



Rapid assessment of Herpetofaunal and invertebrate diversity in Tripura state

Final report
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Introduction

Northeast India is part of two of the world's hotspots for biodiversity, the Himalayas and the Indo-Burma region (Myers et al. 2000). Seven states of Northeast India, that include Sikkim, Arunachal Pradesh, Assam, Manipur, Nagaland, Meghalaya and Tripura are under these two biodiversity hotspots and are known for the high degree of endemic fauna and flora they host. Despite extensive survey that have been conducted over the last few years, new species across varied taxa are being described every year which highlight the need for dedicated explorations of northeast India (Kamei et al. 2009, 2012, Mirza et al. 2016a; b; Siliwal et al. 2015). Faunistic surveys across the northeast have largely been centered around charismatic species, like birds, mammals and to an extent on butterflies among invertebrates. Diversity of invertebrates and lower vertebrates has largely been overlooked across the country (Mirza et al. 2014a; b) and a situation that parallels in northeast India too. Among the seven northeast Indian states, Tripura has thus far been the least explored in comparison with neighboring states (Majumder et al. 2012).

The Tripura Biodiversity Board (TBB) and the Forest department of Tripura in collaboration with the National Centre for Biological Sciences conducted rapid survey of the state to document its herpetofaunal and invertebrate fauna. The results from the first survey are presented herein.

Aim:

Conduct survey across Tripura to document diversity of reptiles and arachnids

Materials & Methods:

Study area: Tripura is located in northeastern India between 24°12'54"N, 91°38'58"E and 22°57'44"N, 91°36'30"E, 23°42'33"N, 91° 8'44"E and 24° 1'25"N, 92°19'57"E. The state is enveloped by Bangladesh on all sides except for its east and northeast which is bordered by Mizoram and Assam (Figure 1). The state largely is low in elevation ranging from 10–90m and areas with highest elevation exceeding 800m are on the borders of Mizoram and Tripura. The state spans over an area of 10,491 km² and its area under forest cover is about 6,294km² which constitutes to about 60.02%. The forest type of the state is of two types, viz. Tropical semi-evergreen and Tropical moist deciduous. The TBB has notified 35 (Figure 2) areas across the state as hotspots for biodiversity based on available data on the biodiversity. As part of the proposed project, these pre-identified hotspots had to be surveyed to assess their diversity of herpetofaunal and arachnid fauna of these areas. The first survey was conducted from September, 2014 to November, 2014 by two researchers assisted by local trackers/forest guards. During this period, we

visited ten areas of the 35 hotspots (Figure 3, Table 1). **Survey methods:** Opportunistic sampling method was followed as these are ideal for a rapid assessment of biodiversity of any given area (Mirza personal observation). Two researchers assisted by a local guard or tracker would walk in identified trails to locate actively moving species of reptiles, amphibians and arachnids. We actively upturned boulders, fallen logs and other similar debris where study species would seek refuge. Night trails were conducted with the aid to record nocturnal species. Three trails were conducted in a day each ranging from two to three hours. We took assistance of local residents to report opportunistic sightings of snakes which are difficult to locate during most surveys to increase the chances of recording species. Specimens were caught, photographed and released if identification was achieved based on photographs. Species that were difficult to identify, two to three specimens per species were collected and are deposited in the collection of the National Centre for Biological Sciences, Bangalore for further studies. **Species identification:** Identification of species was based on standard literature in herpetology and arachnology. For reptiles we followed Smith (1935, 1943), Boulenger (1885), Whitaker & Captain (2004) and for arachnids Pocock (1900), Tikader & Bastawade (1983), Raven (1985). Many species that are widespread may represent cryptic species that require extensive

taxonomic comparisons and hence they are referred to as the same species to which they show affinity as major taxonomic revisions would require extensive sampling which is out of the scope of the present study.

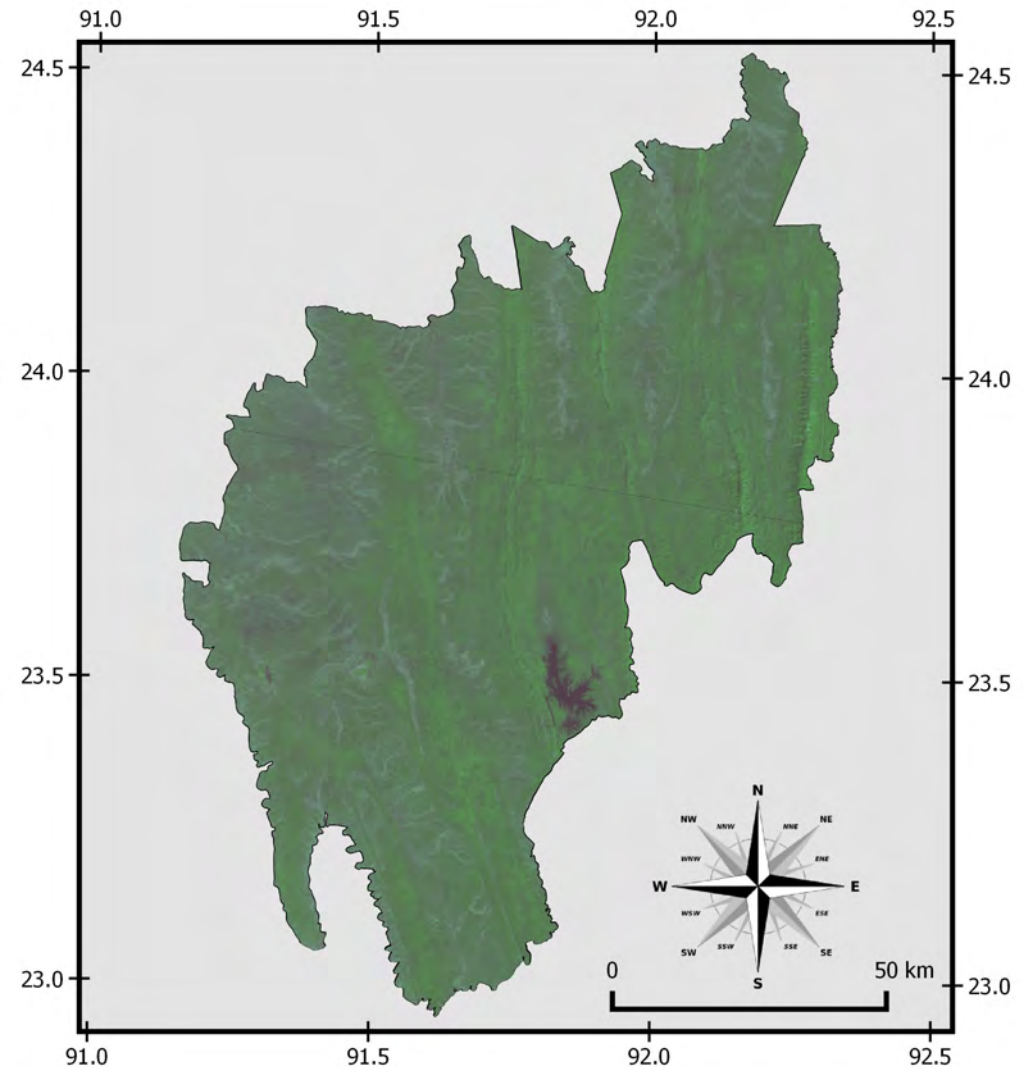
Results:

Over 408 man hours in 34 days to survey ten hotspot across Tripura. The survey yielded nineteen species of reptiles and sixteen species of arachnids. Of the species of reptiles that were recorded from the state during the survey, *Calotes irawadi* constitutes a new national record; *Rhabdophis himalayanus* and *Trimeresurus erythrurus* constitute new state records. The frogs, *Microhyla berdmorei* and *Amolops indoburmanensis* constitute new national records.

