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DESCRIPTION OF A NEW SPECIES OF *LEPTOBRACHIUM* TSCHUDI, 1838, (AMPHIBIA : ANURA : MEGOPHRYIDAE) FROM MEGHALAYA, INDIA

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INTRODUCTION

The genus *Leptobrachium* Tschudi was established in the year 1838 with *hasseltii* as the type species. Subsequently more species were added from South East Asia. Presently there are 21 species in the genus from World (Frost, 2009, online reference). The distribution pattern of the genus shows that it is basically an Indo–Malayan genus. A single species namely *L. smithi* Matsui, Nabitabhata and Panha , 1999 occur in Northeast India (Ohler *et al.*, 2004; Sengupta *et al.*, 2001). Sengupta *et al.*, reported *L. smithi* from Assam claiming it to be a new record for India. They further commented quoting Matsui *et al.*, 1999, that *L. hasseltii* which was reported from North East India by Pillai and Chanda (1979) is actually restricted to Sundas in Thailand and the species of *Leptobrachium* occurring in North East India is *L. smithi*. However, the material of *smithi* deposited in the holdings of E.R.S/Z.S.I by Sengupta agrees with the description of *hasseltii* (Pillai and Chanda 1979). As per Frost (2009) both the species (*L. hasseltii and L. smithi*) are occurring in North East India. Further studies would confirm the availability of *L. hasseltii* in North East India.

While surveying the Nokrek Biosphere Reserve in East Garo Hills district of Meghalaya to document its amphibian fauna we collected, among others, twelve frogs of varying sizes that had scarlet eyes. These specimens with bulging eyes, wide mouth, short limbs and its tongue shape were easily differentiated as belonging to the genus *Leptobrachium.* Further studies revealed the identity of the larger specimens as *L. smithi*, and the smaller ones turned out to be new to science. We describe here these specimens as *Leptobrachium nokrekensis* sp. nov. The presence of a lateral line of white glandular tubercles on either side of belly and other meristic differences separate it from the known species *L. smithi* and establishes its identity as new.

ABBREVIATIONS

SVL Snout to vent length
HW Head width
HL Head length
MN Distance from back of mandible to nostril
MFE Distance from back of mandible to front of eye
MBE Distance from back of mandible to back of eye
IFE Distance between front of eyes
IBE Distance between back of eyes
IN Internarial space
EN Distance from front of eye to nostril
EL Eye length
SN Distance from snout to nostril
SL Distance from front of eye to tip of snout
TYD Maximum tympanum diameter
TYE Tympanum eye distance
IUE Minimum distance between upper eye lids
HAL Hand length (from base of outer palmar tubercle to tip of third finger)
FLL Forelimb length
TFL Length of third finger (from basal border of proximal subarticular tubercle)
FML Length of femur (from vent to knee)
TBL Length of tibia
TTA Tibio-tarsal articulation
FOL Foot length (from base of inner metatarsal tubercle to tip of fourth toe)
FTL Length of fourth toe (from basal border of proximal subarticular tubercle)
SS Distance between shoulder to tip of snout
TAL Length of tarsus
V/A/ERS/ZSI Vertebrata/ Amphibia/Eastern Regional Station/Zoological Survey of India

Leptobrachium nokrekensis sp. nov.

Material examined : 1 example, female (HOLOTYPE); Regd.no.V/A/ERS/ZSI/834, Didari Kchibama, Nokrek Biosphere Reserve, East Garo Hills district, Meghalaya (N 25° 29' 0.09", E 90° 18' 55.2", Altitude 1054 m above msl) 11.02.2008, Coll. R. Mathew and party.

2 examples, male (PARATYPE); Regd. no. V/A/ERS/ZSI/835, Didari Kchibama, Nokrek Biosphere Reserve, East Garo Hills district, Meghalaya (N 25° 29' 0.09", E 90° 18' 55.2", Altitude 1054 m above msl) 11.02.2008, Coll. R. Mathew and party.

4 examples, 1 female and 3 males (PARATYPE); Regd. no. V/A/ERS/ZSI/836, Ganol river, Nokrek Biosphere Reserve, East Garo Hills district, Meghalaya (N 25° 30' 19.6", E 90° 18' 20.7", Altitude 964 m above msl) 13.02.2008, Coll. R. Mathew and party.

