deciduous and secondary forests as well.

Call: Described as typical drumming. 'To-to-to-to....' In chorus, along streams.

Distribution: Karnataka, Kerala, Tamil Nadu and Andhra Pradesh (Dinesh et al. 2009).

Remark: Very common near wet places and collected near water tank.

***Duttaphrynus stomaticus* (Lutken, 1863), Marbled Toad**

Adult size: Medium (Maximum SVL 76mm).

Description of the adult: Dorsal surface of the body is grey or olive, ventral surface including the upper lip whitish in colour. Yellow-olive brown with or without bold marblings. Upper lip and underparts white. Skin smoother than *D. melanostictus*. Parotid glands not cornified. Tympanum about as large as the eye. Fingers free and the first finger longer than the second. Hindlimbs moderate in size. Toes nearly two-thirds webbed. Two sharp-edged and equal-sized metatarsal tubercles present.

Habits and habitat: A rather docile toad capable of burrowing into soil. Found in urban areas to forests.

Call: Described as 'higher pitched and shriller' than *D. melanostictus*.

Distribution: Western and Eastern Himalayas, Assam, West Bengal, Uttar Pradesh, Karnataka, Bihar, Odisha, Maharashtra and Andhra Pradesh (Dinesh et al. 2009).

Remark: Very much common near human settlement, under street lights.

***Duttaphrynus melanostictus* (Schneider 1799) Common Indian Toad**

Adult size: Medium to large (Maximum SVL up to 160mm).

Description of the adult: Yellow to olive brown, red or black. Marbled or plane. White-grey below with fine marblings. Yellow orange throat in mature males. Cornified parts black or tipped black. Tympanum as large as eye. Two rows of paired dorsal warts on hind neck considerably enlarged. Toes ½ webbed.

Habits and habitat: Commensal of humans. Attracted to light within human environs and on roadsides. Found in urban areas, cultivation to dense evergreen forests.

Call: Typical drumming : 'creoo- o', 'cro-ro-ro-ro-ro-ro-ro'. Rather monotonous.

Distribution: Throughout India. (Dinesh et al. 2009).

Remark: One of the commonest toad throughout the plantation.

***Euphlyctis cyanophlyctis* Schneider, 1799 Skipper Frog**

Adult size: Medium (Maximum SVL 70mm).

Description of the adult: Brown – olive (sometimes greenish or black) with distinct black spots on back and limbs. White below. A white stripe along sides and on rear side of thighs distinct. Pale middorsal stripe absent. Skin generally smooth. Tympanum distinct.

Image 3. *Duttaphrynus melanostictus*



Toes fully webbed. Eyes rather dorsally placed. This differs from *Euphlyctis hexadactylus* in having thinner thighs. The first finger is not longer than the second.

Habits and habitat: Aquatic. Floats on surface with all four limbs up often folded close to the body; a rather characteristic posture of the species. Skips on surface when disturbed. Found in urban environments to hill streams, just any place where there is water.

Call: A sharp 'pit-ti-ti-ti-ti-ti-ti-ti-ti' followed by occasional 'prik...prik'. Aggressive and territorial.

Distribution: Throughout India. (Dinesh et al. 2009).

Remark: Quite common in water bodies and floats on water. Feeds on floating aquatic insects.

***Fejervarya keralensis* (Dubois, 1980) Kerala Warty Frog**

Adult size: Small to Medium (SVL up to 40mm).

Description of the adult: Upper surface grayish or brown, with darker spots and markings. A distinct V-shaped marking present between the eyes. Thigh is black at posterior with whitish markings. Skin covered with numerous

prominent warts and glandular folds. Ventral surface smooth except under the thighs where it is granulated. Head moderately large, snout obtusely pointed, depressed and slightly longer than broad. An elliptical and compressed inner metatarsal tubercle present. Male bears internal vocal sac and feebly developed pad on the inner side of the first finger.

Habits and habitat: This is a hill species and generally found in elevations of 1219-2133 m. in the hills of southern India. Usually found near edges of streams and large reservoirs.

Call: Aggressive 'Crok-crok-crok...' (9-11 times) in quick succession. Low pitched.

Distribution: Karnataka, Kerala, Tamil Nadu, Odisha and Goa (Dinesh et al. 2009).

Remark: Very common in arecanut plantations.

***Minervarya sahyadris* (Dubois, Ohler & Biju, 2001) Minervarya Frog**

Adult size: Small. (SVL 17.6- 19.2 mm in adult males 20.6- 23.0 mm in adult females).

Description of the adult: A small frog possessing dorsal skin with longitudinal folds; pupil horizontal and oval, iris golden yellow; sides of head brownish, darker in tympanic region; mid dorsum brown to brick red; upper arm brick red and venter yellowish-white. A rectal gland at the mouth commissure, prominent in life; distinct canthus

Image 4. *Minervarya sahyadris*



rostralis; nostrils near to snout tip than to eye; a white horizontal band along the upper lip in life; vomerine teeth present; median lingual process absent; digital extremities rounded, not dilated; webbing rudimentary; inner metatarsal tubercle present, minute. (Dubois et al. 2001)

Habits and habitat: Semi aquatic, terrestrial species. Recorded from grassy areas and under the leaf litters in paddy fields and plantation.

Call: A low pitch small tik...tik... tik....tik.....tik sound .

Distribution: Karnataka and Kerala (Dinesh et al. 2009).

Remark: Calling of this small frog is very common in the arecanut plantation even in summer near to onset of monsoon.

***Fejervarya syhadrensis* (Annandale, 1919)
Syhadry Frog**

Adult size: Medium (SVL up to 40mm).

Description of the adult: Dorsal surface grayish with a series of black spots. A pale middorsal line is often present. In male, the throat is generally mottled with black. Ventral surface immaculate. Dorsal skin covered with a number of

prominent warts and tubercles. A more or less distinct fold present across the head and behind the eyes. Lower parts generally smooth. Posterior part of the belly and the proximal part of the thighs granulate. Head longer than broad. Snout pointed and projecting slightly beyond the mouth. An oval inner and an outer metatarsal tubercle present.

Habits and habitat: Reported to occur inside dense vegetation at the edge of shady jungle streams. Usually found near edges of streams.

Call: Described as resembling a 'bleating sheep'.

Distribution: Karnataka, Maharashtra and Orissa (Dinesh et al. 2009).

Remark: Very common in the arecanut plantation after irrigation.

***Hoplobatrachus crassus* (Jerdon, 1854) Jerdon's Bull Frog**

Adult size: Large (SVL more than 90mm).

Description of the adult: Generally confused with *H. tigerinus*. Differs from the latter by darker colouration and being more spotted than streaked. White below. Breeding individuals do not develop the bright

yellow colouration as in *H. tigerinus*. Mid dorsal stripes less striking; more often absent than present. Juveniles show traces of green on head and sides; darker than juvenile *H. tigerinus*. Smaller than *H. tigerinus*. Skin more warty (vs. thin long folds). Snout and limbs (especially hind) much shorter. Metatarsal tubercle much larger.

Habits and habitat: More of an active forager. Rests exposed along fields and on edge of water within excavated shallow depressions. Found in urban cultivation and scrub.

Call: A loud and sharp 'Pakapaka- pak' or 'paka-paka' in quick successions. Distinct and strikingly different from that of *H. tigerinus*.

Distribution: Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, West Bengal, Assam, Uttar Pradesh, Madhya Pradesh and Odisha (Dinesh et al. 2009).

Remark: Not so common in arecanut plantations.

***Hoplobatrachus tigerinus* Daudin 1802, Indian Bull Frog**

Adult size: Large. The largest Indian frog (SVL more than 120mm).

Description of the adult: Yellow to olive green (the

green disappearing with age) with black spots and stripes. Pale and broad lateral and mid-dorsal bands frequently present. Pale limbs with bold bands. White underparts. Males turn yellow during breeding. Vocal sacs cobalt blue. Large size. Long snout with wide gap. Prominent tympanum and eyes. Long and powerful limbs. Toes almost fully webbed. Metatarsal tubercle small. Skin on back longitudinally folded.

Habits and habitat: Solitary. Sedentary resting for long in the same place and day after day. Pounce feeds (vs. active search). Found in open to dense forests, river and stream beds, hill cultivation and suburbs, along hill roads and channels.

Call: A loud and low pitched 'bong' or 'oong-awang'.

Image 6. *Hoplobatrachus tigerinus*



Distribution: Throughout India (Dinesh et al. 2009).

Remark: The largest Indian frog, essentially an aquatic amphibian found always near water bodies or inside the water. Gets beautiful colouration during breeding season and starts calling as soon as the western side of the plantation gets rain.

***Sphaerotheca breviceps* (Schneider, 1799) Indian Burrowing Frog**

Adult size: Small-medium (SVL maximum 50 mm).

Description of the adult: Pale to dark brown grey above. Occasionally spotted with yellow or white. White below. Throat darker. Yellowish mid-dorsal line often present. Pale lateral bands and snout. Stocky build.



Image 5. *Sphaerotheca breviceps*

Blunt nose. Metatarsal tubercle well developed. Tympanum 2/3 diameter of eye. First finger much longer than second.

Habits and habitat: Fossorial. Found in open forests and agricultural areas.

Call: A loud 'awang'.

Distribution: Karnataka, Maharashtra, Punjab, Odisha, West Bengal, Rajasthan, Kerala and Tamil Nadu (Dinesh et al. 2009).

Remark: It is seen during feeding and breeding. Its powerful hind legs with daggerlike metatarsal tubercle helps to burry deep in the loose soil.

***Sphaerotheca leucorhynchus* (Rao, 1937) Rao's Burrowing Frog**

Adult size: Small (SVL less than 30 mm).

Description of the adult: Pale brown above with a broad white band on snout extending till anterior margin of eyes. Dark 'W'-shaped band between eyes. White between eyes and shoulders. 'U' shaped mark on sides of body. Limbs cross barred. White below. Undersides of thighs yellow. Foot chocolate brown. Toes short; 1/3 webbed. Inner metatarsal tubercle large, strongly compressed. Outer metatarsal tubercle small and placed at the base of the fourth toe.

Habits and habitat: Usually found hiding under the leaf litter in open forests and agricultural areas.

Call: Not known.

Distribution: Karnataka (Dinesh et al. 2009).

Remark: Rediscovered after 75 years. Comes out for feeding as soon as the irrigation will be done in the plantation.

Microhyla ornata
Dumeril and Birbon,
1841 Ornate Narrow-
mouthed Frog

Adult size: Very small to small (SVL rarely exceeding 26 mm).

Description of the adult: Golden to earth brown with darker symmetrical markings on back (frequently arrow-shaped).

Legs cross barred. White below. Throat black in breeding males. Narrow head and broader trunk is the characteristic. Fingers and toes without dilated tips. Toes without web. Metatarsal tubercles very small.

Habits and habitat: Active. Leaps powerfully and high for its size. Urban, agriculture, deciduous to evergreen forests.

Call: A shrill long drawn 'breep' resembling a finger nail being drawn across a plastic comb. Often in loud chrouses after the first rains. Sometimes during overcast days on forest floor from under logs and stones.

Distribution: Throughout India including Andaman and Nicobar Islands. (Dinesh et al. 2009).

Remark: Most common ornate frog in moist places during night. Calls were common in the plantation.

Uperodon globulosus
(Gunther, 1864) Greater
Balloon Frog

Adult size: Medium (SVL up to 70mm).

Description of the adult: Uniformly grey above with whitish-yellow underparts. Black throat in males. Heavy built. Smooth skin and soft rather limp body. Tympanum concealed.

Very large external vocal sacs. Small head with beady eyes. Hind legs with large shovel like metatarsal tubercle. Legs weak. Fingers and toes without enlarged tips.

Habits and habitat: Excellent burrower. Found in open forests.

Call: Described as a loud grunt, 'Oink'.

Distribution: West Bengal, Odisha, Assam, Bihar, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Kerala (Dinesh et al. 2009).

Uperodon systema
(Schneider, 1799)
Lesser or Marbled
Balloon Frog

Adult size: Medium (SVL up to 70mm).

Description of the adult: Olive green yellow with black marblings. White below. Black throat in breeding males. Smaller size and distinctly marbled colour pattern separate from *Uperodon globulosus*. Metatarsal tubercles less developed.

Habits and habitat: Sluggish, burrowing. Feeds more or less entirely on winged termites. Scrub, cultivation and deciduous forests.

Call: No specific call is reported.

Distribution: West Bengal, Himachal Pradesh, Uttar Pradesh, Odisha, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh (Dinesh et al. 2009).

Remark: Found during breeding season and can be located near wooded water lodged in the plantation.

***Hylarana malabarica* (Tschudi, 1838) Fungoid Frog**

Adult size: Medium (SVL up to 75 mm).

Description of the adult: Brick red to bright crimson dorsally with black sides, limbs and under parts. White marblings on sides and limbs variable. Occasional black markings on back. Skin smooth. A thick fold from tympanum to groin. Toes fully webbed. Tips of fingers and toes swollen but not enlarged into discs.

Habits and habitat: More terrestrial, found within the holes and crevices. Forests, cultivation and sometimes found inside the houses also.

Call: 'Wak-wak-wak'

Distribution: Western Ghats, Assam and Meghalaya (Dinesh et al. 2009).

Remark: During rainy season, it always lives inside the human habitat

and goes out during evening for feeding and again comes inside the house in the morning.

***Pseudophilautus amboli* (Biju & Bossuyt, 2009) Amboli Bush Frog**

Adult size: Medium sized frog (SVL up to 60 mm).

Description of the adult: Adult male will be of the size 27.6- 34.1 mm long and female will be of 37.5 mm long. Dark brown tympanum, in combination with a relatively larger snoutvent length, head width is almost equal to its length. Body rather robust, discs of fingertips much enlarged. Upper 2/3 of tympanum dark brown, throat lemon yellowish with minute black spots.

Habits and habitat: Ground near disturbed evergreen forest patches. Near or inside the vegetation.

Call: Tak... Tak... Tak... Tak.....

Distribution: Western Ghats parts of Maharashtra and Karnataka (Dinesh et al. 2009).

Remark: Common in the plantation. Starts calling during evening. Collected on a small bush while calling.

***Raorchestes bombayensis* (Annandale, 1919) Maharashtra Bush Frog**

Adult size: Small sized frog (SVL 23.3mm).