Among the arachnid species recorded, *Thaicharmus guptai* was described as a new species, *Orientothele alyratus* was described as a new genus and a new species. Other species like *Euscorpiops longimanus*, *Chaerilus pictus*, *Lychas laevifrons*, and *Liocheles australasiae* constitute new state records. A new species of *Liocheles* was recorded from low elevations areas in Trishna Wildlife Sanctuary and Garjee forest division (Mirza in press). Additional work is underway to identify specimens of uropygi which are represented by two species and genera.



Figure 1. Map showing location of Tripura in India highlighted in red (inset) and satellite imagery of the state



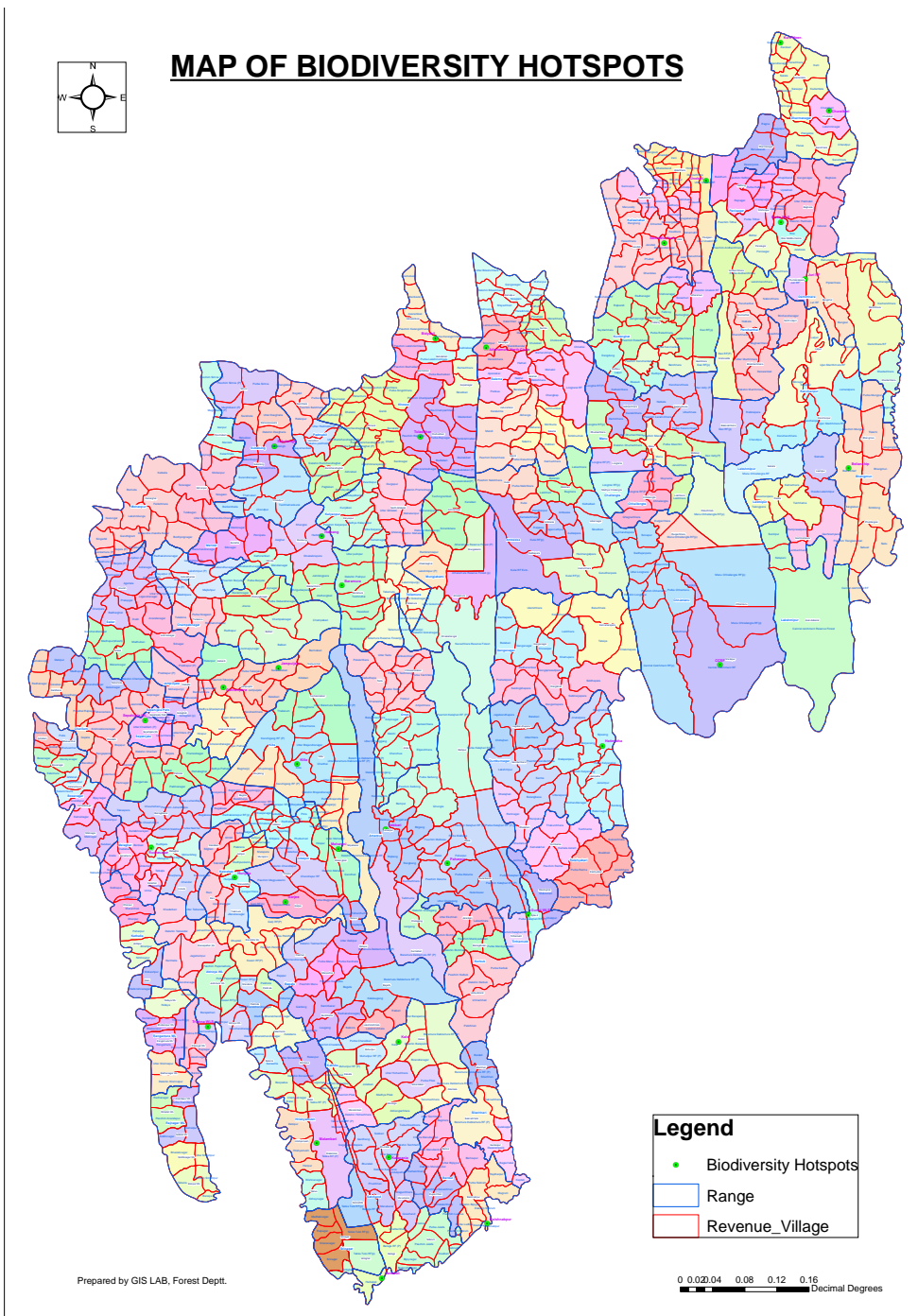


Figure 2. Map showing localtion of hotspots across Tripura

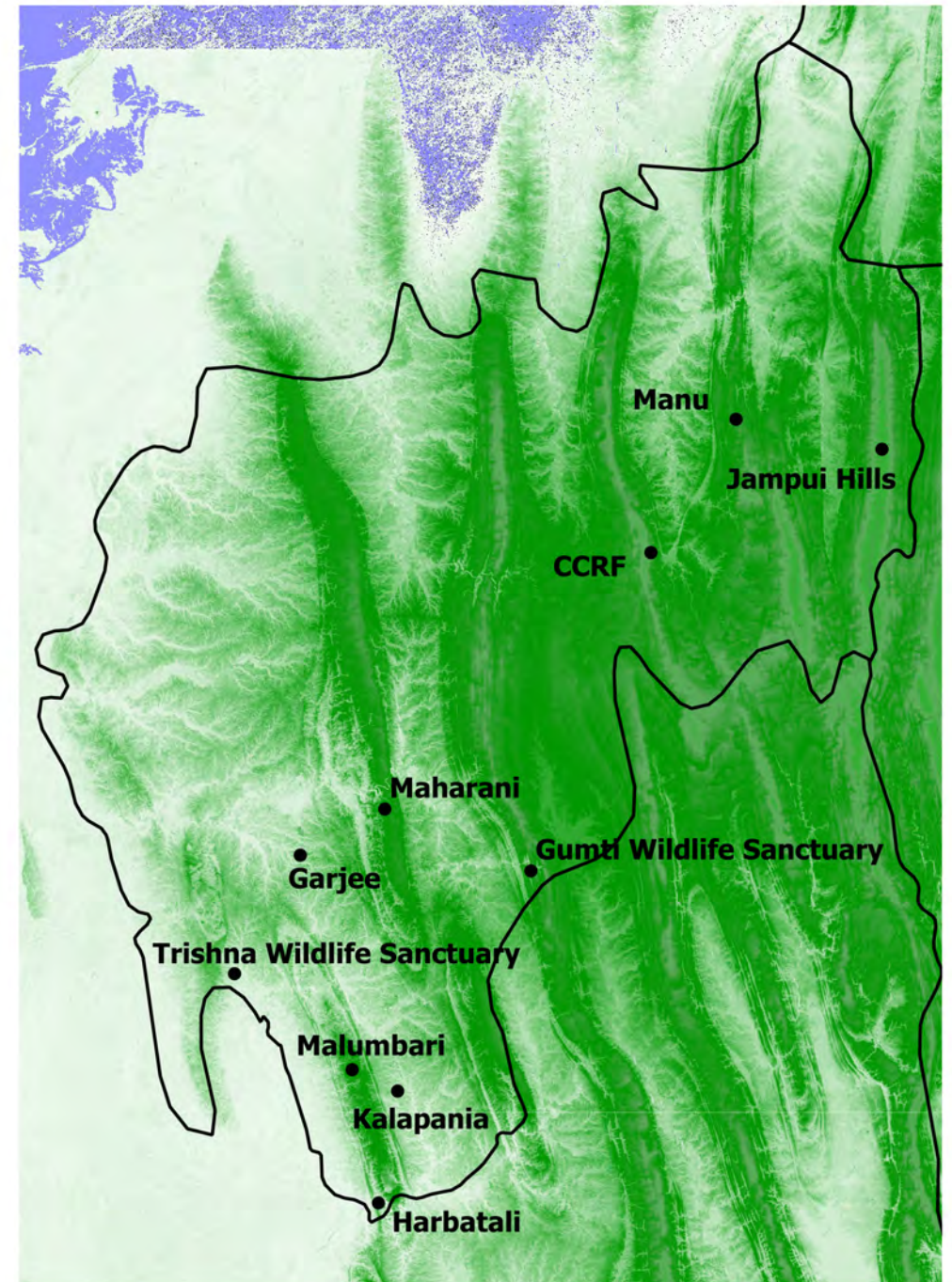


Figure 3. Map showing localtion of hotspots visited during the survey



Calotes irawadi a new species recorded for India

Table 1. Details of areas visited and the time dedicated to each site for survey

Locality	No. of localities surveyed	Start date	End date	No. of days
Trishna Wildlife Sanctuary	1	26-09-2014	7/10/2015	11
Garjee and Maharani	2	7/10/2014	12/10/2014	5
Kalapania, Malumbari, Harbatali	3	13/10/2014	15/10/2014	2
Gumti Wildlife Sanctuary	1	16/10/2014	23/10/2014	7
Manu and CCRF	2	24/10/2014	27/10/2014	4
Jampui Hills	1	27/10/2014	3/11/2014	5
Total	10	-	-	34

Table 2. List of species recorded during the survey

Reptilia	Sr. no.	Sauria		19	<i>Boiga siamensis</i>
	1	<i>Hemidactylus aquilonius</i>	Arachnida		Scorpiones
	2	<i>Hemidactylus</i> sp. 2		1	<i>Liacheles</i> new. sp.
	3	<i>Hemidactylus platyurus</i>		2	<i>Liacheles australasiae</i>
	4	<i>Gekko gekko</i>		3	<i>Lychas laeviform</i>
	5	<i>Calotes emma</i>		4	<i>Thaicharmus guptai</i>
	6	<i>Calotes irawadi</i>		5	<i>Chaerilus pictus</i>
	7	<i>Sphenomorphus maculatus</i>		6	<i>Euscorpius longimanus</i>
	8	<i>Tropidophorus assamensis</i>		7	<i>Isometrus</i> sp.
	9	<i>Varanus bengalensis</i>			Mygalomorphae
		Serpentes		8	Theraphosidae sp.
	10	<i>Lycodon</i> cf. <i>aulicus</i>		9	Nemisidae sp.
	11	<i>Ptyas mucosus</i>		10	<i>Conothele</i> sp.
	12	<i>Dendrelaphis proarchos</i>		11	Theraphosidae sp.
	13	<i>Chrysopelea ornata</i>		12	<i>Oriehtothele alyratus</i>
	14	<i>Boiga ochracea</i>		13	<i>Lyrognathus pugnax</i>
	15	<i>Amphiesma stolatum</i>		14	<i>Chilobrachys</i> sp.
	16	<i>Rhabdophis himalayanus</i>			Uropygi
	17	<i>Xenochrophis piscator</i>		15	<i>Labochirus</i> sp.
	18	<i>Trimeresurus erythrurus</i>		16	<i>Uroproctus assamesnsis</i>

Acknowledgments:

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References

Boulenger, G. (1885) Catalogue of the lizards in the British Museum (Natural History).

