AMPHIBIAN FAUNA OF LOKTAK LAKE, MANIPUR, INDIA WITH TEN NEW RECORDS FOR THE STATE

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Manipur is located between 23°51'- 25°41'N & 93°2'-94°47'E (altitude ranging between 750 and 2020m) in the northeastern part of the country, bordering Myanmar for about 352km in the east and the south. Manipur shares borders with the states of Nagaland, Assam and Mizoram.

The Loktak lake is surrounded by hills on all sides that run in a north-south direction forming parallel folds with altitudes varying from 850m to 3000m above mean sea level.

Manipur has a vast forest area constituting 68% of the total geographic area of the state. Its vegetation ranges from tropical evergreen to temperate evergreen with tropical moist deciduous and dry temperate coniferous trees of subtropical forest.

Loktak lake is the largest freshwater lake in northeastern India. This has been declared as a Ramsar Site (No. 463 declared on 16th June, 1993). It is situated between 24°25'-24°42'N & 93°46' - 93°55'E at an altitude of 750m. The lake is famous for its floating mats of vegetation locally called *phumdis*. These support a large variety of flora and fauna, the most well known and threatened Manipur Brow-antlered Deer or Sangai. The Keibul Lamjao National Park (declared in 1977) is a part of the Loktak lake area.

The present survey of amphibian fauna was carried out in different parts of Loktak lake and its vicinity (Fig. 1). The survey was conducted for a period of one year (August 2004-July 2005) covering all the breeding seasons and different microhabitats. A hill stream near loktak hydro-electric project was also surveyed.

Publications on amphibian fauna of Manipur are very few, with some literature available for northeastern India in general with mention of a few species from Manipur. Chanda (1994) reported 11 amphibian species from Manipur; Keising (2001) recorded the Himalayan Newt *Tylototriton verrucosus* from Ukhrul district; Chanda (2002) recorded 14 species; Sen (2004) in her compilation listed 17 species; and Sarkar *et al.* (2005) listed 14 species from the state.

Important publications from the neighbouring states, *viz.*, 32 species from Nagaland by Ao *et al.* (2003), 24 species by Pawar (2001) from Mizoram and 20 species by Choudhury *et al.* (2001)

Table 1. List of species recorded along with local name and IUCN status

Current Family / Species As per Frost (2007)	Family / Species As per GAA (2004)	Local name	New record for Manipur	IUCN Status (GAA, 2004)
Bufonidae	**Bufonidae**			
Duttaphrynus melanostictus (Schneider, 1799)	*Bufo melanostictus*	Hangoi borabi	R	LC
Dicroglossidae	**Ranidae**			
Euphlyctis cyanophlyctis (Schneider, 1799)	*Euphlyctis cyanophlyctis*	Loubuk hangoi	R	LC
Euphlyctis hexadactylus (Lesson, 1834)	*Euphlyctis hexadactylus*	Pat hangoi	**NR**	LC
Fejervarya nepalensis (Dubois, 1975)	*Fejervarya nepalensis*	Narak hangoi	**NR**	LC
Fejervarya syhadrensis (Annandale, 1919)	*Fejervarya syhadrensis*	Narak hangoi	**NR**	LC
Fejervarya teraiensis (Dubois, 1984)	*Fejervarya teraiensis*	Narak hangoi	**NR**	LC
Hoplobatrachus crassus Jerdon, 1854	*Hoplobatrachus crassus*	Moreh hangoi	R	LC
Hoplobatrachus tigerinus Daudin, 1802	*Hoplobatrachus tigerinus*	Moreh hangoi	R	LC
Hylidae	**Hylidae**			
Hyla annectans (Jerdon, 1870)	*Hyla annectans*	Hangoi	R	LC
Megophryidae	**Megophryidae**			
Xenophrys major (Boulenger, 1908)	*Xenophrys major*	Keng keng pui	**NR**	LC
Xenophrys wuliangshanensis (Ye & Fei, 1995)	*Xenophrys wuliangshanensis*	Keng keng pui	**NR**	DD
Xenophrys parva (Boulenger, 1893)	*Xenophrys parva*	Keng keng pui	**NR**	LC
Microhylidae	**Microhylidae**			
Microhyla ornata (Duméril & Bibron, 1841)	*Microhyla ornata*	Hangoi	R	LC
Ranidae	**Ranidae**			
Amolops formosus (Günther, 1876)	*Amolops formosus*	Keng keng pui	**NR**	LC
Amolops gerbillus (Annandale, 1912)	*Amolops gerbillus*	Keng keng pui	**NR**	LC
Amolops marmoratus (Blyth, 1855)	*Amolops marmoratus*	Keng keng pui	R	LC
Huia livida (Blyth, 1856)	*Rana livida*	Hangoi	R	LC
Humerana humeralis (Boulenger, 1887)	*Rana humeralis*	Hangoi	**NR**	LC
Hylarana erythraea (Schlegel, 1837)	*Rana erythraea*	Hangoi	R	LC
Hylarana tytleri (Theobald, 1868)	*Rana tytleri*	Hangoi	R	LC
Rhacophoridae	**Rhacophoridae**			
Chiromantis vittatus (Boulenger, 1887)	**Ranidae** / *Chirixalus vittatus*	Hangoi	R	LC
Polypedates megacephalus Hallowell, 1861	*Polypedates megacephalus*	Hangoi tangsang	R	LC
Polypedates leucomystax (Gravenhorst, 1829)	*Polypedates teraiensis*	Hangoi tangsang	R	LC
Rhacophorus bipunctatus Ahl, 1927	*Rhacophorus bipunctatus*	Hangoi	R	LC
Rhacophorus maximus Günther, 1858	*Rhacophorus maximus*	Hangoi	R	LC