Description of the adult: Adult male will be of the size 23.3 mm long and snout oval in dorsal view, canthus rostralis sharp, presence of papillae on tongue, groin and lateral side prominently marbled with creamy white blotches in a brown background. Distinct nuptial pad on the first finger of male. Head length less than head width, tympanum rather indistinct. Forelimb shorter than hand, fingers without lateral dermal fringe, webbing absent. Hindlimbs moderately long, webbing reduced, subarticular tubercles rather prominent, rounded, simple, supernumerary tubercles absent.

Habits and habitat: On the ground or on the small bushes near vegetation.

Distribution: Western Ghats parts of Maharashtra and Karnataka (Dinesh et al. 2009).

Remark: Common in the plantation. Starts calling during evening. Sometimes enter the houses also.

Polypedates leucomystax
(Gravenhorst, 1829)
House Tree Frog

Adult size: Medium sized frog (SVL about 60mm).

Description of the adult: Head broader than long; tympanum distinct. Fingers long with well developed. Toes two third webbed; tips of toes dilated into well developed discs and toes and fingers with cutaneous circum-marginal grooves. Dorsal skin finely granulated; belly and thigh granulate and the rest of the ventral surface of the body smooth. Dorsally yellowish to grey; ventral surface almost white (Chanda 1991).

Habits and habitat: Found inside the room specially at night.

Distribution: Assam, Arunachal Pradesh, Nicobar Islands, Meghalaya, Sikkim, West Bengal (Dinesh et al. 2009) and Karnataka.

Remark: Reported first time from Karnataka State.

Polypedates maculates
(Gray, 1833) Chunam or
Common Tree Frog

Adult size: Medium (SVL up to 70 mm).

Description of the Adult: Colour variable from almost

plain white-fawn to yellowish-brown with darker markings. Dark line from snout through eyes and along the sides. Rear side of hind limbs marbled yellow and brown. White below. Toes $\frac{1}{2}$ webbed. Web extends till about half length of fourth toe. Tympanum distinct (more than $\frac{1}{2}$ diameter of eye).

Habits and habitat: A commensal of humans entering living quarters frequently. Urban to secondary forests.

Call: A loud 'ta-ta-tak-tak'.

More commonly a low rumbling 'da-da-da-da' or 'do-do-do-do'. Choruses sound like distant fireworks (softer).

Distribution: Throughout India (Dinesh et al. 2009).

Remark: Common in the sanctuary. Collected on a small plant while calling.

Polypedates occidentalis,
Das and Dutta, 2006
Charpa Tree Frog

Adult size: Medium (47.5-55.1 mm).

Image 7. *Polypedates occidentalis*



Description of the adult: *Polypedates occidentalis* is a medium sized tree frog with SVL of adult males 47.5- 55.1 mm and females unknown. It possess rounded snout, fingers free, un-pigmented nuptial pads on dorsal surface of fingers I and II, vomerine teeth oblique between choanae, fingers with rudimentary webbing, no dermal fold along forearm. Webbing in toe II extending to the base of the discs, skin of forehead free, skin lacking dermal flap, heel lacking a cutaneous spur, dark hour glass-shaped mark on dorsum (Das & Dutta 2006).

Habits and habitat: Lives in plantation. Urban to secondary forests.

Distribution: Kerala (Type locality) and Karnataka (Hegde & Bhat 2011).

Remark: Found near the banana plant.

Discussion:

Since, the arecanut plantation is a well-protected area and there is less human interference, we are able to find 20 species of frogs including the common ones. The presence of many tadpoles in almost all the stagnant water ponds during the monsoon indicates that this plantation is a well-protected area for the amphibian fauna to live and breed. The presence of the tadpoles of the toad indicates the humid climate of this area facilitates the

movement of the amphibians during the day as well. The common Indian toad, Marbled Toad, Skipper frog, Minervarya Frog, bull frogs are very common in the plantation. Since the irrigation system largely mimics the raining, the calling by some frogs during midsummer can also be heard. *Raorchestes bombayensis* sometimes found near on the tap also. During the rainy season, the Fungoid frog usually lives inside the houses and starts calling along with the television or mixer sound. During evening, promptly goes outside the house for feeding and starts entering the house as soon as the door opens in the morning. The extensive study of the amphibian fauna of arecanut plantation during pre and post monsoon season may reveal few more species of frogs, toads and caecilians in near future. Since the arecanut plantation is a good source of insects, we can find large number of frogs feeding on them throughout the year.

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References

Chanda, S.K. (1991) *Amphibia : Faunal Resources of Ganga*, Part1, 51-57pp.

Daniel, J.C. (1963a) Field guide to the Amphibians of Western India Part I. *Journal of the Bombay Natural History Society* 60: 415-438.

Daniel, J.C. (1963b) Field guide to the Amphibians of Western India Part II. *Journal of the Bombay Natural History Society* 60: 490-702.

Daniel, J.C. (1975) Field guide to the Amphibians of Western India Part III. *Journal of the Bombay Natural History Society* 72: 506-524.

Daniels, R.J.R. (1995) Habitat selection in Western Ghats. *Amphibians-Anura: Implications for species conservation. Cobra* 20: 7-16.

Daniels, R.J.R. (2000) Reptiles and Amphibians of Karnataka. *Cobra* 42: 1-11.

Das, I. & S.K. Dutta (2006). New species of *Polypedates* (Anura: Rhacophoridae) from the Western Ghats, southwest India. *Journal of Herpetology* 40(2): 214-220.

Dinesh, K.P & C. Radhakrishnan (2007) Amphibia In: *Fauna of Kudremukh National Park, Conservation Area Series* 32: 133-156 Director, Zoological Survey of India, Kolkata

Dinesh, K.P., C. Radhakrishnan, K.V. Gururaja & G.K. Bhatta (2009). An annotated checklist of Amphibia of India with some insights into the patterns of species discoveries, distribution and endemism. *Records of Zoological Survey of India* 302: 1-153. Director, Zoological Survey of India, Kolkata).

Dubois, A., A. Ohler & S.D. Biju. (2001). A new genus and species of Ranidae (Amphibia: Anura) from southwestern India. *Alytes* 19: 53-79.

Dutta, S.K (1997). *Amphibians of India and Sri Lanka*. Odyssey Publishing House, Bhubaneswar.

Frost, D.R. (2011) Amphibian species of the world: an online reference, version5.5 (31 January 2011) Electronic Database accessible at <http://research.amnh.org/vz/herpetology/amphibia/American>; <http://research.amnh.org/vz/herpetology/amphibia/American>

Table 1. Sytematic list of species

Class Amphibia		
Order Anura		
Family Bufonidae		
	Scientific Name	
1	<i>Duttaphrynus parietalis</i> * (Boulenger, 1882)	Ridged Toad
2	<i>Duttaphrynus stomaticus</i> (Lutken, 1864)	Marbled Toad
3	<i>Duttaphrynus melanostictus</i> (Schneider, 1799)	Common Indian Toad
Family Dicroglossidae		
Subfamily Dicroglossinae		
4	<i>Euphlyctis cyanophlyctis</i> (Schneider, 1799)	Skipper Frog
5	<i>Fejervarya keralensis</i> * (Dubois, 1980)	Kerala Warty Frog
6	<i>Minervarya sahyadris</i> * (Dubois, Ohler & Biju, 2001)	Minervarya Frog
7	<i>Fejervarya syhadrensis</i> * (Annandale, 1919)	Syhadry Frog
8	<i>Hoplobatrachus crassus</i> (Jerdon, 1854)	Jerdon's Bull Frog
9	<i>Hoplobatrachus tigerinus</i> (Daudin 1802)	Indian Bull Frog
10	<i>Sphaerotheca breviceps</i> (Schneider, 1799)	Indian Burrowing Frog
11	<i>Sphaerotheca leucorhynchus</i> * (Rao,1937)	Rao's Burrowing Frog
Family Microhylidae		
Subfamily Microhyliinae		
12	<i>Microhyla ornata</i> (Dumeril & Birbon, 1841)	Ornate Narrow-mouthed Frog
13	<i>Uperodon globulosus</i> (Gunther, 1864)	Greater Balloon Frog
14	<i>Uperodon systoma</i> (Schneider, 1799)	Lesser or Marbled Balloon Frog
Family Ranidae		
15	<i>Hylarana malabarica</i> * (Tschudi, 1838)	Fungoid Frog
Family Rhacophoridae		
Subfamily Rhacophorinae		
16	<i>Pseudophilautus amboli</i> * (Biju & Bossuyt, 2009)	Amboli Bush Frog
17	<i>Raorchestes bombayensis</i> * (Annandale, 1919)	Maharashtra Bush Frog
18	<i>Polypedates leucomystax</i> * (Gravenhorst, 1829)	House Tree Frog
19	<i>Polypedates maculatus</i> (Gray, 1833)	Chunam or Common Tree Frog
20	<i>Polypedates occidentalis</i> * Das & Dutta, 2006	Charpa Tree Frog

Museum of Natural History, New York, USA. Accessed on 14.11.2011

Hegde, V.D. (2009). Check-list of birds of Kadatoka village, Karnataka state. NewsLetter for Bird watchers 49(3): 33-34.

Hedge, V.D. & G. Bhat (2011). New record of Charpa Tree

Frog, *Polypedates occidentalis* from Karnataka state. FrogLeg Newsletter Feb: 10-11.

Hegde, V.D. & Ramakrishna (2006). Faunal Diversity in Bhadra Tiger Reserve, Karnataka. In: *Faunal Diversity of Tiger Reserves in India*. Ramakrishna, Rajesh Gopal

and J.R.B. Alfred eds. Vol. II.: 917-944pp.

Ravichandran, M.S. & S. Krishnan (2006). Amphibia In: *Fauna of Biligiri Rangaswamy Temple Wildlife Sanctuary. Conservation Area Series 27*: 223-232. Director, Zoological Survey of India, Kolkata).

Second known locality of the Critically Endangered *Adenomus dasi* Manamendra-Arachchi & Pethiyagoda, 1998 (Bufonidae) from Samanala Nature Reserve, Sri Lanka

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Introduction

Sri Lanka has 113 species of amphibians and 95 of them are endemic (de Silva 1996, 2009; Dutta & Manamendra-Arachchi 1996; Fernando et al. 2007; Frost et al. 2006; Manamendra-Arachchi & Pethiyagoda 2005, 2006; Meegaskumbura & Manamendra-Arachchi 2005; Meegaskumbura et al. 2007, 2009, 2011). These 113 species of amphibians belong to seven families (Bufonidae, Dicroglossidae, Microhylidae, Nyctibatrachidae, Ranidae, Rhacophoridae and Ichthyophiidae) (de Silva 2009; Frost 2010). There are nine species of bufonids distributed in Sri Lanka, of which six are endemic to the

island (Pethiyagoda et al. 2006; de Silva 2009). The family Bufonidae is represented by three genera *Adenomus* (three species), *Duttaphrynus* (five species) and *Bufo* (one species). The genus

Adenomus is one of the dwarf toad genera which is distributed in moist wet zone of Sri Lanka (Pethiyagoda et al. 2006; de Silva 2009).

There are three species of *Adenomus* [*Adenomus dasi* Manamendra-Arachchi & Pethiyagoda 1998; *A. kandianus* (Günther 1872) and *A. kelaartii* (Günther 1858)] in Sri Lanka and all of them are endemic (endemic relict genus), while *A. kandianus* is Extinct (Kirtisinghe 1957; Manamendra-Arachchi & Pethiyagoda 2006; de Silva 2009). According to the published literature, *A. dasi* is known only from a handful of specimens collected from a small stream with rocky habitat near Moray Estate in Samanala Nature Reserve (>1300m), Mousakelle in

Image 1. The type locality of *Adenomus dasi*, Moray Estate in SNR

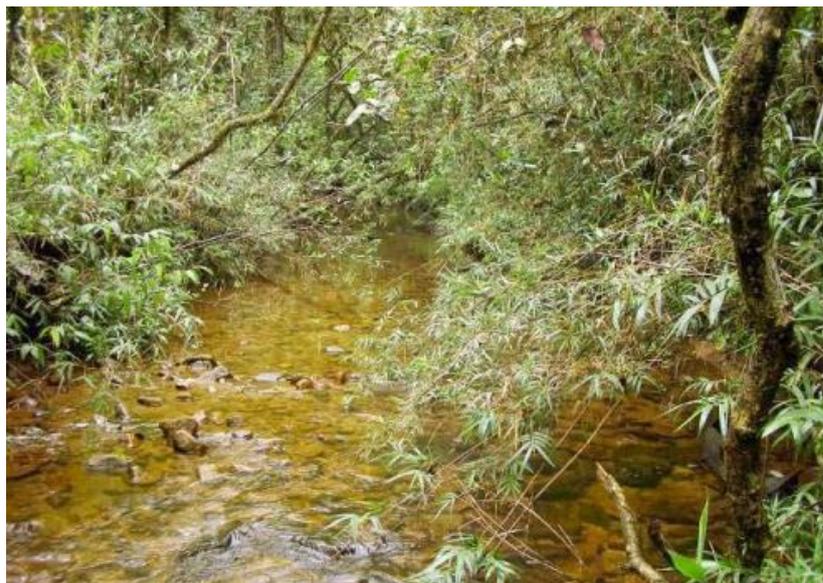


Photo by D.M.S.S. Karunarathna.



Image 2. New location (Disturbed habitat of *Adenomus dasi* in Seetha-gangula area)

the wet zone (Image 1). This species is identified as a Critically Endangered species in Sri Lanka due to its restricted range and also globally as a Data Deficient species due to lack of required information about its biology and ecology (IUCN 2010, IUCN SL & MENR 2007).

New Location and Habitat

We report the occurrence of the rare, endemic *A. dasi* from "Seetha Gangula" area ("Seetha"=cold, "Gangula" = large stream) in Samanala Nature Reserve (SNR; also called Peak Wilderness Sanctuary). SNR is one of the largest and important forest areas in Sri Lanka for endemic biodiversity which lies between 80°25' to 80°50' eastern longitudes and

6°40' to 7°00' northern latitude (Gunatilleke & Gunatilleke 1990). This conservation area belongs to Nuwara-Eliya

District in Central Province and Kegalle and Ratnapura districts in Sabaragamuwa Province (Singhakumara 1995; Gunatilleke et al. 1996). The SNR covers a total land area of 461km² and 0.7% of total land area in Sri Lanka (Wickramasinghe 1995). SNR was declared as a Nature Reserve under the Fauna and Flora Protection Ordinance by gazette Number 8675 of 25 October 1940. Biologically, this reserve is one of the richest forests in Sri Lanka and highly dissected terrain is covered with some of the last remnants of altitudinal gradient rain forest, which range from 400–2245 m.