Kamei, R.G., Mauro, D.S., Gower, D.J., Van Bocxlaer, I., Sherratt, E., Thomas, a., Babu, S., Bossuyt, F., Wilkinson, M. & Biju, S.D. (2012) Discovery of a new family of amphibians from northeast India with ancient links to Africa. *Proceedings of the Royal Society B: Biological Sciences* 279, 2396–2401.

Kamei, R.G., Wilkinson, M., Gower, D.J. & Biju, S.D. (2009) Three new species of striped Ichthyophis (Amphibia: Gymnophiona: Ichthyophiidae) from the northeast Indian states of Manipur and Nagaland. *Zootaxa* 2267, 26–42.

Majumder, J., Bhattacharjee, P.P., Majumdar, K. & Debnath, C. (2012) Documentation of herpetofaunal

species richness in Tripura, northeast India. *NeBio* 3, 60–70.

Mirza, Z.A., Pal, S., Bhosale, H. & Sanap, R. (2014)a A new species of gecko of the genus *Cnemaspis* Strauch, 1887 from the Western Ghats, India. *Zootaxa* 3815, 494–506.

Mirza, Z.A., Sanap, R. V. & Bhosale, H. (2014)b Preliminary review of Indian Eumenophorinae (Araneae: Theraphosidae) with Description of a new genus and five new species from the Western Ghats A. C. Anil (Ed). *PLoS ONE* 9, e87928.

Mirza, Z.A., Sanap, R. V. & Kunte, K. (2016)a A new genus and new species of diplurid spider (Araneae: Mygalomorphae: Dipluridae) from northeast India. *Journal of Asia-Pacific Biodiversity*.

Mirza, Z.A., Sanap, R. V & Kunte, K. (2016)b A new species of buthid scorpion of the genus *Thaicharmus* Kovařík 1995 (Scorpiones: Buthidae) from northeast India. *Euscorpius – Occasional Publications in Scorpiology* 215, 1–11.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., da Fonseca, G.A. & Kent, J. (2000) Biodiversity hotspots for conservation priorities. *Nature* 403, 853–858.

Pocock, R.I. (1900) Taylor & Francis, London, xii The fauna of British India, including Ceylon and Burma. Arachnida. Taylor and Francis, London.

Raven, R.J. (1985) The spider infraorder Mygalomorphae (Araneae): Cladistics and Systematics. *Bulletin of the American Museum of Natural History* 182, 1–180.

Siliwal, M., Kananbala, A., Bhubaneshwari, M. & Raven, R

(2015) Natural history and two new species of the trapdoor spider genus *Conothele* Thorell 1878 (Araneae: Ctenizidae) from India. *Journal of Arachnology* 43, 34–39.

Smith, M.A. (1935) The Fauna of British India, Including Ceylon and Burma. Reptilia and Amphibia. Vol. II. – Sauria. Taylor and Francis, London.

Smith, M.A. (1943) Fauna of British India, Ceylon and Burma, including the whole of the Indo-Chinese Sub-region. Reptilia and Amphibia. Vol. 3. Serpentes. Taylor and Francis, London.

Tikader, B.K. & Bastawade, D.B. (1983) The Fauna of India, Scorpions (Scorpionida: Arachnida). Vol. 3. Zoological Survey of India, Calcutta.

Whitaker, R. & Captain, A. (2004) Snakes of India. The field guide. Draco Books, Chennai.

Outcome

Mirza Z.A, Sanap R.V., Kunte K. 2016. A new species of the genus *Thaicharmus* Kovařík, 1995 (Scorpiones: Buthidae) from northeast India. *Euscorpius*. 215:1-11.