MATERIALS AND METHODS

The specimens were collected with the help of a hand net and preserved in 5% formaline solution. The measurements were taken with the help of an electronic digital caliper and are in millimeters. For comparison the indices are expressed in thousand.

Description of Holotype : Head broader (HW 11 mm) than long (HL 10 mm; MFE 7.5 mm; MBE 3 mm); tympanum sunk, dark coloured, vertically oval (TYD 1.5 mm, TYE 1 mm), on either side of tympanum a pair of reddish tubercles present; supratympanic fold distinct followed by a red tubercle; upper jaw toothed, with black bands; mouth wide; vomerine teeth absent. Tongue distinctly notched, slightly elongated (Fig. 8A). Eyes bulged (EL 4.5 mm), eye balls on upper part reddish orange, pupil vertical (Figs. 5, 6, 9, 10); Distance between front of eye (IFE 4 mm) half the distance between back of eye (IBE 8 mm), loreal region concave, nostril nearer to tip of snout (SN 1.2 mm; SL 4.2 mm; MN 9.5 mm; IN 2 mm). Dorsum brownish with dark irregular markings all over, powdered with white (Figs. 1, 6). A triangular mark between eyes followed by an inverted 'Y' shaped mark (Fig. 4). A pair of axillary and femoral glands (Fig. 3). Belly creamish , laterally bordered with blackish spots and a line of white glandular tubercles (Fig. 7). Dorsum with tubercles and few longitudinal folds; vent below and above with a pair of reddish warts. A prominent fold of skin overhanging the vent.

Forelimbs slender, moderate, with cross bands; fore-arm longer than hand (FLL 8 mm; HAL7 mm); fingers free; 1st finger shorter than 2nd; palmar tubercle swollen, prominent; finger tips blunt, slightly swollen (Fig. 12).

Hind limbs moderate with black bands; length of tibia equals the length of foot but shorter than femur (TBL 13.5 mm, FOL 13.5 mm, FML 14 mm); with many tubercles of varied sizes, particularly on femur; TTA reaching posterior corner of eye. Toes webbed at base, inner metatarsal tubercle oval, rather swollen; outer absent (Fig. 8B).

A gravid specimen with light yellowish round eggs visible externally (Fig. 2)

Variations in Paratypes : Almost similar to the holotype except the following :

1) Males smaller size
2) Lateral glandular line more prominent than in female
3) Femoral glands larger in male
4) More tubercles near vent in males (Fig. 11).

Measurements of ***Leptobrachium nokrekensis*** sp. nov. (in millimeters)

Characters	Holotype Female	Paratype Male	Paratype Male	Paratype Female	Paratype Male	Paratype Male	Paratype Male
SVL	35.00	33.00	33.00	34.00	27.00	27.00	26.00
HW	11.00	11.00	11.00	11.00	9.00	10.00	9.00
HL	10.00	11.00	10.50	10.00	9.00	8.50	8.00
MN	9.50	9.00	9.00	8.00	7.00	6.50	7.00
MFE	7.50	7.50	8.00	8.00	6.00	6.00	6.00
MBE	3.00	3.50	3.50	3.50	2.50	2.50	2.00
IFE	4.00	4.00	5.50	4.70	4.00	4.50	4.50
IBE	8.00	9.00	10.00	9.00	8.50	9.00	8.00
IN	2.00	2.30	2.50	3.00	1.00	1.50	2.00
EN	2.00	2.20	2.00	2.50	1.20	1.70	2.00
EL	4.50	4.50	5.50	5.00	4.50	4.50	3.70
SN	1.20	1.70	1.75	2.00	1.20	1.75	1.50
SL	4.20	4.50	5.00	5.00	4.00	3.50	4.00
TYD	1.50	2.00	2.00	2.00	1.70	1.50	1.70
TYE	1.00	1.00	1.00	1.00	0.70	0.70	0.50
IUE	2.50	2.50	3.00	2.50	2.00	3.00	2.50
HAL	7.00	7.00	8.00	7.00	6.00	6.50	6.00
FLL	8.00	8.50	8.50	7.50	6.00	6.00	5.00
TFL	4.00	5.00	5.00	4.00	4.00	3.50	4.00
FML	14.00	14.00	14.00	13.00	11.00	12.00	11.00
TBL	13.50	14.50	14.50	15.00	11.50	12.50	11.00
FOL	13.50	15.00	13.00	14.00	11.50	11.50	11.00
FTL	7.00	8.00	7.00	8.00	6.50	6.00	6.00
SS	13.00	13.00	14.00	15.00	11.50	11.00	11.00
TAL	7.50	9.00	7.00	8.00	6.00	6.00	6.00