Photo by D.M.S.S. Karunaratna.

The vegetation of

Image3a. Dorsal view and the hourglass making of *Adenomus dasi*



Photo by D.M.S.S. Karunaratna.



Image 3b. Ventral aspect and granulated skin of *Adenomus dasi*



Image 3c. Dorsolateral view and the reddish tubercle of *Adenomus dasi*

SNR range from lowland wet evergreen forest (rain forest) in Gilimale at the foothills on the south through submontane evergreen forest (*Doona*, *Calophyllum* and *Syzygium*

species dominated) to montane evergreen forest (*Michelia*, *Elaeocarpus*, *Syzygium* and *Gordonia* species dominated) at the highest elevations (Werner 1982; Gunatilleke et

al. 1996). The Seetha Gangula area belongs to sub-montane region of Sri Lanka and various landscape patterns were observed. Some human-altered landscapes such as chena (slash-and-burn) and rice cultivations, *Pinus*, *Eucalyptus*, *Cyprus* and *Casuarina* forest plantations and tea plantations are also located in the foothills of the SNR (Perera 1972). Most of these human altered landscapes can be found up to about 800m elevation of the sanctuary. Every year hundreds of people visit Adams Peak, located within the park, to appreciate this historical wonder.

Present Observation

A recent off season expedition to the SNR (06049. 31'N & 80028.14'E; altitude 1000m) from 4-7 July 2010 provided the opportunity to report the second locality of *A. dasi*. There is no previous record of its presence in Seetha-Gangula area (Kuruwita track) in Ratnapura District (Manamendra-Arachchi & Pethiyagoda 1998, 2006; de Silva 2009). The present locality was about 4km away from the 'Adavi Kanda' (hiking track starting area). Two specimens of *A. dasi* were collected from the ground of an open canopy foot path of a disturbed habitat (Image 2). The direct distance between type locality and the

Photo by D.M.S.S. Karunaratna.

Photo by D.M.S.S. Karunaratna.



Image 4. Plastic and polythene mixed garbage dumping in SNR

Photo by D.M.S.S. Karunaratna.

This species is rare in the Moray Estate in the Rajamally as we hardly ever heard the call of this species during our previous surveys. However, this species may be found in other forested areas of this reserve. This frog doesn't change its colour but is very aggressive when handled. We searched for more individuals of *A. dasi* at night using headlamps in microhabitats such as ground, tree holes filled with water, ground shedding bark on trees, crevices on rock walls, under leaf litter, under rocks and decaying logs. However, we failed to locate more individuals of *A. dasi*. In addition to *A. dasi* we were able to record the following amphibian species, *Ramanella obscura*, *Fejervarya kirtisinghei*, *Lankanectes corrugatus*, *Nannophrys ceylonensis*, *Hylarana temporalis*, *Pseudophilautus microtympanum*, *P. reticulatus*, *P. schmarda*, *P. sordidus* and *Taruga eques* from the same locality. This is also the lowest known altitude record of *A. dasi*.

Conservation

Every year thousands of people visit Adams Peak which is located within the SNR, to appreciate this historical wonder. Nevertheless, this critically endangered species like many other amphibian taxa are seriously affected by increasing pressure from

new location is about >3km. The measurements were taken to the nearest 0.1mm with dial calipers and to the nearest 1 mm with measuring tapes. These two individuals were sexed and they belonged to a male (SVL 21mm) and a female (SVL 27mm). The collection site was about 100m away from the nearest permanent water body, which is a small stream.

The dorsal color of the collected specimens was golden yellow with dark brown hour glass shape mark (Image 3a). Feet were dorsally purple brown with mixed red subconical tubercles and in the dorsal back side with a thin golden line. Ventrally they were dirty white or pale yellowish and marbled with dark brown. Tympanum hardly visible and

interorbital area slightly convex or flat. Digits rudimentary webbed, tips mostly rounded and short (Image 3b). Dorsal skin smooth, but granular hour glass shape pattern present with a smooth chin; chest and abdomen area smoothly granulated (Image 3c). The original description of this species matched with these individuals collected and also photographs of the present individuals also perfectly matched the holotype of Manamendra-Arachchi & Pethiyagoda (1998). Both collected specimens were examined carefully, sexed and measured before being released back into the same habitat without any injuries. These specimens were caught following a week long intermediate rains.

loss and degradation of natural habitats such as montane forests and marshes. Major threats can be identified as illicit timber and fuel wood extraction, illegal land encroachments for settlement and cultivation, and gem mining. All of these human activities continue to degrade and erode the remaining vestiges of primary forest in the reserve. Disposal of garbage by tourists should be monitored by the Department of Wildlife Conservation and Forest Department of Sri Lanka (Image 4).

Without any doubt SNR is providing shelter for very high number of amphibians and this reserve is the most important amphibians hotspot in Sri Lanka when considering the future conservation of endemic amphibians. Identification and designation of forest reserves on the perimeter of the sanctuary that could function as suitable buffer zones, demarcation of boundaries, and implementation of conservation education awareness programmes among villagers and visitors are some possible measures towards the conservation of endemic amphibians in SNR area.

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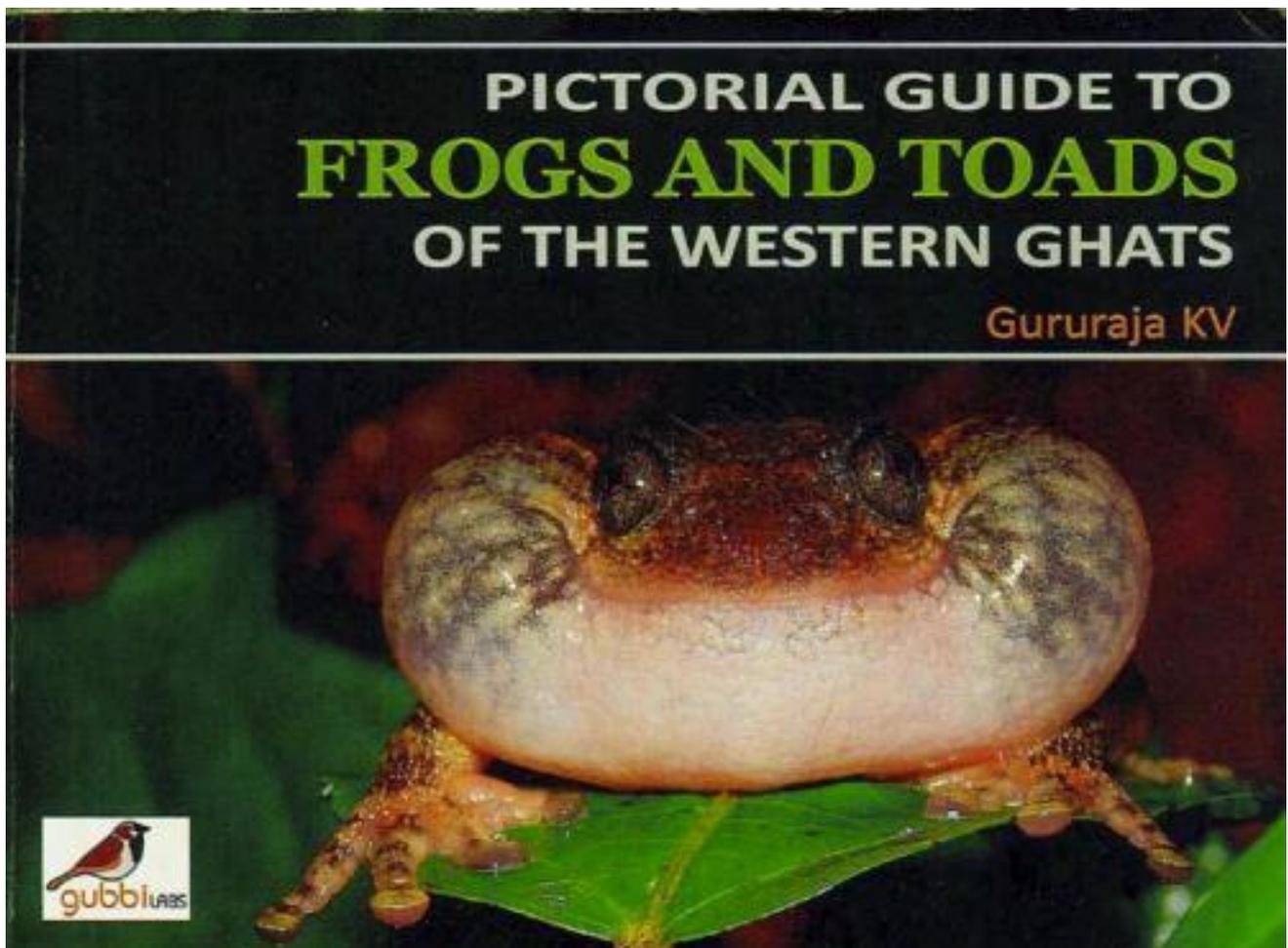
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References

- de Silva, A. (1996).** The Herpetofauna of Sri Lanka: a brief review. Graphic Land, Kandy, Sri Lanka, 99pp.
- de Silva, A. (2009).** Amphibians of Sri Lanka: A photographic guide to common frogs, toads and caecilians. Published by author, creative printers and designers, Kandy, Sri Lanka, 168pp+ 82 pls.
- Dutta S.K. & K.N. Manamendra-Arachchi (1996).** The Amphibian Fauna of Sri Lanka, Wildlife Heritage Trust of Sri Lanka, 230pp.
- Fernando, S.S., L.J.M. Wickramasingha & R.K. Rodirigo (2007).** A new species of endemic frog belonging to genus *Nannophrys* Günther, 1869 (Anura: Dicroglossinae) from Sri Lanka. *Zootaxa* 1403: 55-68.
- Frost, D.R., T. Grant, J. Faivovich, R.H. Bain, A. Haas, C.F.B. Haddad, R.O. De Sa, A. Channing, M. Wilkinson, S.C. Donnellan, C.J. Raxworthy, J.A. Campbell, B.L. Blotto, P. Moler, R.C. Drewes, R.A. Nussbaum, J.D. Lynch, D.M. Green & W.C. Wheeler (2006).** The amphibian tree of life. *Bulletin of the American Museum of Natural History* 297: 1-370.
- Frost, D.R. (2010).** Amphibian Species of the World: an Online Reference. Version 5.4 (downloaded 12 July 2010). <http://research.amnh.org/vz/herpetology/amphibia/American Museum of Natural History, New York, USA>
- Gunatilleke, I.A.U.N. & C.V.S. Gunatilleke (1990).** Distribution of floristic richness and its conservation in Sri Lanka. *Conservation Biology* 4(1): 21-31.
- Gunatilleke, I.A.U.N., A.M. Greller, A.H.M. Jayasuriya, C.V.S. Gunatilleke & S. Balasubramaniam (1996).** Vegetation of the Peak Wilderness and its conservation. *Phytia* 4(1): 1-9.
- IUCN (2010).** IUCN Red List of Threatened Species. Version 2010.2. <www.iucnredlist.org>. Downloaded on 05 August 2010.
- IUCN SL & MENR (2007).** The 2007 Red List of Threatened Fauna and Flora of Sri Lanka. Colombo, Sri Lanka, 148pp.
- Kirtisinghe, P. (1957).** The Amphibia of Ceylon. Published by the author, Colombo, 112pp.
- Manamendra-Arachchi, K. & R. Pethiyagoda (1998).** A synopsis of the Sri Lankan Bufonidae (Amphibia: Anura) with description of two new species. *Journal of South Asian Natural History* 3(2): 213-248.
- Manamendra-Arachchi K. & R. Pethiyagoda (2005).** The Sri Lankan shrub-frogs of the genus *Philautus* Gistel, 1848 (Ranidae: Rhacophorinae) with description of 27 new species. *Raffles Bulletin of Zoology (Suppl.)* 12: 163-303.
- Manamendra-Arachchi, K. & R. Pethiyagoda (2006).** Amphibian Fauna of Sri Lanka (Sri Lankawe Ubhayajeewen), (text in Sinhala). Wildlife Heritage Trust of Sri Lanka, 440pp.
- Meegaskumbura M. & K. Manamendra-Arachchi (2005).** Description of eight new species of shrub-frogs (Ranidae: Rhacophorinae: *Philautus*) from Sri Lanka. *Raffles Bulletin of Zoology (Suppl.)* 12: 305-338.
- Meegaskumbura, M., K. Manamendra-Arachchi, C.J. Schneider & R. Pethiyagoda (2007).** New species amongst Sri Lanka's extinct shrub frogs (Amphibia: Rhacophoridae: *Philautus*). *Zootaxa* 1397: 1-15.
- Meegaskumbura, M., K. Manamendra-Arachchi & R.**

- Pethiyagoda (2009).** Two new species of shrub frogs (Rhacophoridae: *Philautus*) from the lowlands of Sri Lanka. *Zootaxa* 2122: 51-68.
- Meegaskumbura, M. & K. Manamendra-Arachchi (2011).** Two new species of shrub frogs (Rhacophoridae: *Pseudophilautus*) from Sri Lanka. *Zootaxa* 2747: 1-18.
- Perera, W.R.H. (1972).** A study of the protective benefits of the Wet Zone forestry reserve of Sri Lanka. *Sri Lanka Forester* 10(3&4): 87-102.
- Pethiyagoda, R., K. Manamendra-Arachchi, M.M. Bahir & M. Meegaskumbura (2006).** Sri Lanka Amphibians: Diversity Uniqueness and Conservation," In: Bambaradeniya C.N.B. (Ed.), *Fauna of Sri Lanka: Status of Taxonomy, Research and Conservation*. The World Conservation Union, Colombo, Sri Lanka and Government of Sri Lanka. 125-133.
- Singhakumara, B.M.P. (1995).** Floristic survey of Adam's Peak Wilderness. Forest Department of Sri Lanka, 156 pp.
- Werner, W.L. (1982).** The uppermontane forest of Sri Lanka. *Sri Lanka Forester* 15(3&4): 119-135.
- Wickramasinghe, A. (1995).** People and the forest: management of the Adam's Peak Wilderness. Forest Department of Sri Lanka, 299pp

This pictorial guide covers 73 species of frogs and toads including some of the new discoveries and rediscoveries. It is designed to help students, researchers, forest managers, photographers and general public in identifying a species along with its status, ecology and distribution.