Mirza, Z. A., R. V. Sanap, and K. Kunte. 2017. A new genus and new species of diplurid spider (Araneae: Mygalomorphae: Dipluridae) from northeast India. *Journal of Asia-Pacific Biodiversity*, 10:32–38



A new species of the genus *Thaicharmus* Kovarik, 1995 (Scorpiones: Buthidae) from northeast India

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<http://zoobank.org/urn:lsid:zoobank.org:pub:85BF1181-214F-4471-B504-9A37A075145C>

Summary

A new species *Thaicharmus guptai* sp. nov. is described from the northeast Indian state of Tripura. The new species differs from the known members of the genus in the following set of morphological characters: large size (total length 45.6 mm); trichobothrium *d*₁ is distal to *i*₁ on femur; trichobothria *ort*, *ov* and *er* on the external surface of the patella do not form a straight line. Subacicular tubercle is absent. The movable finger of pedipalp chela has 1 cutting rows of denticles. The movable finger is much longer than the pedipalp patella. Number of pectinal teeth 20/19; pectines with distinct lamellae and fulcra. Two horn-like projections are present on the ventrolateral aspect of the metasomal segment V.

Introduction

Northeast India is among the globally recognized biodiversity hotspots (Myers et al., 2000). Its vertebrate fauna is somewhat well-documented, and some invertebrate groups are being studied intensively. Arachnids have remained largely undocumented from this area with the only available surveys conducted during the British era in India (Pocock, 1900) and a single study of arachnids of Arunachal Pradesh (Bastawade, 2006). Based on available literature, members of the family Buthidae are poorly represented in northeast India with two genera *Lychas* and *Isometrus* being the only ones recorded so far (Tikader & Bastawade, 1983).

During a biodiversity survey of Tripura State, a single male specimen of a buthid scorpion was collected which was later identified as belonging to the “*Charmus*” group. The “*Charmus*” group presently consists of three genera: *Charmus* Karsch, 1879 (southern India and Sri Lanka), *Thaicharmus* Kovarik, 1995 (Thailand and Goa State, India), and *Somalicharmus* Kovarik, 1998 (Ethiopia) (Kovarik, 1995, 2013; Kovarik et al., 2007) (Fig. 1). After a detailed comparison of recent literature (Kovarik, 1995, 2013; Kovarik et al., 2007) and museum collections, we concluded that the Tripura scorpion belongs to an undescribed species of the genus *Thaicharmus*.

Methods

The specimen was located with the help of an ultra violet torch and preserved in 70% ethanol. The specimen has been deposited in the collection of the National Centre for Biological Sciences, Bangalore. Photographs were taken with a Canon™ 70D and a Canon 100 mm macro lens illuminated with two Canon 430EX-I flashes. This specimen and related comparative material were examined using an Olympus SZ42 stereo binocular microscope and measured with the help of a digital caliper to the nearest 0.1 mm. Descriptive terms and abbreviations follow Stahnke (1971) and Sissom (1990). Terminology for trichobothria follows Vachon (1974).

Systematics

Family Buthidae C. L. Koch, 1837

Genus *Thaicharmus* Kovarik, 1995

Thaicharmus Kovarik, 1995: 195–199; Kovarik et al., 2007: 201–209; Kovarik, 2013: 1.

Diagnosis (modified after Kovarik, 2013): Total length 16–45 mm. Dorsal trichobothria of femur arranged in *alpha*-configuration. Pedipalp chela with three

Original article

A new genus and new species of diplurid spider (Araneae: Mygalomorphae: Dipluridae) from northeast India

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ABSTRACT

A new diplurid genus and species is described from northeast India based on a single female specimen from Jampui hills. *Orientalthele* gen. nov. is placed in the subfamily Diplurinae based on the presence of one row of teeth on the chelicerae. The new genus and species can be diagnosed from most diplurid genera in lacking lyra on the prolateral face of maxilla, paired claw with one row of teeth, maxilla with numerous cusps, scapulae absent on all legs, and spermathecae consisting of two elongate stalks with bulbous receptacles at their tips which are bent inwards. *Ischnothele indicola* Tikader, 1969 is here treated as *incertae sedis* with regards to its generic placement in light of the discovery of *Orientalthele* gen. nov.

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Introduction

The mygalomorph spider family Dipluridae Simon, 1889 is represented globally by 188 species in 24 genera (World Spider Catalog 2016). Members of this family are presently known to be distributed in the Neotropical, southern Neartic, Afrotropical, Madagascar, Oriental, Sino-Japanese, Oceanian, and Australian realms with its greatest diversity in Australia and the Neotropical region. These spiders possess long posterior lateral spinnerets which are used to make an irregular web with a retreat within it (Schwendinger 2009). In Asia, however, their diversity seems to be poorly represented largely due to the fact that only a handful of investigations have been made on mygalomorph spiders as a whole (Coyle 1995; Mirza et al. 2014; Raven 1985; Sanap and Mirza 2015; Silwal et al. 2015b). In India, this family is represented by 2 genera and 4 species namely: *Indothele dunicola* Pocock, 1900; *Indothele mala* Coyle, 1995; *Indothele rothi* Coyle, 1995; *Ischnothele indicola* Tikader, 1969 (Hadole and Rajoria 2012). Of these, the generic allocation of *Ischnothele indicola* is here called into doubt (see discussion).

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Northeast India is a biodiversity hotspot (Myers et al. 2000) and several vertebrate-centric studies have been carried out in this area. However, with a few invertebrate inventories, the arthropod assemblage remains poorly documented. With regards to this, we visited the northeast Indian state of Tripura during which we collected a specimen of a diplurid spider. The collected specimen differs from all known species and genera from Asia. A detailed comparison of museum material aids us to conclude that the specimen is a new species and we also propose a new genus to embody it.

Materials and methods

Specimens were collected and preserved in 70% ethanol and the holotype was deposited in the collection of the National Centre for Biological Sciences, Bangalore. Measurements were taken using a Mitutoyo digital caliper (Mitutoyo Corporation, Japan). Spermathecae were dissected and cleaned using a needle. Specimens were examined using an Olympus SZ40 stereo-binocular microscope. Photographs were taken using a Canon 70D (Canon Inc, Tokyo) mounted with a 100-mm macro. Eye measurements were taken using the software ImageJ (National Institutes of Health, USA) (<http://imagej.nih.gov/ij/>). All measurements were given in millimeters and with a standard error of ± 0.01 mm. To study the morphology of spigots, an apical segment of one of the posterior

Biodiversity portfolio

Images by

Rajesh V. Sanap & Zeeshan A. Mirza



Family Buthidae
Thaicharmus guptai

A new species of scorpion of the family of fat tailed scorpions. The new species was recorded only from Jampui Hills and only a single specimen was found.



Family Euscorpidae
Euscorpiops longimanus

A species of scorpion found in crevices of rock and slit-like burrows in soil. Common at Jampui hills . Constitutes first record for the state.



Family Hormuridae
Liocheles australasiae

A scorpion species that is widespread across Asia and Pacific islands. Found in slit-like burrows on mud escarpments and in crives on tree trunks. Common at Gumti WLS, Manu FD, CCRF and Jampui hills. Constitutes first record for the state.



Family Chaerilidae
Chaerilus pictus

Constitutes first record for the state. Individuals were found in rock crevices at CCRD, Manu and Jampui hills.



Family Hormuridae
Liocheles new species

A new species found at lower elevations forests of Trishna WLS, Garjee FD. Burrows are concentrated around mud embankments.