The only known species of *Leptobrachium* in India is *L. smithi* Matsui, Nabhitabhata and Panha, 1999 (Ohler. *et al.*, 2004; Sengupta *et al.*, 2001). We collected 5 specimens (measuring 33-59 mm) of *Leptobrachium smithi* from Nokrek Biosphere Reserve between April to June, 2008. The largest specimen was collected in the night from the nursery bed of the forest department in June,

2008. Sensing the approach of the collector it ducked (lowered its head forward) and it allowed sufficient time to be picked up. Another specimen measuring 38 mm collected during the day was picked up from under the stone. This exhibited a contrasting colour pattern of ashy white with dark dorsal and limb markings. However being held in a polythene bag it changed its colour to the dark brown/black customary to *L. smithi* (Figures 13 and 14). We have taken detailed measurements of *L. smithi* to compare with the newly described species.

Leptobrachium smithi Matsui, Nibhitabhata and Panha, 1999

Material examined : 1 ex. Regd.no. V/A/ERS/ZSI/860, Rengsangre, Norkrek Biosphere Reserve, West Garo Hills district, Meghalaya (N 25° 34' 21.2" E 90° 17' 57.8"; Altitude 522 m above msl), 19.06.2008, Coll. R. Mathew and party.

1 ex., Regd. no. V/A/ERS/ZSI/861, Daribokgre, Nokrek Biosphere Reserve, East Garo Hills district, Meghalaya (N 25° 29' 34.8" E 90° 19' 26.9" ; Altitude 1119 m above msl) 24.06.2008, Coll. R. Mathew and party.

3 exs. Regd. no. V/A/ERS/ZSI/862, Daribokgre, Nokrek Biosphere Reserve, East Garo Hills district, Meghalaya (N 25° 28' 33.5" E 90° 19' 57"; Altitude 1119 m above msl) 30.04.2008, Coll. R. Mathew and party.

Diagnostic characters : Larger species , dorsum smooth with large dark markings; flanks with distinct dark spots; belly light coloured, mottled with brown.

Measurements and indices of ***Leptobrachium smithi***

Charac-ters	**Measure-ments in mm**	**Index**	**Measure-ments in mm**	**Index**	**Measure-ments in mm**	**index**	**Index/ Mean**
SVL	59.0	59 mm	38.0	38 mm	35.0	35 mm	
HW	25.0	424	16.0	421	15.0	429	425
HL	21.0	356	14.0	368	12.5	357	360
MN	18.0	305	11.5	303	11.5	329	312
MFE	13.0	220	10.0	263	8.5	243	242
MBE	8.0	136	4.0	105	4.5	129	123
IFE	10.0	169	8.0	211	6.0	171	184
IBE	17.0	288	13.0	342	12.0	343	324
IN	5.0	85	4.5	118	3.5	100	101
EN	5.5	93	3.0	79	3.5	100	91
EL	6.5	110	5.5	145	3.5	100	118

Charac-ters	Measure-ments in mm	Index	Measure-ments in mm	Index	Measure-ments in mm	index	Index/ Mean
SN	4.5	76	4.0	105	4.0	114	98
SL	10.0	169	7.5	197	6.0	171	179
TYD	3.0	51	2.0	53	1.5	43	49
TYE	3.0	51	1.5	39	1.5	43	44
IUE	6.0	102	5.0	132	4.0	114	116
HAL	12.5	212	9.0	237	8.5	243	231
FLL	18.0	305	11.5	303	12.0	343	317
TFL	9.5	161	6.0	158	5.0	143	154
FML	24.0	407	16.0	421	15.0	429	419
TBL	21.0	356	14.0	368	13.0	371	365
FOL	18.0	305	13.0	342	11.0	314	320
FTL	12.0	203	7.5	197	7.0	200	200
SS	24.0	407	17.5	461	16.0	457	442
TAL	12.0	203	8.5	224	8.0	229	219

Comparison of indices of ***Leptobrachium smithi*** and ***L. nokrekensis*** sp. nov.