A note on records of rare and endemic *Duttaphrynus hololius* (Günther, 1876) from Tamil Nadu, Eastern Ghats, India

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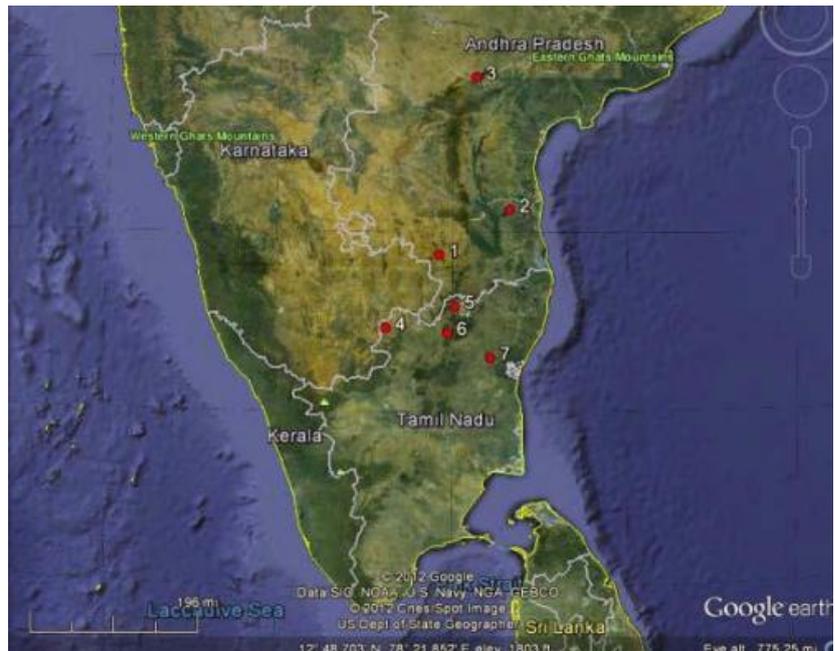
Duttaphrynus hololius is an endemic, rare and Data Deficient (Biju et al. 2004) toad found in southern India. So far, this species has been reported from three locations in Andhra Pradesh and one location in Tamil Nadu in the Eastern Ghats hill ranges (Table 1; Image 1). The occurrence of this species in Western Ghats is not confirmed (Biju 2001; Chandramouli et al. 2011). Furthermore, general information on *D. hololius* is scanty (Dubois & Ohler 1999; Daniel 2002; Daniels 2005) and does not throw light on this species (Chandramouli et al. 2011). In this note, we report the presence of this species at Tirupattur Forest Division and Rajagiri Hill, Gingee in Tamil Nadu.

We encountered *D. hololius* on 15 September 2011 around 13.40hr on the rock boulders of Thommaguddai (12°49'22'N & 78°40'09'E), Ambur Range at an elevation

of 240m. The toad was photographed and the morphological characteristics were noted. The top head is smooth without any bony ridges. The skin on the underside is smooth. Dorsum grayish-tan to brown with alternating patches of lighter and darker shady marbling. An inverted 'V' mark of a

pale grayish-white, consisting of a broad, indistinctly outlined grayish-brown wash suffused with reddish-brown marbling and dorsal part of both fore and hind limbs pale grayish-white with three dark brownish-black oblique ovoid crossbars (Image 2). Additionally, an imago of *D. hololius* was encountered on 20 October 2011 at 11.28hr in one of the caves of Kundu Reddiyur (12°33'39'N & 78°41'54'E), Yelagiri Hills, Alangayam Range at the elevation of 450m. Both Ambur Range and Alangayam Range fall under Tirupattur Forest Division. In addition, on 7 July 2012 at 11.00hr we sighted 10 imagoes of *D. hololius* in a small water pool, which was

Image 1. Known distribution of *Duttaphrynus hololius* 1: Horsley hills, 2: Nellore, 3: Nagarjuna Sagar Tiger Reserve, 4: Devarbetta, Hosur, 5: Thommaguddai, Ambur, 6: Kundu Reddiyur, Alangayam, 7: Rajagiri Hill, Gingee)



Source: Google Earth.

Table 1. Past and present sighting records of *Duttaphrynus hololius* from Eastern Ghats, southern India.

	Location	District	State	Reference	GPS Location
1	Horsley Hills	Chittoor	Andhra Pradesh	Satyamurthi 1967	13°39'N, 78°23'E
2	Nellore	Nellore	Andhra Pradesh	Satyamurthi 1967	14°25'N, 79°57'E
3	Nagarjuna Sagar Tiger Reserve	Nalgonda	Andhra Pradesh	Pillai & Ravichandran 1991	16°28'N, 79°13'E
4	Devarbetta, Hosur Forest Division	Krishnagiri	Tamil Nadu	Chandramouli et al. 2011	12°35'N, 77°41'E
5	Thommaguddai, Ambur Range, Tirupattur Forest Division	Vellore	Tamil Nadu	Present sighting	12°49'22"N, 78°40'E
6	Caves of Kundu Reddiyur, Alangayam Range, Tirupattur Forest Division	Vellore	Tamil Nadu	Present sighting	12°33'39"N, 78°41'E
7	Rajagiri Hill, Gingee	Villupuram	Tamil Nadu	Present sighting	12°14'N 79°23'E

40cm in diameter and 5.5cm in depth located at Rajagiri Hill, Gingee, Villupuram District, Tamil Nadu (12°14' N 79°23' E) at an elevation of 157m. The imagoes were brightly and contrastingly coloured; dark blackish and pale whitish shade intermixed with bright scarlet red

dots present on the dorsal side (Image 3 & 4). The individuals we encountered at Tirupattur Forest Division and Rajagiri Hill, Gingee matched with the colour descriptions provided by Chandramouli et al. (2011); except for a very thin, pale vertebral stripe

running dorsally from snout to vent. During both occasions the species was found to reside on the rocky substratum at Tirupattur and small water pool in Rajagiri Hill. The surrounding habitat was dominated by scrub jungles scattered across the rocky undulating terrain (Image 5). Chandramouli et al. (2011) also found *D. hololius* in the rocks near stream more or less having similar habitat characteristics from where we encountered this species. The distance between the two sightings at Tirupattur Forest Division is almost 27km from each other and almost 80km from Gingee. Chandramouli et al. (2011) recorded this species in 2009 from Devarbetta, Hosur Forest Division which is near about 110km from Tirupattur Forest Division. Hence, this present communication adds new localities to this species in the southern



Photo by Kalaimani

Image 2. Dorsal view of *Duttaphrynus hololius* on rock boulders of Thommaguddai, Ambur range, Tamil Nadu, southern India.

Image 3. Imago *Duttaphrynus hololius* with bright scarlet red dots on the dorsal side in Kundureddiyur, Alangayam range, Tamil Nadu, southern India.



Photo by Kalaimani

Biju, S.D., S.K. Dutta, K. Vasudevan, S.P. Vijayakumar, C. Srinivasalu & G.D. Bhudhe (2004). *Duttaphrynus hololius*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011. www.iucnredlist.org. Downloaded on 06 February, 2012.

Bocxlaer, V., S.D. Biju, S.P. Loader & F. Bossuyt (2009). Toad radiation reveals into-India dispersal, as source of endemism in Western Ghats-Sri Lanka biodiversity hotspot. *BMC Evolutionary Biology* 9:131.

Chandramouli, S.R., S.R. Ganesh & N. Baskaran (2011). On recent sightings of a little-known south Indian toad *Duttaphrynus hololius* (Günther, 1876) with notes on its morphological characterization and ecology. *Herpetology Notes* 4: 271-274.

Daniel, J.C. (2002). *The Book of Indian Reptiles and Amphibians* Bombay Natural History Society, Oxford University Press, Bombay, India, viii+238pp.

Daniels, R.J.R. (2005). *Amphibians of Peninsular India*. Hyderabad, India, Indian Academy of

most part of the Eastern Ghats.

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References

Biju, S.D. (2001). A synopsis to the frog fauna of the Western Ghats, India. Occasional Publication Indian Society Conservation Biology 1: 1-24.

Photo by Kalaimani

Image 4. Imagoes of *Duttaphrynus hololius* in Rajagiri Hill, Gingee, Tamil Nadu, southern India.



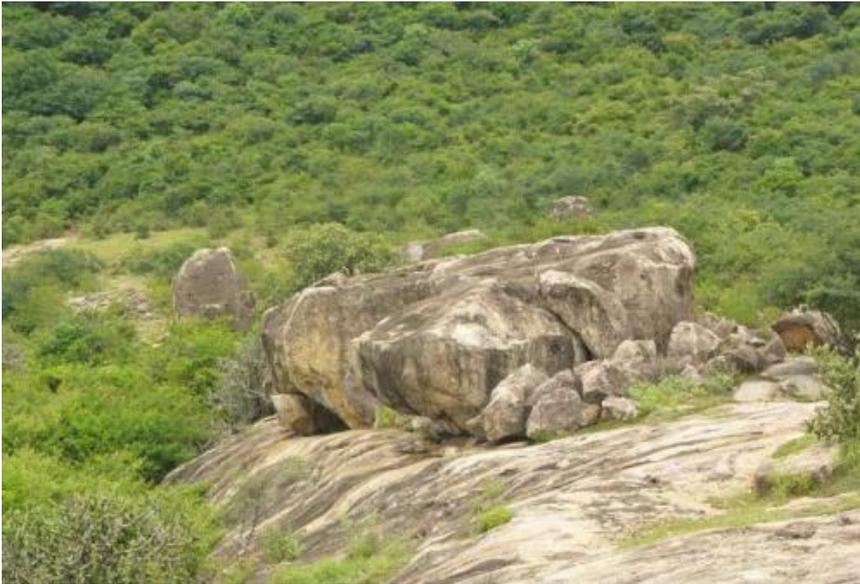


Photo by Kalaimani

Image 5. Habitat of *Duttaphrynus hololius* in Tirupattur Forest Division, Eastern Ghats, southern India.

Sciences Universities Press.

Dubois, A. & A. Ohler (1999).

Asian and Oriental toads of the *Bufo melanostictus*, *Bufo scaber* and *Bufo stejnegeri* groups (Amphibia, Anura): a list of available names

and redescription of some namebearing types. *Journal of South Asian Natural History* 4 (2): 133-180.

Pillai, R.S. & M.S. Ravichandran (1991). On a rare toad *Bufo hololius* Günther from Nagarjunsagar, Andhra

Pradesh. *Records of Zoological Survey of India* 88(1): 11-14.

Satyamurti, S.T. (1967). The South Indian Amphibia in the Collection of the Madras Government Museum. Madras Government Museum.

Amphibians of Punakha-Wangdue Phodrang Valley, Bhutan

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Introduction

Amphibians were the first vertebrates to have colonized the land about 220 million years ago (Daniels 2005). They are grouped under three orders, namely Caudata (tailed), Gymnophiona (limbless) and Anura (quadruped). Studies have confirmed the sensitivity of the amphibians to climate and habitat changes. Hence, they are used as source of information for the local and global climate changes for taking up necessary mitigation works for the sake of mankind. Therefore, this taxon is one of the most explored subjects outside Bhutan. The amphibian fauna of Bhutan is poorly explored. Thus, this study in Punakha-Wangdue Phodrang Valley is significant being the first study of its kind in the Kingdom. Even a few existing papers on the amphibians of Bhutan are questionable. Reports of Frost (1985) on presence of Himalayan Newts *Tylotriton verrucosus* (Anderson, 1871), Delorme & Dubois (2001) on endemic *Scutigera bhutanensis* (Delorme &

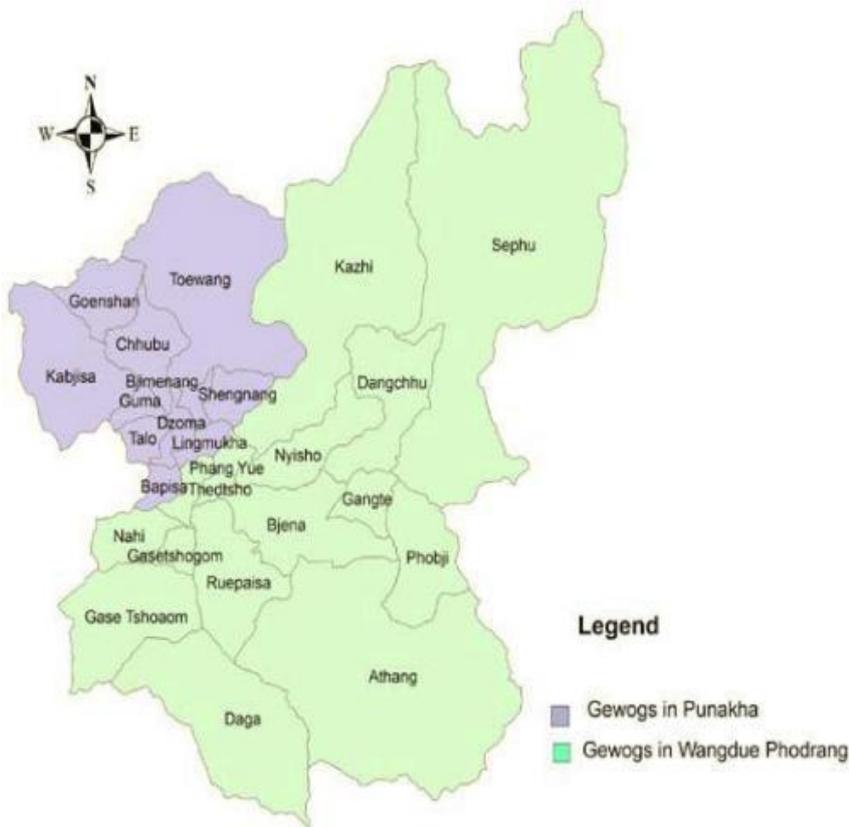
Dubois, 2001), and Ahmed et al. (2009) on presence of *Clinotarsus alticola* (Boulenger, 1882) do not specify location. Except for the *Tylotriton verrucosus*, which was confirmed by Palden (2003) from Thinleygang, then Thimphu District, others still remain an enigma even today. Even the record of *Raorchestes annandali* (Boulenger, 1906) in (AmphibiaWeb) is questionable. Further the work of Frost (2012) also does not specify the location, raising questions on the credibility of the information. But, there are some confirmed works that include Das & Palden (2000) who reported the presence of *Duttaphrynus melanostictus* (Schneider, 1799), *Amolops marmoratus* (Blyth, 1855), *Euphlyctis cyanophlyctis* (Schneider, 1799), *Hoplobatrachus tigerinus* (Daudin, 1802), *Fejervarya* cf. *limnocharis* (Gravenhorst, 1829) and *Rana (Sylvirana)* sp. from southern Bhutan. Deuti (2010), who, based on the 1969 collection of Zoological Survey of India, reported presence of Liebig's Hill Frog, *Nanorana liebigii* (Gunther, 1860) in

Haa District.