Family Buthidae
Lychas laevifrons

Constitutes first record for the state.. Only two specimens of this specie were found, one at Garjee FD and another one atManu FD.



Family Buthidae
Isometrus sp.

An unidentified species of the genus of Bark scorpions. Need additional specimens to identify. A single Individual was found at the Garjee forest rest house.



Whiptail scorpions
Labochirus sp.

An unidentified species of whiptail scorpion. A details revision is underway which will help identify this species. Common across all areas surveyed.



Whiptail scorpions
Uroproctus assamensis

Constitutes first record for the state.



Family Dipluridae
Orientothele alyratus

A new genus and a new species to science. A single female specimen was found at Jampui hill on a tree trunk.



Family Theraphosidae
New genus and new species

A new genus and species of tarantula from Gumti WLS and Jampui hills. Work is in progress to describe this species.



Family Theraphosidae
Chilobrachys sp.

An unidentified species of the genus. Likely represents a species described from adjoining areas and work is underway to identify this species.



Family Theraphosidae
New genus and new species

A new genus and species of tarantula from Gumti WLS and Jampui hills. Work is in progress to describe this species.



Family Theraphosidae
Eumenophorinae sp.

First record of this subfamily outside Western Ghats. Represents a new species.



Family Nemesiidae
New genus and new species

A new genus and species of mygalomorph spider from all surveyed areas. Work is in progress to describe this species.



Bwnt toed gecko
Cyrtodactylus new species

A new species of gecko. A few colleagues are working on describing this as a new species.



Water skink
Tropidophorus assamensis

A rare skink. A paper on redescription of the species with notes on its distribution is under preparations



Spotted forest skink
Sphenomorphus maculatus

A common skink species across forests of Tripura.



Tokay gecko
Gekko gekko

A common gecko across Tripura



Burmese garden lizard
Calotes Irawadi

Constitutes a new national record of this species decribed from Burma. Common across Tripura.



Leaf toed gecko
Hemidactylus aquilonius

A common gecko at most areas surveyed. Seen on walls near human habitation.



Red tailed pit viper
Trimeresurus erythrurus

Constitutes a new state record. Common across Tripura.



Boulenger's bronzeback tree snake
Dendrelaphis proarchos

Recorded from Trishna WLS and Garjee FD.



Bamboo pit viper
Trimeresurus gramineus

A common nocturnal snake, especially in the hills.



Leaf toed gecko
Hemidactylus sp.

Recorded from Trishna WLS and Garjee FD.



Keelback
Rhabdophis himalayanus

A single specimen of a juvenile was found in Trishna WLS. Constitutes a new state record.



Narrowmouthed frog
Microhyla berdmorei

A large sized species of the genus. Recorded from Gumti WLS.



Ywllow sac spider
Cheiracanthium sp.

Recorded from Jampui hills



Torrent frog
Amolops cf. indoburmanensis

Recorded from Jampui hills. Likely constitutes a new national record.



Common Indian toad
Duttaphrynus melanostictus

Common throughout the study area.



Cricket frog
Fejervarya sp.

Common around water bodies across areas surveyed.

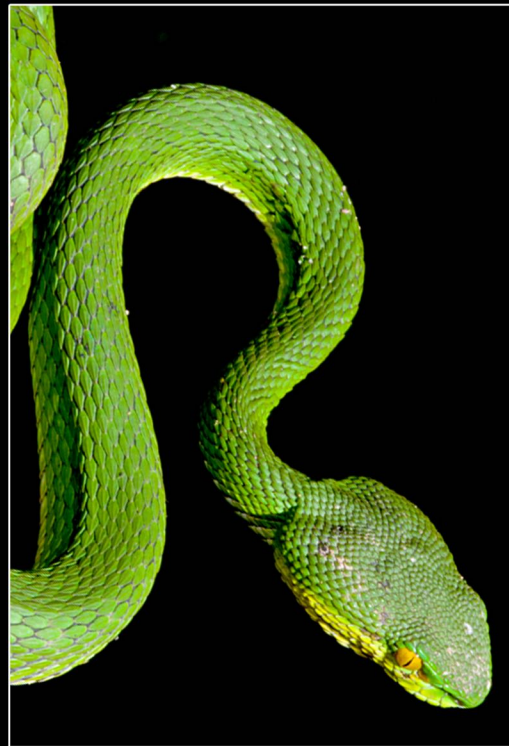


Treet frog
Polypedates sp.

Recorded from Kalapania and Garjee FD.



Rapid assessment of herpetofaunal and invertebrate diversity in Tripura State



**Project funded by
Tripura Biodiversity Board**



Rapid assessment of herpetofaunal and invertebrate diversity in Tripura State

Second Phase

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INTRODUCTION

The drastic upsurge in habitat loss and global climate change has adversely affected biodiversity over last decades (Brooks et al. 2006). Thus, conservation of biodiversity is utmost essential and given prime importance in many places. The vital component for effective and measurable conservation is the sound knowledge of the biodiversity itself. India is one of the biodiversity rich countries in the world with abode to three global biodiversity hotpots. Although all the northeastern states in India are part of these biodiversity hotpots, this region remains poorly explored.

Tripura is one of the smallest states in northeast India with abode to rich diversity of flora and fauna. This can be attributed to the wide array of habitats, altitudinal gradient, rainfall and affinities with faunal elements of Southeast Asia from neighboring Indian states and other countries. Although Tripura is least explored in terms of its biodiversity compared to other neighboring states, there are reports of 90 species of mammals, 342 species of birds and 55 species of amphibians and reptiles (Gupta, 2000; Majumdar et al. 2012). In terms of the lower vertebrates like amphibians and reptiles, this appear to be underestimated diversity as these reports are mostly based on anecdotal observations and not based on systematic surveys or sampling.

As one of the primary mandates, the Tripura Biodiversity Board (TBB) initiated various projects towards conservation of biodiversity. They have notified 35 biodiversity hotspots in this state based on available knowledge. As a part of the ongoing study, a rapid assessment surveys for herpetofauna and invertebrates were conducted in these biodiversity hotspots. This was a collaborative study between TBB and National Centre for Biological Sciences (NCBS). In the initial phase surveys were conducted in ten selected biodiversity hotspots. During this survey 19 species of reptiles and 17 species of arachnids were reported. One of the major finding of this survey was description of a new genus and a new species of scorpion from Tripura (Mirza et al. 2016). As a continuation of this study intensive survey was conducted in another nine biodiversity hotspots in Tripura from 30 June to 24 July 2016. This survey also resulted in the findings of many known and hitherto unknown species of herpetofauna from Tripura. Although most of the localities visited during this survey comprised of lowland forest, considerable diversity of amphibians and reptiles is reported during this study.

The studies on herpetofauna are still in the nascent stage for this state and diversity is poorly documented. Sarkar et al. (2002) reported 11 species of amphibians belong to five genera and four families in the state fauna series. In the same book Sanyal et al. (2002) reported 32 species belong to 28 genera and 11 families. These reports were based on museum specimens in the Zoological Survey of India, which were collected from various localities in Tripura. Some of the amphibians mentioned in this publication appear to be wrongly identified and needs further confirmation. In their recent study, Majumdar et al. (2012) reported of 17 species of amphibians and 38 species of reptiles from Tripura. This list was based on the surveys conducted across various localities in this state in 2007 and 2008. Some of the species mentioned by Majumdar et al. (2012) need to be confirmed by using proper taxonomic keys.