DD - Data deficient; LC - Least Concern; NR - New record; R - Recorded earlier

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from Assam reveal that extensive survey in the inaccessible areas will lead to many more important species from Manipur.

Methodology: Frogs were collected through (i) visual encounter survey, and (ii) sampling of breeding sites. Frogs obtained from road kills and killed for by the locals for purposes such as for food and persecution (to deter increase in snake populations) were also recorded. Measurement of only one sample is given in Table 2 as these species have been recorded earlier from neighbouring states and some from Manipur itself and published elsewhere. Samples were preserved in 8% formaldehyde solution for fixation and preservation. The specimens are deposited in the museum of the Institute of Advanced Study in Science and Technology (IASST), Guwahati (Registration numbers IASSTAM1-25). For identification, publications such as Boulenger (1920), Chanda (1994), Dubois & Ohler (2000), Ao *et al.* (2003) and Dutta (1997) were followed. Specimens from other states like Nagaland Ao *et al.* (2003) and Arunachal Pradesh (Borah & Bordoloi, 2003) collected and identified with the help of Paris Museum (Dr. Anne-Marie Ohler), available in our collections were used as comparative material for identification. Current species and family names are as per Frost

Figure 1. Map of Manipur showing Loktak lake

Table 2. Some important morphometrics of the amphibians collected (in mm)