This study attempted to supplement the earlier works and aimed to document the diversity of amphibians of Punakha-Wangdue Phodrang Valley with the notion to create awareness on what kinds of amphibians we have in the valley and how helpful they are to human kind, for the local people and others. The research also intended to supplement the claim that Bhutan is rich in biodiversity and produced an annotated list of amphibians for Bhutan. Further, it is expected to indicate changes in local habitats due to the ongoing Punatshangchu Hydropower Project and provide baseline data for the pre dam situation of the valley and data for further studies. The specific objectives of this study included mapping of amphibian habitats, listing species, collection of wet specimens and creating awareness amongst the people of the valley.

Methods

Since the primary objective of this study was the collection and identification of species to understand the diversity, the method applied was visual encounter surveys (Campbell & Christman 1982; Corn & Bury 1989) followed by pursued collection whenever possible. A systematic



Map by Jigme Tshethrim Wangyal

Figure 1. The map of two Dzongkhags where the study was conducted results and discussion

search during day and night in the month of July and August was conducted in and around the identified forests, paddy fields and roadsides. All the amphibians that were encountered during the survey were identified and recorded. Specific habitat details of where the specimen was collected such as time of collection, altitude, habitat, behavior, etc. were recorded as field data with the help of GPS and physical observations.

Since killing has been considered unethical, the species collected were released after necessary morphometric data collection. Cameras and portable tape-recorders were used to record the species specific data. Taxonomically important photographs of live amphibians were taken. The identification references used in the field include Smith (1931, 1935, 1943), Daniels (2005), Yang & Rao (2008), Ahmed et al. (2009), Fei et al.

(2010), and Vasudevan & Sondhi (2010). Besides photography, calls were recorded to help field identifications. A time-constrained search technique was used because the study area had several habitat types, viz., paddy fields, roadsides, and forests. However, the search area (Figure 1) within the valley was not fixed as any amphibian species encountered anywhere within the valley was considered for diversity. The search time for the selected areas was three hours in a day and three hours at night constantly for two weeks which proved rewarding as the researcher was alone most of the time. The other methods applied in this study were nocturnal road cruising and opportunistic collecting. Rainy nights were taken as an advantage to catch the amphibians that move along the roads. While short distances were covered by walking, longer distances were covered using cars. The records of the dead amphibians on roads and human habitats were also considered for the study.

Results and discussion

The study uncovered nine amphibian species in the valley belonging to six families. The result is significant in view of the lack of data and studies on the taxon in Bhutan. Counting on the past

Table 1. Shannon Index (H) and evenness (E) Table for Toebisa

Sl. #	Species	No. of individuals	Pi	LnPi	pi*Lnpi
	<i>Polypedates cf.</i>				
1	<i>himalayensis</i>	13	0.18	-1.70	-0.31
2	<i>Nanorana liebigii</i>	2	0.03	-3.57	-0.10
3	<i>Nanorana species (new)</i>	1	0.01	-4.26	-0.06
	<i>Duttaphrynus</i>				
4	<i>melanostictus</i>	7	0.10	-2.32	-0.23
	<i>Xenophrys cf.</i>				
5	<i>nankiangensis</i>	11	0.15	-1.86	-0.29
6	<i>Tylotriton verrucosus</i>	37	0.52	-0.65	-0.34
		71	1.00	-14.36	-1.33

* To calculate E, natural log of diversity (S) has been used throughout (E =H/LnS).

records based on the papers by Das & Palden (2000), Frost (2012), Ahmed et. al (2009), the total number of amphibian species so far recorded from Bhutan was 13. With this study, five more species, *Duttaphrynus cf. stuarti* (Smith, 1929), *Amolops cf. monticola* (Anderson, 1871), *Xenophrys cf. nankiangensis* (Liu & Hu, 1966), *Polypedates cf. himalayensis* (Annandale, 1912) and an undescribed species of *Nanorana* are added to the list of amphibians of Bhutan, pushing the number of species from Bhutan to 18 which may just be a small proportion of the Kingdom's

amphibian species. However, the most significant finding of this study was the discovery of a *Nanorana* species for Bhutan creating an opportunity for further research.

Diversity

This study confirms presence of nine species including the *Tylotriton verrucosus* belonging to two orders (Caudata and Salientia) and six families, viz., Salamandridae, Ranidae, Rhacophoridae, Dicroglossidae, Bufonidae and Megophryidae. The results of the analysis showed diversity index (H)

of -1.33 in Toebisa (Table 1), -1.4 in Kabjisa (Table 2) and -1.41 in Kazhi (Table 3). This indicates that the diversity is slightly higher in Toebisa than Kabjisa and Kazhi which is substantiated by the value of S which is equal to 6, 6 and 5 respectively in three habitats. Therefore, it is fair enough to assume that Toebisa is richer than the other two localities.

Evenness (E) and Shannon Diversity Index (H) of the three study sites were compared (Table 4). The result showed insignificant differences between the three

Table 2. Shannon Index (H) and evenness (E) Table for Kabjisa

Sl. #	Species	No. of individuals	Pi	LnPi	pi*Lnpi
1	<i>Polypedates cf. himalayensis</i>	17	0.35	-1.06	-0.37
2	<i>Nanorana liebigii</i>	2	0.04	-3.20	-0.13
3	<i>Duttaphrynus himalayanus</i>	3	0.06	-2.79	-0.17
4	<i>Duttaphrynus melanostictus</i>	5	0.10	-2.28	-0.23
5	<i>Duttaphrynus cf. stuarti</i>	2	0.04	-3.20	-0.13
6	<i>Tylotriton verrucosus</i>	20	0.41	-0.90	-0.37
		49	1.00	-13.43	-1.40

Table 3. Shannon Index (H) and evenness (E) Table for Kazhi

Sl. #	Species	Kazhi	Pi	LnPi	pi*Lnpi
1	<i>Amolops cf. monticola</i>	3	0.05	-2.93	-0.16
2	<i>Polypedates cf. himalayensis</i>	12	0.21	-1.54	-0.33
3	<i>Duttaphrynus himalayanus</i>	5	0.09	-2.42	-0.22
4	<i>Duttaphrynus melanostictus</i>	13	0.23	-1.46	-0.34
5	<i>Tylototriton verrucosus</i>	23	0.41	-0.89	-0.37
		56	1.00	-9.23	-1.41

localities, the value of both E and H being very close to each other in all habitats (Figure 2). The value (E<1), indicated that the species distribution was not equal. In ideal situation the value of E=1, which means that the species are equally distributed all across the habitat.

Distribution

As indicated by the diversity index (H), the distribution of the species is uneven in the three habitats. In Toebisa, the amphibians were found around the paddy fields and numerous streams that dissect the Gewog. Toebrongchu, a perennial stream which is the lifeline of the people of Gewog has numerous species of fishes, macroinvertebrates and it

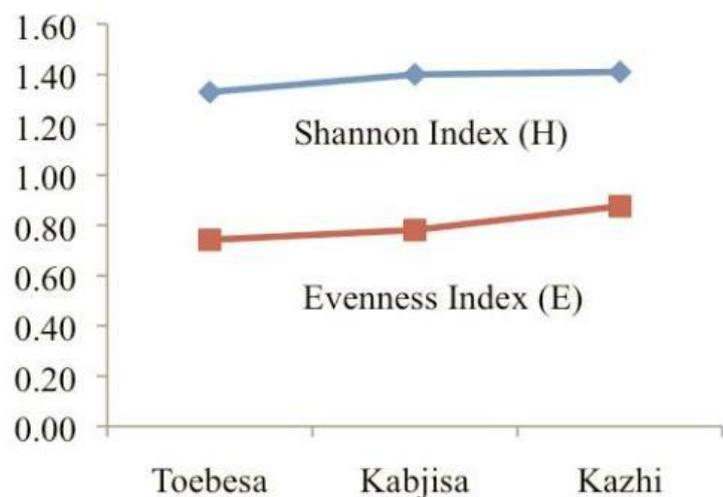
is home to several other animals including the amphibians. Further investigation at the villages of Thinleygang, Lemjikha, Totokha, Lumitsawa and Menchuna may reveal new species of amphibians. A new species for Bhutan, *Xenophrys cf. nankiangensis* was found in these areas. At least four species, *Polypedates cf. himalayensis*, *Duttaphrynus melanostictus*, *Nanorana leibigii* and *Tylototriton verrucosus* comes from a single village, Goemkha. A villager gave a description

of an *Amolops* species being available in the area. Unfortunately though, none could be collected during the study. In Kabjisa, the most abundant amphibian was *Polypedates cf. himalayensis*. The village paddy fields are full of noise by the evening in August with the sound of "tak, tak, tak..." indicating the rich presence of the species. The villages of Kazhi are big and there could be lot more species besides *Tylototriton verrucosus* and *Polypedates cf. himalayensis*. Further

Table 4 Evenness (E) and diversity index (H) compared

Study areas	Shannon Diversity Index (H)	Evenness (E)
Toebisa	-1.33	-0.74
Kabjisa	-1.4	-0.78
Kazhi	-1.41	-0.88

Figure 2. Comparison between the E and H in three study sites



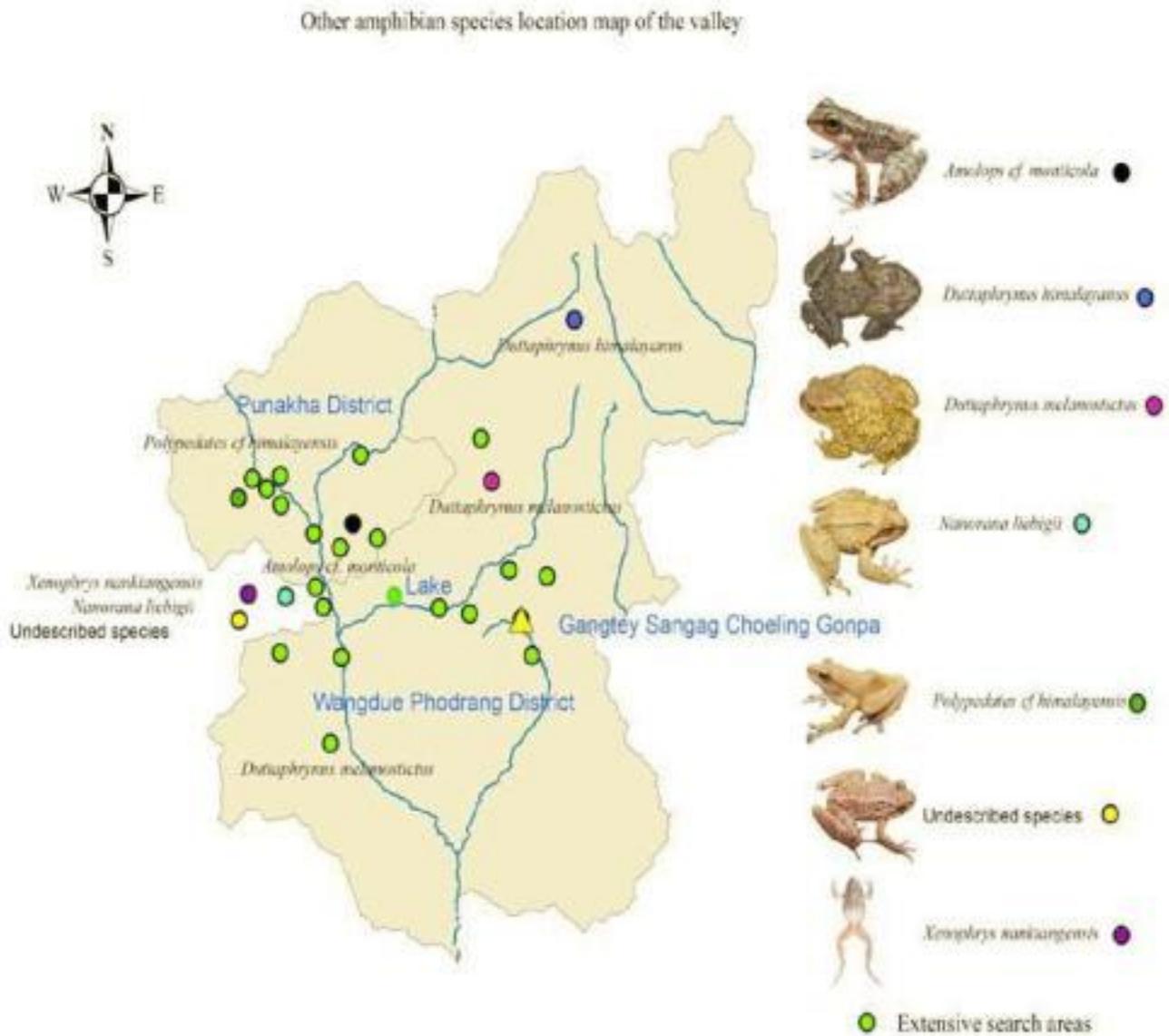


Figure 3. The distribution map of amphibians in the study area

survey could reveal more species in the locality, because the current distribution (Figure 3) and diversity has been based on a very short study period.

Species accounts

This study found nine species amphibian including an urodele,

Tylototriton verrucosus, the accounts of which are given in the following species accounts family wise. The species accounts include family, their distribution world over and their basic morphometric data such as the snout to vent length, the fore arms and the forelimb length. Data on which side

of Punakha Wangdue Valley, the species were collected and their geolocations are all provided with a representative photographs taken in the field.

Salamandridae

Himalayan Salamander/ Crocodile Newt, *Tylototriton verrucosus* Anderson, 1871



Image 1. Newt from Lampelri Botanical Garden

Photo by Dorji Namgay

Tylototriton verrucosus is the only salamander known from Bhutan.