METHODS

In the second phase of this study, we conducted intensive surveys in ten biodiversity hotspots (Table 1). As this is rapid assessment study, we spent two to three days in localities with diverse habitats. Some sites were visited ones as they were wetlands surrounded by farmlands. Both nocturnal and diurnal surveys were conducted. Visual Encounter Survey technique was followed and the survey sites were thoroughly checked by turning rocks, logs and leaf litter for the presence and absence of herpetofauna. This technique is adopted because the objective of this survey was documentation of herpetofauna. A team of three researchers conducted most of this survey. The taxonomic identification was mainly followed using published literature and available taxonomic keys. The experts in respective fields were contacted for confirmation of the species identification wherever needed. Some representative specimens collected during this survey were deposited in the Research Collection of National Centre for Biological Sciences (NCBS), Bengaluru for long-term maintenance and further research. In view of the recent developments in the taxonomic revaluation of Indian herpetofauna, due care is taken in the identification of specimens collected and reported during the survey. In case the species is not properly identified, only genus name is mentioned. Further work on the identification of these species is in progress.

RESULTS

Amphibians and reptiles play a key role in maintaining the biodiversity by controlling the population of insects and being food for higher vertebrates. They are strongly associated with fresh water and hence are the best indicators of healthy and non-polluted environment. They live in wide array of microhabitats and hence their protection will lead to the conservation of these habitats in general and large landscapes in particular. The herpetofaunal assemblage of northeast India has strong biogeographic affinities with those of Southeast Asia. Although most of the species are considerably widely distributed and reported from neighboring countries, there are a few endemic species too.

During both the surveys 28 species of amphibians and 35 species of reptiles are reported from surveyed biodiversity hotspots in Tripura (Appendix I and II).

During the second phase surveys were conducted in nine biodiversity hotspots from 30 June to 24 July 2016. These sites represented wide array of habitats and elevational gradient. Details of the site-specific finding are as below:

A. Kanchanpur Forest Division

1. Sataramia Howr

This biodiversity hotspot is also a wetland among agricultural fields in North Tripura district. The trees were mostly seen close to the human habitat. The habitat was mostly homogenous and thus poor diversity of amphibians and reptiles were reported from this site. During this survey 6 species of amphibians and 2 species of reptiles reported from this hotspot (Table 1).

The commonly seen amphibians were *Duttaphrynus melanostictus*, which was seen near human habitat and *Euphlyctis cyanophlyctis* was seen near among pools and water in agricultural land. The commonest reptile was *Hemidactylus cf. frenatus*, which was mostly seen on trees and among houses near human settlement. Two individuals of *Xenochrophis* sp. were seen in the water in this site.

2. Churaibari

This biodiversity hotspot is located in the North Tripura district, at an altitude of 800 msal. The habitat at this site is mostly composed of monoculture plantation and natural forest in small valleys. The vegetation is predominantly composed of teak and sal plantation with natural forest mostly in valleys. These valleys are difficult to access due to thick vegetation and steep gradient. During this survey 14 species of amphibians and 6 species of reptiles reported from this landscape (Table 1).

The common amphibians seen here are Common Indian Toad, *Duttaphrynus melanostictus* and *Microhyla berdmorei* and *M. ornata*. These species were encountered in the forest and near human settlement as well. A few specimens of interesting *Microhyla* sp. were also seen in similar habitats. These individuals were morphologically different to the other two congeners. A single individual of frog *Hylarana taipehensis* is seen near a forest path during night survey. This frogs of this genus are considerably uncommon and rarely encountered. We also reported occurrence of *Hylarana* sp. and *Clinotarsus cf. alticola* in this site. These frogs were seen among leaf litter near forest path. The common microglossid frog reported from this site were *Euphlyctis cyanophlyctis* and *Fejervarya* sp. These species were mostly seen in or near the stagnant pools or in paddy fields. The only rhacophorid reported from this landscape is *Polypedates* sp. This species was mostly seen on trees near stagnant pools in the forest and near close to human settlement as well. The call of uncommon species of frog, *Leptobrachium cf. smithi* were heard from vegetation in valleys in the forest. No individual was seen.

The common reptiles seen in this landscape were Flat-tailed House Gecko *Hemidactylus platyurus* and *H. cf. frenatus*. These species were encountered on trees in the forest and on walls or outside houses in human settlement. A few individuals of *Calotes cf. irawadi* were seen in the forest and close to human settlement.

3. Kurti Howr

This biodiversity hotspot is in North Tripura district. This site is a mostly composed of wetland habitat and agricultural fields. The plantation was mostly seen close to the human habitat. The habitat at study site is mostly homogenous thus poor diversity of amphibians and reptiles was recorded during this survey. During this survey 5 species of amphibians and 2 species of reptiles reported from this hotspot (Table 1).

The commonly seen amphibians were *Duttaphrynus melanostictus* and *Euphlyctis cyanophlyctis*. Earlier species was seen near human habitat and latter was common among pools and water in agricultural land. The commonest reptile was *Hemidactylus cf. frenatus*, which was mostly seen on trees and among houses near human settlement. Two individuals of *Xenochrophis* sp. were seen in the water in this site.

4. Belianchip

This biodiversity hotspot is located in the Jampui Hills, North Tripura district, at an altitude of 800 msal. The habitat at this site is mostly composed of pristine, less disturbed natural forest. This region also experiences high rainfall resulting in high humidity and low temperature. The diversity of habitats, altitudinal gradient, ample water resources combined with favorable climatic conditions support rich diversity of amphibians and reptiles in this landscape. During this survey 18 species of amphibians and 14 species of reptiles reported from this landscape (Table 1). The occurrence of species like *Amolops* cf. *assamensis*, *Ingerana* sp., *Kurixalus* sp., *Philautus* sp., *Lycodon zawi* and *Hebius xenura* highlights the importance of this landscape. Most of these species are habitat specific and reported from less disturbed habitats.

The common amphibians seen here are Common Indian Toad, *Duttaphrynus melanostictus* and *Megophrys* sp. Both these species were encountered in the forest and near human settlement as well. A single individual of tree frog *Kurixalus* sp. is seen near a forest stream near Sabual. This frogs of this genus are considerably uncommon and rarely encountered. The other rhacophorids reported from this landscape are Doriei's Bush Frog, *Chiromantis* cf. *dorei*, *Philautus* sp. and two different species of *Polypedates*. All these tree frogs were mostly seen in large congregation near stagnant pools in the forest. The males of all these species were actively calling along these pools. The only report of legless amphibian, *Ichthyophis* sp. during this survey is from this landscape. A total of nine individuals of this species were reported in two days, out of which four were road kills. This proves that the caecilians are common in this place. Most of these individuals were sighted on the road during nocturnal search while two were seen under rocks during day. The other species *Amolops* cf. *assamensis* is also reported from this landscape only. This species was described in 2008 with little information about their habitat and natural history. The frogs of this genus (*Amolops*) are called as cascade frogs mainly due to their presence on the rocks or banks along forest streams. This appear to be a common species and was mostly seen on road cuttings and compound walls of houses near Vangmun, Phuldunsui and Sabual.

Among reptiles, Flat-tailed House Gecko *Hemidactylus platyurus* is the commonest species, encountered on trees in the forest and on walls or outside houses in human settlement. A pair of uncommon agamid, *Japalura* sp. is seen among leaf litter near a perennial pool at Belianchip. The female appears to be loaded with eggs. A single juvenile of *Takydromus* sp. is reported from this landscape only during this survey. Five species of snakes were encountered (Table 1) and except Wall's Keelback *Hebius xenura*, all species were seen crossing road or close to the road. Wall's Keelback is an uncommon species and was seen among leaf litter near a pool of water in Phuldungsei.