Species	Sex	Reg. No.	SVL	HW	HL	FLL	HAL	TL	FTL	IN	EN	EL	TYD	FOL	SL	NS	TW
Amolops formosus	M	IASSTAM7	62.5	22.5	21	15.6	19.6	38.7	17.4	7.6	5.5	7.3	2.75	32.1	10.7	4.8	9.7
Amolops gerbillus	M	IASSTAM8	22.3	7.1	7.1	5.5	7.15	14	6.1	3.4	1.8	3.8	1.25	11.4	4.15	1.8	2.85
Amolops marmoratus	M	IASSTAM9	67.7	19.9	19.2	14.4	19.9	42.4	18.6	7.5	5.4	8.3	2.55	36.3	10.6	5.15	10.6
Chiromantis vittatus	M	IASSTAM10	21.8	6.95	6.4	4.15	5.65	11.2	5.7	2.4	1.75	3.25	1.2	9.55	3.4	1.8	2.3
Duttaphrynus melanostictus	M	IASSTAM1	53	18.1	11.75	16.8	12.8	18.8	9.8	2.3	4.5	6	3.2	20.2	7	2.5	5.15
Euphlyctis cyanophlyctis	F	IASSTAM11	33.2	11	11.8	6.95	8.4	13.8	6.8	1.6	2.9	3.8	2.35	14.5	5.35	2.65	3.8
Euphlyctis hexadactylus	F	IASSTAM12	52.4	17.7	18.5	10.7	11.6	25.5	16.1	3.3	6.5	6.1	4.05	27.7	9.7	4.1	6.45
Fejervarya nepalensis	F	IASSTAM14	30.2	8.8	10.2	5.35	6.35	11.7	7.8	2	1.8	3.2	1.8	13.7	5.4	2.4	4.6
Fejervarya syhadrensis	F	IASSTAM15	36.9	9.65	10.8	5.1	7.8	14.6	9.9	3	2.55	3.75	2	16.4	5.05	2.6	4.7
Fejervarya teraiensis	F	IASSTAM13	41.9	13.8	14.3	8.7	9.6	18.8	7.85	2.5	3.65	5	2.75	20.7	6	2.7	6
Hoplobatrachus crassus	M	IASSTAM16	60.2	19	17.55	12.2	13.2	6.5	15	3.8	5	6.85	5	28.9	9.55	3.8	7.3
Hoplobatrachus tigerinus	F	IASSTAM17	103	32.4	33.6	22.2	19.7	7.85	26.7	6	9.2	10.8	8.4	46	11.9	6.35	7.5
Huia livida	M	IASSTAM22	50	15.4	16	11	14.8	31.2	14.5	4.9	4.5	6.1	4.5	27.1	7.35	3	4.35
Humerana humeralis	M	IASSTAM21	65.2	22.3	22.25	13.7	18.3	37.5	20.7	6.5	6.1	8.8	6.05	36.6	10.5	5.9	9.15
Hyla annectans	M	IASSTAM2	33.3	13.2	11.85	7.8	13.1	17.2	9.5	2.8	3.5	4.3	2.4	19.9	5.2	1.6	3.25
Hylarana erythraea	M	IASSTAM20	64.5	19.2	18.3	13.7	17.2	34.6	19.2	6.2	5.45	6.9	5.6	32.8	10.5	4.1	7.95
Hylarana tytleri	F	IASSTAM23	31.6	8.6	9	6.2	9.1	16	10.3	2.8	3	3.75	3.3	17.3	5.35	2.1	3.3
Microhyla ornata	M	IASSTAM6	20.3	7.65	5.35	3.25	4.05	8.65	5.8	1.5	2.8	1.95	1.3	10.4	2.65	1.05	3.55
Polypedates leucomystax	M	IASSTAM19	58.8	19.1	18	14.2	17.7	22	15.2	4.3	6.8	5.7	4.2	26.7	9.25	2.6	4.8
Polypedates megacephalus	F	IASSTAM18	70	23	21.55	15.2	19.2	34.9	18.5	5	7.25	6.25	4.1	31.7	11	2.8	4.9
Rhacophorus bipunctatus	M	IASSTAM24	44.8	15.9	12.65	8.1	14.5	22.2	10.6	4.3	3.5	5	3	20.3	7.3	3.3	4.3
Rhacophorus maximus	M	IASSTAM25	77.7	25.5	25	18.9	24.3	38.1	21.5	7.3	6.15	6.3	3.8	40.2	13.1	5.75	7.35
Xenophrys major	M	IASSTAM3	73.3	24.5	24.5	15.7	19.2	41.5	20.3	7.5	4.2	8.35	3.6	38.2	10.6	6.15	9.2
Xenophrys parva	M	IASSTAM5	39.5	14.5	13.35	9.2	9.1	21.7	8.7	4.7	2.25	5.45	1.65	17.8	5.75	2.75	4.45
Xenophrys wuliangshanensis	M	IASSTAM4	25.4	7.55	9.3	6.7	7	11.4	5.75	2.7	1.6	2.8	1.35	11	3.45	1	2.6

EN - Eyenostril length; EL - Eye length; F - Female; FLL - Fore limb length; FOL - Foot Length; FTL - Fourth toe length; HAL - Hand length; HL - Head length; HW - Head width; IN - Internasal; M - Male; NS - Snout-nostril length; Reg. No. - Registration No; SL - Snout Length; SVL - Snout vent Length; TL - Tibia length; TW - Tibiawidth; TYD - Tympanum Diameter

(2007). In addition, old names as well as the global status after IUCN *et al.* (2004) is provided (Table 1).