Characters	Index/ Mean *L. smithi*	Index/ Mean *L nokrekensis*
HW	425	336
HL	360	312
MN	312	260
MFE	242	228
MBE	123	95
IFE	184	147
IBE	324	289
IN	101	66
EN	91	63
EL	118	151
SN	98	52

Characters	Index/ Mean *L. smithi*	Index/ Mean *L nokrekensis*
SL	179	141
TYD	49	58
TYE	44	27
IUE	116	85
HAL	231	221
FLL	317	229
TFL	154	138
FML	419	415
TBL	365	431
FOL	320	418
FTL	200	226
SS	442	412
TAL	219	230

DISCUSSION

Colouration of the eye in the genus *Leptobrachium* is considered as an important taxonomic character and might also play a role in behaviour, especially in intraspecific relationships (Ohler, *et al.*, 2004). The phylogenetic significance of this character was discussed by Matsui *et al.*, 1999. Red, orange or scarlet coloured eyes are seen in *Leptobrachium hasseltii* Tschudi, 1838, *L. hendricksoni* Taylor, 1962, *L. mouhoti* Stuart, Sok and Neang, 2006, *L. pullum* (Smith, 1921) and *L. smithi* Matsui, Nabhitabhata and Panha, 1999. Only *Leptobrachium smithi* has its distribution in India (Ohler. *et al.*, 2004; Sengupta *et al.*, 2001).

The present material numbering 7 examples (2 females and 5 males) do not agree with the description of the known species *L. smithi* . After comparative studies the following observations are drawn to differentiate the two species and establish the identity of *L. nokrekensis* sp. nov.

i) *Leptobrachium nokrekensis* sp. nov. differs from *L. smithi* in body size and shape : (SVL 26-35 mm in *L. nokrekensis* versus 35-59 mm in *L. smithi*); body is somewhat narrow anteriorly in *L. nokrekensis* and more roundish in *L. smithi*. In *L. nokrekensis*, dorsum is not smooth and is with tubercles and few longitudinal folds. Belly in *L. nokrekensis* is creamish, laterally bordered with black spots and a line of white glandular tubercles; *L. nokrekensis* has a pair of axillary and femoral glands. In *L. smithi* dorsum is smooth with or without discrete dorsal markings, flanks with dark brown roundish and small white spots, belly light coloured.

ii) *L. nokrekensis* differs from *L. smithi* by having a narrower head (HW index 336); broader in *L. smithi* (HW index 425).

iii) *L. nokrekensis* has shorter head (HL index 312); longer head in *L. smithi* (HL index 360).

iv) Distance between mandible to nostrils is less in *L. nokrekensis* (MN index 260); more in *L. smithi* (MN index 312)

v) Distance between mandible to back of eye is less in *L. nokrekensis* (MBE index 95) and the same is more in *L. smithi* (MBE index 123)

vi) Distance between front of eyes less in *L. nokrekensis* (IFE index 147); more in *L. smithi* (IFE index 184)

vii) Distance between back of eye is less in *L. nokrekensis* (IBE index 289) and the same is more in *L. smithi* (IBE index 336)

viii) Internarial distance is less in *L. nokrekensis* (IN index 66) and the same is more in *L. smithi* (IN index 101)

ix) Eye to nostril distance is less in *L. nokrekensis* (EN index 63) and the same is more in *L. smithi* (En index 91)

x) Eye length is more in *L. nokrekensis* (EL index 151) and the same is less in *L. smithi* (EL 118)