5. Rowa Wildlife Sanctuary

This is one of the smallest wildlife sanctuaries in Tripura. The habitat is mainly composed on natural forest which is comparatively less disturbed. Terrain is slightly undulating with fresh water pools and streams. Although this site has a small area of 86 hectares, it has rich and natural floral diversity. The forest is mainly mix deciduous

with bamboo thickets. During this survey 11 species of amphibians and eight species of reptiles were reported from this biodiversity hotspot (Table 1).

During this survey, large numbers of *Duttaphrynus melanostictus*, two different *Fejervarya* sp. and *Hoplobatrachus tigerinus* were seen in this site. All these species were seen along the forest path during nocturnal survey. The highest density of *D. melanostictus* was seen at this site. We counted about 200 individuals in a single night search. The other species seen in good numbers at this site was *Microhyla berdmorei*. This species was seen among leaf litter along the forest path. The other amphibians seen were *Megophrys* sp., *Hylarana* sp. and *Kaloula pulchra*, all these were uncommon and only a few individuals were seen. Among rhacophorids, a few individuals of *Polypedates* were sighted during this survey.

Hemidactylus platyurus and *H. cf. frenatus* were the commonest reptiles seen in this site. These geckos were seen on trees and on walls of the forest complex. The other common gecko at this site was *Cyrtodactylus* sp. These geckos were mostly seen along the road cuttings and close to the base of the trunk of large trees. All the individuals were reported during nocturnal search. Among agamids, *Calotes cf. irawadi* were commonly seen in the Sanctuary. The adults and juveniles both seen sleeping on trees during the nocturnal surveys. A few individuals of another unidentified species of *Calotes* and *Eutropis cf. macularia* were also seen in this site. A large individual of a snake, *Trimeresurus erythrurus* was seen among bushes during night survey. This individual was seen moving in lower canopy.

B. Kailashahar Forest Division

6. Juri Reserve Forest

This reserve forest is a recognized biodiversity hotspot in Unokoti district. The habitat in this site was like Churaibari. The habitat is composed of undulating terrain with steep valleys with small streams. The vegetation is predominantly composed of teak and sal dominated forest and natural forest is mostly in valleys. These valleys are considerably difficult to access due to thick vegetation and steep gradient. During this survey 11 species of amphibians and eight species of reptiles reported from this hotspot (Table 1).

Among amphibians *Duttaphrynus melanostictus* was the commonest species seen in the forest and close to human settlement as well. In this site, a few individuals of *Fejervarya* sp. and *Euphlyctis* sp. were recorded. These species were seen on the road and close to forest path. The other commonly seen amphibian was *Hylarana* sp. These frogs were seen close to the streams and along the forest path as well. *Microhyla berdmorei*, *M. ornata* and *Kaloula pulchra* were also encountered during this survey. The calls of *Leptobrachium cf. smithi* were commonly heard during the nocturnal search in this site. This species was only reported from four sites and in this hotspot, they appear to be relatively common. A few individuals of *Polypedates* sp. were also encountered during this survey.

The commonest reptiles seen in this hotspot were *Hemidactylus platyurus* and *H. cf. frenatus*. These geckos were commonly seen on trees in the forest and on walls in human settlement. The other common reptile was *Gekko gekko*, they were seen on trees in the forest and among houses close to human settlement as well. Only three

individuals of *Cyrtodactylus* sp. were recorded in this site. The blind snakes, *Indotyphlops* sp. were seen in only two sites during this survey. In this hotspot, we spotted five individuals of this species under rocks and among leaf litter near human settlement. Another snake seen in this site was *Xenochrophis* sp.

7. Unokuti

This biodiversity hotspot is one of the famous tourist destinations Tripura. This is well known pilgrimage centre with rock sculptures dating back to 7th to 9th century. Apart from the exposed rock sculptures, the adjoining habitat at this site is mostly composed of pristine, less disturbed natural forest. The terrain is hilly with very steep valleys with streams. The pristine undisturbed habitats, constant source of water resources and favorable climatic conditions resulted in rich diversity of amphibians and reptiles in this hotspot. We conducted survey in the forest close to this rock sculpture site and in the adjoining stream. During this survey 16 species of amphibians and 11 species of reptiles reported from this site (Table 1).

The common amphibians seen at this site are *Hylarana* sp., *Megophrys* sp. and *Clinotarsus* cf. *alticola*. All these species were seen in or close to the stream. A mating pair of *Leptobrachium* cf. *smithi* was seen in the same stream. This was seen in amplexus at the bottom of a deep pool this stream. Male was comparatively smaller in size than female. Calls of this species were heard from the nearby forest. In the same stream, multiple individuals of *Ingerana* sp. were also seen under rocks in the stream. The toad, *Duttaphrynus melanostictus* was also commonly seen at this locality. Three different species of microhylids, two different species of rhacophorids and five different species of dicroglossid frogs are reported from this biodiversity hotspot.

Among reptiles, commonest species was Tockey gecko, *Gekko gekko*. We counted 59 different individuals in three hours of active search during the night. All these individuals were seen on rock sculptures or on trees near these monuments. The other common reptile was *Cyrtodactylus* sp. A total of nine individuals seen on the vegetation close to the bank of the stream during night survey. A mating pair of this species was also seen on a rock near the stream, predicting the breeding season of the poorly known gecko. Interestingly a few individuals of *Hemidactylus platyurus* and *H.* cf. *frenatus* were seen during this survey at Unakoti. A single individual of *Hebius xenura* was seen in the leaf litter close to the stream. This uncommon snake was only reported from two localities during this survey. Another species of snake, *Oligodon* cf. *albocinctus* was also encountered close to a big rock sculpture at this site. This uncommon species is only reported Unakoti biodiversity hotspot during this study. A single individual of *Xenochrophis* sp. was seen and interestingly this snake was resting on a tree at the height of about seven feet in the stream.

C. Teliamura Forest Division

8. Bidyabil

This biodiversity hotspot is in Khowai district bordering Bangladesh. The habitat in this site is hilly with undulating terrain and steep valleys intervened by numerous forest streams. The vegetation is predominantly composed of rubber plantation and natural forest is mostly in valleys. These valleys are considerably difficult to

access due to thick vegetation and steep gradient. During this survey nine species of amphibians and 11 species of reptiles reported from this hotspot (Table 1).

Although a suitable habitat for amphibians, their abundance was less compared to other similar sites visited during this survey. Among amphibians *Duttaphrynus melanostictus* was the commonest species seen in the forest and close to human settlement as well. A few individuals of *Fejervarya* sp., *Euphlyctis* sp., *Hoplobatrachus tigerinus*, *Megophrys* sp., *Microhyla berdmorei*, *Kaloula pulchra* and *Polypedates* sp. were encountered during this survey. All these individuals were seen in the forest and close to human settlement as well.

The commonest reptiles seen in this hotspot were *Hemidactylus platyurus* and *H. cf. frenatus*. These geckos were commonly seen on trees in the forest and on walls in human settlement. This is the only site in the study area where four different species of skinks were recorded (Table 1). All these skinks were seen under rocks or among leaf litter. The other common reptile was *Gekko gecko*, they were seen on trees in the forest and among houses close to human settlement as well. The blind snakes, *Indotyphlops* sp. were seen in only two sites during this survey. In this hotspot, we spotted more than ten individuals of this species under rocks and among leaf litter near security force settlement near India – Bangladesh border. Another snake seen in this site was *Xenochrophis* sp.