Results: Loktak lake provides congenial breeding ground for the different species of frogs. This unique ecosystem has not been surveyed so far for its amphibian faunal richness. This is the first ever record of amphibians from this wetland of international importance. The frogs recorded so far belong to lotic as well as lentic ecosystems. In the present survey we have been able to record 25 amphibian species just from Loktak lake and the neighbouring wetlands, of which 21 species are new records for the state (Table 1). The surrounding area of loktak lake includes some undisturbed habitat and hence we could record some rare frogs like *Xenophrys wuliangshanensis*, *X. major* and three species of *Amolops*. *Xenophrys wuliangshanensis* was first reported as a new record for India from Nagaland (Ao *et al.* 2003), since then the frog has been reported from Arunachal Pradesh (Borah & Bordoloi, 2003) and now from Manipur. *Xenophrys major*, *X. wuliangshanensis*, *X. parva*, *Amolops formosus*, *Amolops gerbillus*, *Humerana humeralis*, *Euphlyctis hexadactylus*, *Fejervarya teraiensis*, *F. nepalensis* and *F. syhadrensis* are new records for the state of Manipur. The 25 species recorded from the area reveals that the area abounds in suitable breeding grounds of diverse groups of frogs. Extensive survey in the Keibul Lamjao National Park may lead to discovering many species not recorded so far.

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OBSERVATIONS ON FRUIT HANDLING TECHNIQUES OF FRUGIVOROUS BIRDS IN CHITTAGONG, BANGLADESH

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Most species of fruit-eating birds either crush fruit during mandibulation, often dropping the seeds, or swallow intact fruits with little mandibulation (Moremond & Denslow, 1985). The predicted differences between the two groups of birds carry important consequences for both fruit-eating birds and fruiting plants. From a plant's perspective, seeds that are swallowed are likely to be deposited farther from the parent tree than seeds dropped during fruit handlings, because survival is higher farther from the parent plant (Janzen, 1970; Connell, 1971; Augspurger, 1984; Augspurger & Kelly, 1984; Clark & Clark, 1984; Howe *et al.*, 1985).

Study area: The Chittagong University Campus lies in between 22°27'30"-22°29'0"N & 91°46'30"-91°47'45"E. The campus is mainly hilly and the total area is 1264.73ac of which 720ac is hills and hillocks and the remaining are either plains or valleys. About 30% of the hills are higher than 70m and the remaining are less than 30m high from the mean sea level. There are some creeks and streams running through the area. The soil varies from clay to clayey-loam in valleys and plains and sandy-loam in hills. The pH of the soil is mostly acidic in nature. There are distinctly four synoptic seasons (Ahmed, 1991) prevailing in the area, namely, pre-monsoon (March to May), monsoon (June to September), post-monsoon (October to November) and winter (December to February). The vegetation of the campus is of semievergreen type. The primary vegetation of this area is totally lost. After the establishment of the University in 1966, plantation of tree species was undertaken. This has gradually changed the vegetation to a secondary type. Vegetables and rice are grown in the plains and in valleys. The grasses, sedges and reeds are also seen in swamps and ditches. About 30% area of the campus consists of road, building, habitations and gardens. About 312.25ac of hills are under plantations. Most of plantations are mixed type, comprising both indigenous and exotic species. Exotic species includes *Eucalyptus* spp., *Acacia* spp., *Meloleuca* spp., *Swetenia* spp., and many others. The planted indigenous species are *Chukrasia* spp., *Albizzia* spp., *Lagerstroemia* spp. among others. Alam and Pasha (1999) have recorded about 665 angiospermic species from the study area. About 600 settlements are situated inside the area. Most of their settlements are situated around the foothills. They practice shifting cultivation. This rich flora attracts and sustains large

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