The genus is considered to be amongst the most primitive of the living salamanders (Das, 1987). John Anderson, who described the species in 1871, first discovered the species in the flooded rice fields near the small Chinese town of Nantin. Body, rather slender with flat head with characteristic ridges and large slightly concave parotoids (Image 1). Snout rounded and broad with nostrils close to the tip with lateral terminal nares. Eyes lateral with large, granular upper eyelids. Outstanding glandular vertebral ridge. Dorso-lateral row of 15-16 knob-like warts on each side of body and anterior part of the tail. Has

diverging vomerine dentition. Fingers and toes not webbed; five well developed toes with median toe being the longest. Skin dorsally granular but ventrally smooth. Paratoids large and distinct, slightly concave. Gular fold present. Tail compressed laterally, with well-developed fin fold shorter than snout-vent length. Dorsum and venter are uniformly dark brown in colour with tail and palm being lighter. The ventral edge of tail is sometimes yellow or orange. Females are longer and heavier than males and during the breeding season, female body is much thicker. Females have larger heads and longer limbs, but smaller cloacae and lower tails (Seglie, 2002). The male cloaca is distinguished by a small longitudinal slit while female have a small

rounded opening. Female cloaca in the breeding season appears more conical in shape than that of the male (Anders, Schleich, & Shah, 1998).

Distribution

Outside Bhutan, it occurs in the humid forests of India (West Bengal and Sikkim and smaller, disjunct populations in Manipur and Arunachal Pradesh) and eastern Nepal through the Kachin and Shan Hills of Myanmar to south-western Yunnan China and spread out to mountains in northern Thailand. It has recently been recorded from Lai Chau Province in Vietnam.

By way of altitude, the records from other countries show its lowest range at 1200m (Das 1987; Anders et al. 1998) and highest to be 3350m from Ukhrul, Manipur, India (Dutta 1997). In Nepal, the lowest is recorded from 1300m (Biodiversity Profile Project 1995b) and highest from 2150m (Anders et al. 1998). In Bhutan, the lowest record comes from Toebrongchu bank at an altitude of 1255m while the highest altitude record is from Lampelri at 2679m. Bhutan does not figure in the distribution map of this species in the world due to poor reporting. However, with this study, we confirm *Tylototriton verrucosus* from Punakha Wangdue Phodrang Valley, Bhutan

Bufonidae

Himalayan Toad, *Duttaphrynus himalayanus* (Günther, 1864)

A large stocky toad with brown or yellow skin, the body being covered by many large warts. Unlike the Common Asian Toad, which has strong ridge, it has a faint black ridge like crown on the head outlining the eye and snout. Head wider than long with short and blunt snout. Parotid glands elliptic elongate and at least as long as head. Inter-orbital length greater than diameter of upper eyelid. Tympanum small and less than two-third of eye diameter. Dorsum with irregular, partially porous warts that are globular and smooth and only a few warts on the legs have keratinized tips. Venter has small flattened warts of equal sizes. Free fingers have relative finger length of $2 < 1 < 4 < 3$. Toes full webbed between digit 1 and 2 and 2 and 3. Dorsum colour uniform greyish-brown to dark brown. Venter uniform yellow to dark grey. The species can be found in glades and openings, footpaths and fields in villages and forests far from streams. Takes advantage of breeding sites created by man (Schleich & Kastle 2002). Found from 1300m to 2600m (Schleich & Kastle 2002). Mostly nocturnal hiding in wall crevices and earth holes. Reproduction period from mid-April to mid-August

A specimen was seen and photographed by an Forest Extension Agent on 20 July 2011 from Damji (27010.7'N & 11032.42'E), Gasa Dzongkhag at 1548hr at an altitude of 2229m. According to local information, the toad is found almost everywhere in Khamy Gewog mostly nearby streams and paddy fields and also in around water tanks. The specimen was taken from within water tank.

Common Asian Toad, *Duttaphrynus melanostictus* (Schneider, 1799)

Large sturdy toad. Head wider than long. Concave crown has low and blunt supraorbital ridges. Snout short, blunt and interorbital space broader than the upper eyelid. Tympanum inconspicuous. Numerous warts

on the head and dorsum has black tips while warts on the sides of the body and venter are ash grey classical to the basic body colour. Eye pupils horizontal, parotids kidney shaped and thickly covered with warts with black tips. Fingers tips black and rounded with relative length of $2 < 1 < 4 < 3$ and has two tubercles on the palm. First finger does not extend beyond second. Toes half webbed with black rounded tips. Two metatarsal tubercles of equal sizes are flat. Relative toe length is $1 < 2 < 5 < 3 < 4$. Dorsal colouration ranges from yellowish olive through reddish beige to grey or brown with a pattern of irregular dark olive or blackish-brown spots as is seen in various specimen photos collected from

Photo by Jigme Tshethrim Wangyal



Image 2. *Duttaphrynus melanostictus* from Goemkha

different parts of the country. Habitat wise, the species can be seen up to 1800m (Schleich & Kastle 2002) in open spaces nearby the streams and paddy fields. Feeds on ants, beetles, etc. and stomach contents varies with environments. The species is crepuscular as well as nocturnal with even turning diurnal during the mating season. It is common in South Asia and in Bhutan it was first reported by Das & Palden (2000) from Maukhola, Sarpang District, southern Bhutan. A specimen (Image 2) of the species was photographed from Goemkha (27030.53'N & 89049.25'E), Thinleygang, Punakha District on 7 August 2011 at 1030hr at an altitude of 1900m.

Duttaphrynus cf. stuarti
(Smith, 1929)

Unlike the other toads, it did not secrete sticky mucus when handled. Nevertheless, some distinguishing secretions were observed from the skin with unique smell after being touched. Adults measured approximately 75-80mm possessed an inconspicuous ridge on the head with less keratinized warts compared to those of *Duttaphrynus melanostictus* or *D. himalayanus*. It possessed prominent parotid glands with diffused margins. The fore limbs were longer than the other two sympatric species with the third finger being the longest and the second finger shortest. The feet carry big conspicuous inner metatarsal tubercles and palmar tubercles are

present on the hands, suggesting a cursorial habit of the species. The fingers and toes sides carry spinous warts and the warts on the dorsum observed under high magnification reveals a rounded base with a pointed tip at the centre. The tympanum was indistinct and smaller than the pupil. The ventral surface of the skin was uniformly granular throughout with barring on the limbs. This species probably has a wide distribution in north of Punakha and Gasa districts. The distribution of this species is restricted to Arunachal Pradesh in India and Myanmar. It is thus a new record for Bhutan. Two specimens, one from Punakha - Gasa highway (27041.52'N & 89046.01'E) Goenshari Gewog, Gasa at an altitude of 1483m on 7 August 2011 at 0810hr with SVL = 78mm (Image 4) and another species was recorded from Rimchu Range Office area (27041.38'N & 89046.08'E), Punakha on the highway at 1725hr at an altitude of 1489m on 7 August 2011.

Image 3. *Duttaphrynus cf. stuarti*



Photo by Sonam Phuntsho

Rhacophoridae

Himalayan Tree Frog
Polypedates cf.
himalayensis

The most common species (Image 4), was found throughout the study area along the edges of ponds, paddy fields, stream edges and even on the roads at night while driving. Most of the time they were found hiding among the short grasses. The snout is

pointed and the back carries a cross mark like that of an hourglass. The shapes and sizes of the patterns on the dorsum are prominently dark brown on a light brown or sometime yellow background. Sometimes, the shape appear as an X disjoined at the centre (Image 5) extending only to one half of the body length. In most of the specimen caught, the posterior half had discontinuous stripes of dark brown colour mingled with blotches that were lined up by the length of the body. The triangular snout has a blunt tip with a black stripe that extends from the tip of the snout to the shoulder marking through the eye. The circular tympanum appears distinct and is placed in between the supratympanic fold and the upper lip. A cream coloured line passes by the margin of the upper lip stretching up to the

tympanum. The head skin being co-ossified to the skull proves the genus of the species to Polypedates. The toes are webbed with score of 12 out of 23. The palm has three clear-cut tubercles with the middle being the largest. The feet own oval and small inner metatarsal tubercles. The hind limbs carry bands dorsally which are slightly dark brown in colour. While the throat region is smooth, the belly has uniform large granules with the granules on the ventral surface of the skin in the thigh region being even larger. This species is found throughout the lower reaches of Punakha - Wangdue Phodrang Valley. Commonly called as Himalayan Tree Frog (*Polypedates* cf. *himalayensis*) or Indian Tree Frog, this frog is new record for Bhutan and is reported from India, Nepal, Sri Lanka, and Bangladesh up to 1500m.

Photo by Jigme Tshelthrim Wangyal



Image 5. Dorsal view of *Polypedates* cf. *himalayensis*

Megophryidae

Nankiang Horned Toad
Xenophrys cf.
nankiangensis (Liu & Hu,
1966)

A medium-sized frog with the head hardly broader than long. Pattern on the body highly variable but blotches of different patterns and shapes prominent on the light brown dorsum. Body ovoid in ventral view. Short forelimbs, however the forelimbs are a bit less than three times the length of forearm. Fingers free with a big globular tubercle at the base of the shortest finger, the third finger being the longest. Toes almost free with the traces of web at the base. Dorsum colour light brown with some small granular warts arranged in rows along the body length and darker brown patches of various patterns. Eye

Image 4. *Polypedates* cf. *himalayensis*



Photo by Jigme Tshelthrim Wangyal

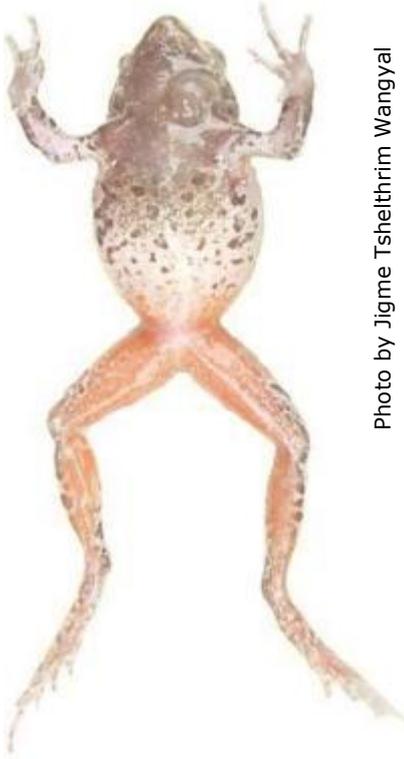


Photo by Jigme Tshelthrim Wangyal

Image 6. *Xenophrys* cf. *nankiangensis*

the streams (27029.522'N & 89044.622'E) at an altitude of 2094m, between Lumitsawa and Thinleygang, Punakha District. Of the many species heard calling, a lone individual measuring 50mm (SVL) was caught and photographed (Image 6) on 5 August 2011 at 2145hr. Considered a native of China, the species is found in Sichuan and Gansu Provinces from 1,600-1,850 m. IUCN considers it as vulnerable because the species is known from nearby villages, where infrastructure development is heavy. The case is same for Bhutan and further study is needed to confirm its status.

A medium sized to large frog with slender elongated body, flat head and long legs. In dorsal view, the body is oblong with moderately pointed anterior and posterior ends. The length of the head is almost equal to its width. The snout which is rounded mainly between the nares juts slightly over the lower jaw. The nares are closer to the snout than the eyes. The canthus rostralis is indefinite and rounded. The weak supratympanal fold is rounded and ends at the posterior tympanum margin. The fingers possess large pads with circum-marginal grooves that are largest on the 4th finger and smallest on the 1st finger with the relative of 1<2<4<3. Only one inner

Ranidae

Mountain Cascade Frog

Amolops cf. *monticola*
(Anderson, 1871)

pupil vertical and tympanum inconspicuous. Venter colour is greyish-black in the throat and up to the middle of the stomach with deep black blotches. The posterior part of the stomach is white with black dirty blotches suddenly followed by deep red pectoral region and the thighs and tibia up to the toes. A single vocal sac is clearly visible. The limbs have black bars that are not so distinct. It's known to occupy temperate shrub land and rivers, inhabiting hill streams and surrounding shrub land habitat. This species are found occupying

Photo by Jigme Tshelthrim Wangyal

Image 7. *Amolops* cf. *monticola* from Rurichu



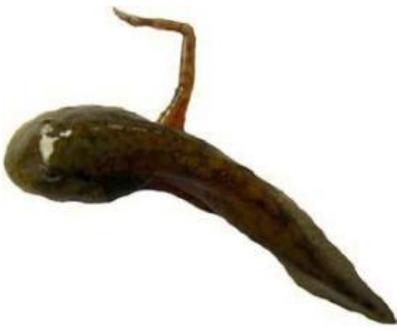


Image 8. A metamorphosing tadpole

Photo by Jigme Tshelthrim Wangyal

oblong and flat metacarpal tubercle present, while the subarticular tubercles are noticeably large, globular and are projecting. The completely webbed toes have adhesive pads smaller than those on fingers. A single inner, flat and oblong metatarsal tubercle is present while the subarticular tubercles

are oval and spectacular. The tibo-tarsal articulation extends beyond snout. The dorsal and ventral skin surfaces smooth with only very small rounded warts found posterior to the eyes and ventrolateral to the anus. The dorsolateral folds are somewhat striking and finish between the axilla and groin. A gular and a pectoral fold are slightly prominent on the ventral surface. The species is olive green and grayish in colour with the dorsum having a few circular to irregular darker spots. The upper eyelids are conspicuously lighter and somewhat yellowish while a bluish-black stripe extends from the snout tip along the canthus rostralis and the lateral fold. The colour of upper lip, post-oral glands and supratympanal fold are

yellow. The bluish-green iris is marbled with dark color and is flamboyantly contrasting with the dorsal pattern. The limbs are weakly uniformly striped. The adhesive pad on the first finger is white while the others look grey. The venter is uniformly yellowish-grey. An adult (Image 7), a juvenile and a metamorphosing tadpole (Image 8) each was caught from Rurichu (27020.30'N & 89054.49'E), Wangdue Phodrang District at an altitude of 982m, on 16 April 2011 at 1700 hr. An inhabitant of woods of tropical to subtropical regions in still to rapidly flowing waters and torrents, the frogs sit in crevices of rock faces that are moist with spray water (Image 9). While it is a new record for Bhutan, it has already been reported from Nepal, India and China between 850-2,350 m.