xi) Distance between snout to nostril is less in *L. nokrekensis* (SN index 52) and the same is more in *L. smithi* (SN index 98)

xii) Distance from front of eye to tip of snout is less in *L. nokrekensis* (SL index 141) and the same is more in *L. smithi* (SL index 179)

xiii) Minimum distance between upper eyelids is less in *L. nokrekensis* (IUE index 85) and the same is more in *L. smithi* (IUE index 116)

xiv) Forelimb length is less in *L. nokrekensis* (FLL index 229); more in *L. smithi* (FLL index 317)

xv) Length of tibia is more in *L. nokrekensis* (TBL index 431) and the same is less in *L. smithi* (TBL index 365)

xvi) Length of foot is moe in *L. nokrekensis* (FOL index 418) and the same is less in *L. smithi* (FOL 320)

xvii) Length of 4th toe is more in *L. nokrekensis* (FTL index 226) and the same is less in *L. smithi* (FTL index 200)

xviii) Distance between shoulder to tip of snout is less in *L. nokrekensis* (SS index 412); more in *L. smithi* (SS index 442)

Etymology : The specimen is named after Nokrek Biosphere Reserve from where it was collected.

Habitat : Both Holotype and Paratypes were collected from river/stream inside the reserve forest with less sunshine.

Distribution : Meghalaya.

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Figure 1. *Leptobrachium nokrekensis* sp. nov. (Dorsal view)

Figure 2. *Leptobrachium nokrekensis* sp. nov. (Ventral view showing eggs under skin)

Figure 3. *Leptobrachium nokrekensis* sp. nov. (Dorsal view of holotype and ventral view of Paratype)

Figure 4. *Leptobrachium nokrekensis* sp. nov. (Dorsum showing colour pattern)

Figure 5 & 6. *Leptobrachium nokrekensis* sp. nov.

Figure 7. *Leptobrachium nokrekensis* sp. nov. (Showing lateral line of glandular tubercles)

Figure 8A. *Leptobrachium nokrekensis* sp. nov. (Shape of tongue)

Figure 8B. Hindlimbs showing femoral glands & inner metatarsal tubercles in *L. nokrekensis* sp. nov.

Figure 9. *Leptobrachium nokrekensis* sp. nov. (Showing eye, pupil & tympanum)

Figure 10. *Leptobrachium nokrekensis* sp. nov. (Lateral view)

Figure 11. *Leptobrachium nokrekensis* sp. nov. (Showing tubercles near vent)

Figure 12. *Leptobrachium nokrekensis* sp. nov. (Showing glandular palmer tubercle)

Figure 13. *Leptobrachium smithi* A & B. Dorsal view, C & D. Ventral view

Figure 14. *Leptobrachium smithi* A & B. Lateral view, C. Shape of tongue

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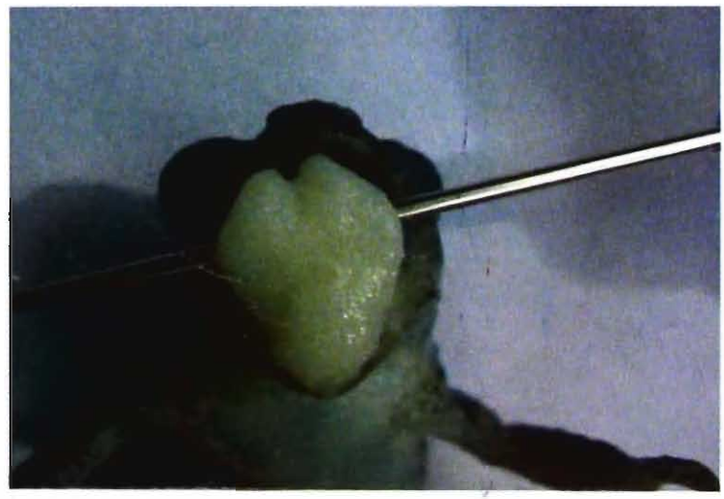

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A

B

C

D

Figure 13. *Leptobrachium smithi* A & B. Dorsal view, C & D. Ventral view

A

B

C

Figure 14. *Leptobrachium smithi* A & B. Lateral view, C. Shape of tongue