Image 9. An individual using wet rocks facing the flow



Photo by Jigme Tshelthrim Wangyal

Dicroglossidae

Liebig's Mountain Frog
Nanorana liebigii
(Guenther, 1860)

Head flat and broader than long, pointed to the nares but blunt in between with visible occipital fold. Snout blunt in lateral view. Body sturdy and elongated with prominent dorsolateral folds which are large and warty. Legs long. Dorsal skin smooth with numerous rounded warts on the sides of the body. Venter uniformly smooth. Tympanum indistinct with its membrane



Photo by Jigme Tshelthrim Wangyal

Image 10. *Nanorana liebigii* from Goemkha

directly below the skin but large and distinct supratympanal fold. Relative finger length $1 < 2 < 4 < 3$, 1st finger hardly shorter than 2nd and 4th finger almost equal to the 3rd all with rounded tips. Subarticular tubercles globular and distinct with large oval inner metacarpal tubercle and small outer metacarpal tubercle. Toe fully webbed with relative length of $1 < 2 < 5 < 3 < 5$, tips rounded, subarticular tubercles oval. Colour chocolate brown. Ventral white with brown speckles in the gular and pectoral region. Nocturnal and shy by habit. It can be found in oak and conifer forest between 1500-3000 m

(Schleich & Kastle 2002). The species is known to feed on earthworms, beetles, insects, etc. The breeding period of the species vary with altitude. Between 1500-2000 m, they breed from March to end of May (Schleich & Kastle 2002) and between 2000-2500 m asl, they breed from January till July and above 2500m asl they breed exclusively in June (Spath 1990). It is distributed throughout midlands and lower mountain ranges of Nepal, India (Uttar Pradesh, Sikkim, West Bengal, Himachal Pradesh, Jammu & Kashmir) and South China. Deuti (2010), reported the presence of

this species from Susuna highway, Haa road (27.360N & 89.310E) at an altitude of 2350m. But his report was based on the 8 February 1969 collection of the specimen which has been given accession number ZSIC A10964 with the SVL of 169mm (female) by Biswas and Saha. A specimen (Image 10) was collected from Goemkha village (27030.53N & 89049.25'E), Toeb Gewog, Punakha at an altitude of 1900m on 8 August 2011 at 2300 with lengths of 90mm, 167mm and 55mm SVL, HLL and FLL respectively.

It's a *Nanorana* sp. (Image 11) because of its ossified sternal stylus. It has fusions in the tarsus and carpus. The tongue is notched.

Conclusion

This study, the first of its kind in Bhutan is significant as much as the new species record for the country that has come as an outcome of the effort put for this research. The amphibians in the Punakha-Wangdue Phodrang Valley were found in the paddy fields, roadsides and forest of three study areas of Toebisa, Kabjisa and Kazhi. Conserving the paddy fields especially for the newts is found to be very important. *Polypedates* cf. *himalayensis*, *Xenophrys* cf. *nankiangensis*, *Duttaphrynus* cf. *stuartii* and *Amolops* cf. *monticola* are



Photo by Jigme Tshelthrim Wangyal

Image 11. *Nanorana* species from Dochula

all new records for Bhutan. The comparison of Shannon Diversity Index amongst the three habitats in the valley did not reveal much difference, indicating that all the three areas are equally diverse. The Evenness value ($E < 1$) for the three habitats also indicates that the species distribution in the study areas is uneven. The standout package of the study, which was the encounter of a new *Nanorana* species at Dochula at an altitude of 2963m is encouraging giving reason for further research. If at all the species is proven new, a new species specific epithet name after provenience Bhutan, *bhutanensis*, will be proposed. But repeated

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Over the course of last five months, the research described below entailed: catching and counting more than 100 amphibians, many of them late on cold, rainy nights; driving throughout the valley at nights; wading through ponds, bogs and swamps looking for amphibians enduring cool winds, bites of mosquitoes and leeches while looking for newt. To say that we depended upon the generous assistance of others is a whopping understatement. We never failed to be amazed at the willingness of many friends and acquaintances to help. Further, we would like to, in no particular order thank the following individuals. Sonam Phuntsho in Kabjisa and Rimchu areas; Yeshe Phuntsho in Gasa and Punakha areas; Yeejay, Nima Gyeltshen and Dorji Namgay in Lamperi, Thinleygang and Dochula areas; Namgay Tshering and Kuenzang Tshering in Sha areas. They have helped us collect and take measurements of the specimens and have never denied befriending us even at the middle of the night. Sonam Dorji (GP), Baep Tshering and few others accompanied us to the field in Thinleygang when in college, our sincere thanks to them. Ap Sonam of Goemkha village, Toebisa helped us catch at least four species, thanks

to his spirited search for the animals. Thanks are also due to all people of the study areas. The first author in particular is glad to receive the assistance of England based Rufford's Small Grant for the study of this group of animals. So, a heartfelt thanks to the RSG. Phurba Lhendup, WWF Bhutan programme needs a special mention for generously allowing me to use his camera during the study. The National Soil Service Centre, Simtokha, also deserves a mention for helping out with soil analysis. The support of our family members is worth mentioning for all their understanding and patience. Had it not been for their moral support, this paper could never have been written.

References

- Ahmed, M.F., A. Das, & S.K. Dutta (2009).** *Amphibians and reptiles of Northeast India: A photographic guide.* Aaranyak, Society for Biodiversity Conservation. 50 Samanwoy Path, Survey, Beltola, Guwahati 781028, Assam, India, 168pp.
- Anders, C.C., H.H. Schleich, & K. B. Shah, (1998).** Contributions to the Biology of *Tylototriton* East Nepal (Amphibia: Caudata, Salamandridae). Fuhlrott Museum, Wuppertal. *Contributions to the Herpetology of South Asia (Nepal, India)*. 4: 1-26.
- Campbell, H.W. & S.P. Christman (1982).** *Field techniques for herpetofaunal community analysis.* Pp. 193-200. In: N.J. Scott, Jr. (ed.), *Herpetological Communities.* U.S. Department of the Interior, Fish and Wildlife Service, Wildlife Research Report 13.
- Corn, P.S. & R.P. Bury (1989).** Logging in western Oregon: responses of headwater habitats and stream amphibians. *Forest Ecology and Management* 29:39- 57.
- Daniels, R.J.R. (2005).** *Amphibians of Peninsular India.* University Press (India), 169pp.
- Das, I. (1987).** Natural history of the Indian Salamander *Herpetofauna News* 9: 3.
- Das, I. & J. Palden (2000).** A herpetological collection from Bhutan, with new country records. *Herpetological Review* 31(4): 256- 258. Delorme, M. &
- Dubois, A. (2001).** Une nouvelle espèce de Scutigier du Bhutan, et quelques remarques sur la classification subgénérique du genre Scutigier (Megophryidae, Leptobrachiinae). *Alytes* 19 (2-4): 141-153.
- Deuti, K. (2010).** *Nanorana liebigii* from Bhutan. *Herpetological Review* 41 (1): 104.
- Dutta, S.K. (1997).** *Amphibians of India and Sri Lanka (Checklist and bibliography.* Bhubaneswar; Odyssey Publishing House; (4) + xiii 342 + xvii pp.
- Fei, L., C. Ye, & J. Jiang (2010).** *Coloured Atlas of Chinese Amphibians.* Sichuan Publishing Group. Sichuan Publishing House of Science and Technology, China, East Nepal (Amphibia: Caudata, Salamandridae). Fuhlrott Museum, Wuppertal. *Contributions to the Herpetology of South Asia (Nepal, India)*. 4: 1-26.
- Frost, D.R. (1985).** *Amphibian species of the world. A taxonomic and geographic reference.* Allen press, Inc., and Associations of systematic collections, Lawrence. (iv) + v + 732 pp.
- Ningombam, B. & S. Bordoloi (2007).** Amphibian fauna of Loktak Lake, Manipur, India with ten new records for the state *Zoos' Print Journal* 22(5): 2688-2690.
- Palden, J. (2003).** New records of *Tylototriton verrucosus* Anderson, 1871 from Bhutan. *Hamadryad* 27: 286-287.
- Schleich, H.H., & W. Kästle (Eds). (2002).** *Amphibians and Reptiles of Nepal. Biology, Systematics, Field Guide.* A. R. G. Gantner Verlag, Ruggell, Germany, 1211 pp.
- Seglie, D. (2002).** *Tylototriton verrucosus*, an Endangered Species of India. DAPTF Report, pp. 1-43.
- Smith, M.A. (1931).** *The fauna of British India, Ceylon and Burma: Amphibia and Reptilia, Vol.I. - Loricata, Testudines.* (1st edn). Taylor and Francis Ltd. London. Smith, M. A. (1935). *The fauna of British India, Ceylon and Burma: Amphibia and Reptilia, Vol.II. - Sauria.* (1st edition). Taylor and Francis Ltd. London.
- Smith, M.A. (1943).** *The fauna of British India, Ceylon and Burma, including the whole of the Indo - Chinese region. Reptilia and Amphibia. Vol. III. Serpentes.* Taylor and Francis, London. Pp. i-xii +583 pp +1 map.
- Vasudevan, K. & S. Sondhi (2010).** *Amphibians and Reptiles of Uttarakhand, India.* Wildlife Institute of India. Chandrabani 18, Dehradun, Uttarakhand, India.
- Yang, D. & D. Rao (2008).** *Amphibia and Reptilia of Yunnan.* Yunnan Publishing Group Corporation, Yunnan Science and Technology Press, Kunming (in Chinese).

Seasonal Fluctuation of Different Nematode Parasites of *Duttaphrynus melanostictus* from Aurangabad (Maharashtra), India

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Introduction

The effect of parasites in animal ecology has received much attention in recent years. The hosts harbor a luxuriant nematode fauna in their alimentary tract. The present study deals with the mean incidence, mean parasite load and density of infection by different nematode parasites in different body weight groups in both sexes of the Common Indian Toad *Duttaphrynus melanostictus* in the industrial and non industrial areas of Aurangabad in different seasons during the year.

Material and Methods

Toads killed due to road accidents were collected and brought to the laboratory from surrounding area of Aurangabad at different seasons of year during the period of June 2007 to May 2008. They were collected from different sites. Only the adult parasites were taken out in normal

saline and washed 2-3 times. They were further processed and permanent slides were made (Gibson 1984). All adult nematodes collected were transferred in hot 70% alcohol for fixing and preserved in 70% alcohol in a vial with a few drops of glycerine. They were then sorted according to their respective genera with the help of identification keys given by Yamaguti (1961, 1963), "CIH Keys to the Nematode Parasites of Vertebrates" (1974-1983 ed.). A proper record of the host, locality, location of parasite, date of collection and name of collector were maintained. The incidence, mean parasite load and density of infection were calculated following Margolis et al. (1982) and Muzzal (1991).

Incidence of infection = $B \times 100 / A$; where B- the number of host infected, A total number of host collected
Mean parasite load = C / B ; where C- total number of parasites collected in a host.
Density = C / A

Rainy (S1), autumn (S2), winter (S3), and summer (S4) constituted four seasons each comprising of three months.

Result and Discussion

The present investigation revealed that out of 110 hosts 105 (95%) was infected with different nematode parasites, comprising four genera, i.e., *Oswaldocruzia* Travassos, 1917, *Oxysomatium* Railliet & Henry, 1913, *Monhysterides* Baylis & Daubney, 1922 and *Meteterakis* Karve, 1930. The nematode parasites showed highest presence in rainy season. The parasites were found in both male and female hosts but their numbers varied with the season. During rainy season and with the accompanied rise in water level, moderately high temperature, high humidity and low sunshine, the hosts dominate in many water bodies in study area.

Overall, the infection was noted to be more in the rainy season, moderate in winters and least in summer. This might be due to high availability of source of infestation like insects which are the intermediate hosts and thus causing an increase in the number of parasites in an animal. The liver, mucosal lining, intestine, mesenteries and rectum appeared to be the most preferred sites for

Table A. The effect of sex and seasons on distribution of parasites during June 2007-May 08.

Seasons	Sex	Number of hosts collected	Number of hosts infected	Percentage of infection (%)
Rainy	Male	20	19	95
	Female	12	12	100
Autumn	Male	10	10	100
	Female	26	25	96.15
Winter	Male	10	9	90
	Female	11	11	100
Summer	Male	9	8	88.88
	Female	12	12	100

Table B. Seasonal fluctuation of intensity of infection by different nematode parasites in *Duttaphrynus melanostictus*.

	Body weight (g)	Seasons	No. of hosts examined	No. of hosts infected	No. of parasites collected	Incidence of infection (%)	Mean parasite load	Density of infection
1	15-30	Rainy (June-Aug.)	15	15	1090	100	72.66	72.66
2	30-45		9	9	482	100	53.55	53.55
3	45-60		8	7	403	87	57.57	50.37
4	15-30	Autumn (Sept.-Nov.)	16	16	792	100	49.5	49.5
5	30-45		12	11	520	91	47.27	43.33
6	45-60		8	8	537	100	67.12	67.12
7	15-30	Winter (Dec.-Feb.)	10	9	370	90	41.11	37
8	30-45		5	5	150	100	30	37
9	45-60		6	6	92	100	15.33	15.33
10	15-30	Summer (Mar.-May.)	12	11	223	91	20.27	18.58
11	30-45		5	5	95	100	19	19
12	45-60		4	4	65	100	16.25	16.25

Table C. Distribution of nematodes in different organs of host.

	Parasite sp.	Organs	Parasitic stage	Number of parasites in sample		
				range	mean	± S.E.
1	<i>Oswaldocruzia goezei</i>	Mucosal lining	adult	1-11	3.45	0.48
2	<i>Monhysterides sp.</i>	Coelom, liver, mesentry	larvae	3-19	8.6	1.46
3	<i>Oxysomatium macintoshii</i>	Rectum	adult	1-12	4.58	0.38
4	<i>Meteterakis govindi</i>	Intestine and rectum	adult	5	5	Single specimen

parasitic infection.

Throughout the study period incidence of infection, and density of infection by different nematode parasites were calculated. The calculated values were not equal for all the seasons and showed sex wise differences. The most commonly encountered nematodes in order of prevalence were *Oxysomatium*, *Meteterakis*, *Oswaldocruzia* and *Monhysterides*.

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References:

Anderson, R.C., A.G. Chabaud & S. Willmott (1974). CIH keys the nematode parasites of vertebrates. No.1. General introduction. *Commonwealth Agricultural Bureaux, Farnham Royal, Slough, Headley Brothers Ltd.*

Anderson, R.C. & O. Bain (1976). Diplostriaenoidea and Filarioidea. Pages 59-116 in R. C. Anderson, A. G. Chabaud and S. Willmott. Eds. CIH keys to the Nematode Parasites of Vertebrates NO.3 Keys to the Geners of the Order Spirurida. Farmingham Royal Bucks, England, *Common-Wealth Agricultural Bureaux.*

Anderson, R.C. (1978). Key to the genera of the superfamily

Metastrongyloidea. Pp. 1-44. In "Commonwealth Institute of Helminthology keys to the Nematode Parasites of Vertebrates". No.5. Eds. R. C. Anderson, A. G. Chabaud and S. Willmott. *Commonwealth Agricultural Bureaux, Farnham, Farnham Royal: England.*

Anderson, R.C. & O. Bain (1982). CIH keys to the Nematode parasites of Vertebrates No.9. Keys to the genera of the super families Rhabditoidea, Dioctophymatoidea and Muspiceoidea. Anderson, R. C., Chabaud, A. G. and Willmott, S. (Eds.). *Common Wealth Institute of Helminthology*, London 1-25.

Bhalerao, G.D. (1935). "Helminth parasites of the domesticated animals in India." Scientific Monograph No. 6; Indian council of Agricultural Research New Delhi, India 1-365.

Gibson, D.I. (1984). Technology as applied to museum collection : the collection, fixation and conservation of helminths. *Systematic Parasitology* 6, 141.

Graiffin, C.T. (1989). *Oswaldocruzia filiformis* (Nematoda: Trichostrongyloidea) in frogs (*Rana temporaria*) from three localities in Ireland. *Journal of Helminthology* 63(1): 53-62.

Margolis, et al. (1982). The use of ecological terms in parasitology. Report of an ad hoc committee of the American Society of Parasitologists. *The Journal of Parasitology* 68: 131-133.

Ragoo, R.M. & I.R. Omat Maharaj, (2003). Helminths of the cane toads *Bufo americanus* from Trinidad, West Indies. *Caribbean Journal of Sciences* 39: 242-245.

Travassos, L. (1917). *Trichostrongylinas*

brazileiras (5 e nota previa). *Oswaldocruzia* n.gen. *Brazil Medico.*, 31: 9.

Vanderburgh, D.J. & R.C. Anderson (1987). Preliminary observation on seasonal changes in prevalence and intensity of *Cosmocercoides variabilis* (Nematoda: Cosmocercidae) in *Bufo americanus* (Amphibia). *Canadian Journal of Zoology* 65(7): 1666-1667.

Vashetko, E.V. & B.H. Siddikov (1999). The effect of the ecology of toads on the distribution of helminths. *Turkish Journal of Zoology* 23 (1): 107-110.

Waltonm, A.C. (1935). The nematoda as parasites of Amphibia II. Proceeding of the United States National Museum; 315.

Yamaguti, S. & Y. Mitunaga (1943). Intestinal helminths from *Duttaphrynus melanostictus* of Formosa. Transactions of the Natural History Society of Formosa. Taiwan; 236 (33): 142-154.

Yamaguti, S. (1961). Systema Helminthum Vol.III. The nematodes of vertebrates. *Interscience Publishers Inc., New York*, Part I, 679pp. part II, pp.681-1261.

Defensive and burrowing behaviour of *Kaloula assamensis* Das et al., 2004 and *Kaloula pulchra* Gray, 1831 (Microhylidae)

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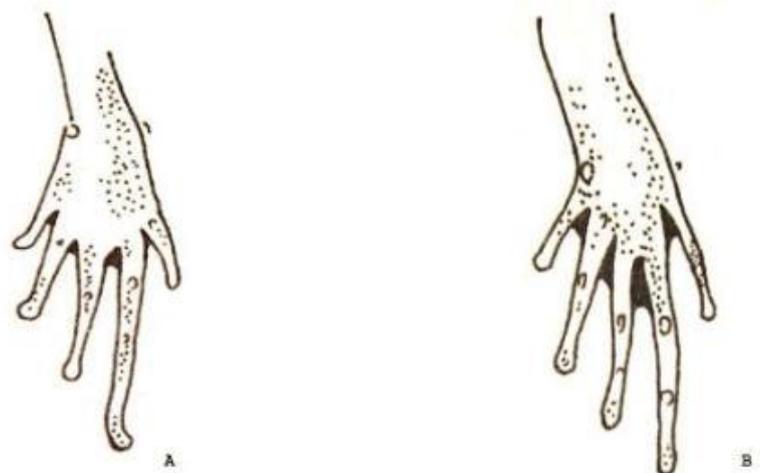
Microhylidae is a geographically widespread family of frogs with 413 species in 69 genera and nine subfamilies, which is the largest number of genera in any frog family. *Kaloula assamensis*, Das et al., 2004, was first described based on 6 specimens collected between 1998 and 2004 from four different localities of Majbat, Sirajuli, Orang National Park and Nameri Wildlife Sanctuary of Sonitpur District, Assam, and one locality of Pakhui Wildlife Sanctuary, Arunachal Pradesh (Das et al. 2004). Range extension of this species was reported from Bongaigaon District, Assam (Talukdar et al. 2007) and West Bengal (Paul et al. 2007). Nothing significant has been done related to the ecology and behavior of this species, which is assessed as Data Deficient in IUCN 3.1. *Kaloula pulchra* Gray, 1831

was first reported from India by Romer (1949) in Nagaland. It was subsequently reported from Tinsukia and Cachar districts of Assam (Dutta 1997; Dey & Gupta 2000) and from Cherrapunjee, East Khasi Hills District, Meghalaya, (Hooroo et al. 2002), West Bengal, Orissa, Bihar, Madhya Pradesh, Karnataka, Tamil Nadu, Kerala (Dutta 1997),

and Gujarat (Vyas et al. 2004).

Defense of resourcebased territories are common in anurans (Höglund & Alatalo 1995) and there exists difference in views over the issue of dominance of defensive behavior even in the lek mating system in anurans (Wells 2007). Our observations on the defensive and burrowing behaviour of *Kaloula assamensis* in Bongaigaon (26°28.70'N & 90°32.48'E) and *Kaloula pulchra* in Assam University (24°41.04'N & 92°45.03'E) Cachar District, Assam, northeastern India, were made in July 2006 after a heavy monsoon shower when the temperature and relative humidity were c. 28°C and 75%, respectively. Both species are basically nocturnal and

Fig 1. Sketch of Foot of *Kaloula pulchra* (A) and *Kaloula assamensis* (B)



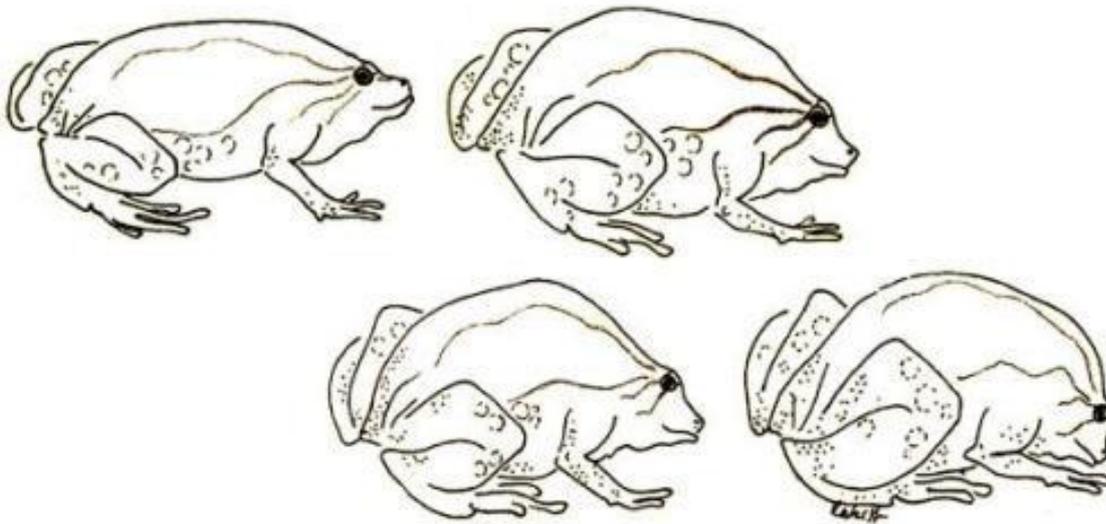


Fig 2. Sketch of Defensive posture of *Kaloula assamensis*

fossorial in nature, but diurnal and arboreal behavior can also be found. The fossorial nature of these species provide them several ecological opportunities like suitable microhabitat for estivation, clutch protection and subterranean foraging and thus adapted to a burrowing mode of life (Emerson 1976; Nomura et al. 2009). Phylogenetic analysis based on literature survey of burrowing behavior suggests that hindlimb-first burrowing is a basal behavior and headfirst burrowing behavior has evolved several times in anuran history forming a convergence complex (Nomura et al. 2009). Most burrowing anurans are hindlimb-first burrowers (Emerson 1976). Both *K. assamensis* and *K. pulchra* burrow into the cooler

subsoil to avoid predators and to avoid unsuitable weather conditions. They start digging backward into the soil with the help of their hindlimbs and push the body under the soil surface with the forelimbs. There is continuous movement of the body during the process. They can burrow several inches into the soil and stay underground for a long time according to their convenience. Both species have well developed foot with an average size of c. 28mm (male) and 29.5mm (female) *Kaloula pulchra* and c. 26mm (male) and 28mm (female) *Kaloula assamensis*, respectively. The foot also bears adhesive tips which are adapted for underground digging and climbing habits. Despite these similarities, *K. pulchra* appeared to be able

to burrow relatively faster into the soil because of its sturdier hindlimbs with more complete webbing (Fig. 1). It is possible that the more efficient burrowing ability of *K. pulchra* could be one of the contributing factors to its wider distribution compared to *K. assamensis*. Microhylid frogs are also known to show several defensive mechanisms to avoid predation. For instance, *Kaloula taprobanica*, which occurs in parts of Sri Lanka and peninsular India, is known to hide its limbs and head under the body to assume a semi-globular form (Somaweera 2006). When the defensive postures of *K. assamensis* and *K. pulchra* were recorded by creating an artificial disturbance to produce alarm response in the frogs, it was seen that

Hind feet burrowing posture of *K. pulchra* and *K. assamensis*



Kaloula pulchra (Photo: Kripaljyoti Mazumdar)



Kaloula assamensis (Photo: Rakesh Soud)

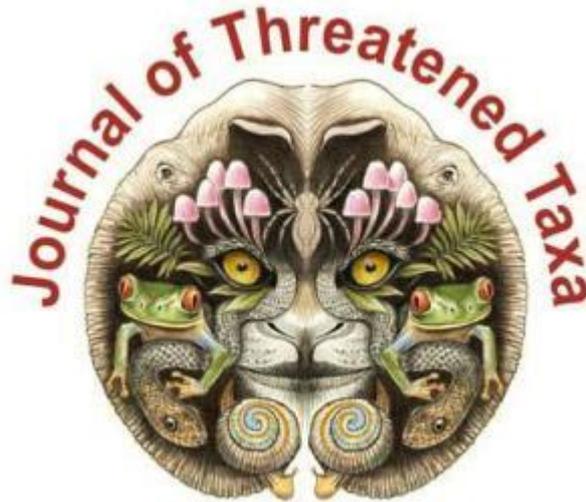
they inflated their body and bent their head down. This posture helped to make their body appear larger in size to their natural predators. Thus, opposed to the evasive defensive posture of *K. taprobanica*, *K. assamensis* and *K. pulchra* adopted a more aggressive approach. However, the three species shared the ability to produce a sticky secretion that also served as a defense mechanism. These studies indicate that the microhylids could have a rich and varied repertoire of defensive behavior that might be worth investigating.

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References

- Das, I., S. Sengupta, M.F. Ahmed & S.K. Dutta (2004).** A new species of *Kaloula* (Anura: Microhylidae) from Assam State, North-eastern India. *Hamadryad* 29(1): 101-109.
- Dey, M & A. Gupta (2000).** Record of *Kaloula pulchra* from Cachar district, Assam, North Eastern India. *Hamadryad* 25(2): 214-215
- Dutta, S.K. (1997).** *Amphibians of India and Sri Lanka* (Checklist and Bibliography). Odyssey Publishing House, Orissa, India, xxii + 342pp.
- Emerson, S.B. (1976).** Burrowing in frogs. *Journal of Morphology* 149(4): 437-458.
- Talukdar, S., R. Soud & K. Deuti (2007).** Range extension of the Assam painted Frog, *Kaloula assamensis* (Anura: Microhylidae) to western Assam. *Cobra* 1(1): 18- 20.
- Hooroo, R.N.K, S. Khongwir & B.B.P. Gupta (2002).** Record of *Kaloula pulchra* (Gray, 1831) (Anura: Microhylidae) from Cherrapunjee, East Khasi Hill District, Meghalaya, North Eastern India. *Hamadryad* 27(1): 146-148.
- Höglund, J. & R.V. Alatalo (1995).** *Leks*. Princeton University Press, New Jersey, xiii + 248pp.
- Nomura, F., C. Denise, R. Feres & F. Langeani (2009).** Burrowing behavior of *Dermatonotus muelleri* (Anura, Microhylidae) with reference to the origin of the burrowing behavior of Anura. *Journal of Ethology* 27: 195-201.
- Romer, J.D. (1949).** Herpetological observation in Assam and Bengal (1944). *Journal of the Bombay Natural History Society* 48: 376- 387.
- Somaweera, R. (2006).** Defensive posture in *Kaloula taprobanica* Parker (Microhylidae: Amphibia). *Journal of the Bombay Natural History Society* 103(1): 108-109.
- Vyas, R. (2004).** Painted frog (*Kaloula pulchra*) from Anand and Surat, Gujrat, India. *Zoos' Print Journal* 19(4): 1444.
- Wells, K.D. (2007).** *The ecology and behaviour of Amphibians*, University of Chicago Press, Chicago, xii+1148pp.
- Paul, S., M.C. Biswas & K. Deuti (2007).** First record of the Assam Painted Frog, *Kaloula assamensis* (Das et al.) from West Bengal. *Cobra* 1(3): 15-16



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