9. Tulashikhar

This is another biodiversity hotspot in Khowai district bordering Bangladesh. The habitat visited by us was mostly hilly with undulating terrain, intervened by a streams and farmlands. The vegetation was composed of rubber plantation and natural forest. During this survey nine species of amphibians and 10 species of reptiles reported from this hotspot (Table 1). This site was visited once due to logistic concerns.

Among amphibians *Duttaphrynus melanostictus* and *Euphlyctis cyanophlyctis* was the commonest species seen in the forest and close to human settlement as well. A few individuals of *Fejervarya* sp., *Euphlyctis* sp., *Hoplobatrachus tigerinus*, *Megophrys* sp., *Microhyla berdmorei*, *Kaloula pulchra* and *Polypedates* sp. were encountered during this survey. All these individuals were seen in the forest and close to human settlement as well.

The commonest reptiles seen in this hotspot were *Hemidactylus platyurus* and *H. cf. frenatus*. These geckos were commonly seen on trees in the forest and on walls in human settlement. A few individuals of *Cyrtodactylus* sp. were also seen in this site. These geckos were seen on vegetation close to the forest path. The other common gecko was *Gekko gecko*, they were seen on trees in the forest and among houses close to human settlement as well. The only report of a wolf snake, *Lycodon* sp. was from this site. This snake was seen moving on a road cutting near a forest path. We also encountered a single individual of *Trimeresurus erythrurus*, on a small bush near human settlement in this site.

10. Subalsingh

This biodiversity hotspot is in Khowai district. The hilly terrain, natural forest and forest streams at this site support rich diversity of amphibians and reptiles. Due to

time constraint, only a single nocturnal survey was conducted in a stream and nearby forest at this site but we reported 15 species of amphibians and 11 species of reptiles during this survey (Table 1).

The commonly seen amphibian at this site was *Euphlyctis cyanophlyctis*. They were common in and along the stream. The other uncommon amphibians reported from this site are *Megophrys* sp and *Leptobrachium* cf. *smithi*. Both these species were encountered along the stream. The calls of many *Leptobrachium* cf. *smithi* were heard and a single individual was spotted after intensive efforts. This male was calling from the base of a small bush near stream. Five species of microglossids, three species of microhylids and two species of ranids were reported from this site. Two species of rhacophorids, *Chiromantis* cf. *doriae* and *Polypedates* sp. were reported from this site. Many individuals of *Chiromantis* were seen calling from the bushes near the road. This species was recorded from only two sites during this study.

Among reptiles *Hemidactylus platyurus* and *H. cf. frenatus* were common. They were seen in the forest and near human settlement as well. The other common lizards encountered at this site were *Cyrtodactylus* sp., *Gekko gecko* and *Calotes* cf. *irawadi*. All these species were seen in the forest. We reported a single juvenile individual of *Dendrelaphis* cf. *pictus* resting on a small tree near the stream. In the same stream, we also spotted another uncommon species of snake, *Psammodynastes* cf. *pulverulentus*. This individual was seen on a tree during the night. A single individual of *Trimeresurus erythrurus* was also seen in a small tree in this stream.

DISCUSSION

These rapid assessment surveys resulted in the documentation of 28 species of amphibians (Appendix I) and 35 species of reptiles (Appendix II) from various biodiversity hotspots in Tripura. The hotspots like Belianchip, Unakoti and Subalsingh are the important sites for the herpetofauna, as they support rich and unique species diversity of amphibians and reptiles. Many of the species reported from these sites are habitat specific and known to have restricted distribution. This exceptional diversity may be mainly due to diverse and pristine habitats at these sites. These sites also have fresh water pools and streams which are considerably less polluted and away from human settlements. These fresh water pools and stream are the breeding grounds for many amphibians. Other sites are also abode to good numbers of amphibians and reptiles but these sites mostly have common and widely distributed species. The habitat at most of these sites is homogenous with monoculture plantation and comparatively disturbed as they are close to human settlement.

The amphibians like *Leptobrachium* cf. *smithi*, *Megophrys* sp., *Amolops* cf. *assamensis*, *Clinotarsus* cf. *alticola*, *Kurixalus* sp. and *Ichthyophis* cf. *khumzi* are reported for the first time to this state. The reptiles like *Takydromus* sp., *Lycodon zawi*, *Oligodon* cf. *albocinctus*, *Hebius xenura*, *Psammodynastes* cf. *pulverulentus* and *Trimeresurus erythrurus* are the first reports for this state.

The present study, although a rapid assessment survey, it is the first dedicated effort to document the diversity of amphibians and reptiles across various localities in Tripura. An annotated checklist of amphibians and reptiles is provided. This checklist

is based on the specimens collected / photographed during these surveys. Many of the species, especially amphibians and reptiles are identified upto genus level. For species level identification, detailed studies using molecular tools is essential. This is mainly due to the recent developments in the taxonomic studies on amphibians and reptiles in India, where more than 100 species were described in the last two decades. A study on the proper identification of these specimens is under process and updates on these identifications will be provided to TSBB on regular basis.

The present study, although a rapid assessment survey, is the first dedicated effort to document the diversity of amphibians and reptiles across various localities in Tripura. An annotated checklist of amphibians and reptiles is provided. This checklist is based on the specimens collected / photographed during these surveys. Many of the species, especially amphibians and reptiles are identified upto genus level. For species level identification, detailed studies using molecular tools is essential. This is mainly due to the recent developments in the taxonomic studies on amphibians and reptiles in India, where more than 100 species were described in the last two decades. A study on the proper identification of these specimens is under process and updates on these identifications will be provided to TSBB on regular basis. Some basic information on the habitat of some amphibians and reptiles from Tripura is also provided. This information will serve as a supporting document to develop management plans or to conduct any conservation activities in these sites.

These rapid assessment surveys also highlight the present of rich diversity of herpetofauna in Tripura. It appears that the presently known diversity of amphibians and reptiles is underestimated and there is need of long term studied on amphibians and reptiles across various seasons and habitats in this state. For effective conservation of these smaller vertebrates, information on their distribution, natural history and treats is crucial. These species live in different habitats and their protection will not only result in the conservation these biodiversity hotspots but large landscapes as well.

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REFERENCES:

- Dutta, D., Sengupta, S., Das, A.K. & Das, A. (2013). New distribution of records of *Lycodon zawi* (Serpentes: Colubridae) from Northeast India. *Herpetology Notes*, 6: 263-265.
- Mirza, Z.A., Sanap, R.V. & Kunte, K. (2016). A New Species of the Genus *Thaicharmus* Kovařík, 1995 (Scorpiones: Buthidae) from Northeast India. *Euscorpius* – Occasional Publications in Scorpiology, No. 215.
- Majumder, J., Bhattacharjee, P.P., Majumdar K., Debnath, C. & Agarwala, B.K. (2012). Documentation of herpetofaunal species richness in Tripura, northeast India. *NeBio* 3(1): 60-70.
- Sanyal, D.P., Dattaguptaband, B. and Gayen, N. C. 2002. Reptilia. State Fauna Series 7: Fauna of Tripura, Part I. Zoological Survey of India 159-177.
- Sarkar A. K., Das, S. and Ray, S. 2002. Amphibia. State Fauna series 7: Fauna of Tripura Part I. Zoological Survey of India 179-190.
- Uetz, P. & Hošek, J. (eds.): The Reptile Database, <http://www.reptile-database.org>, accessed April 20, 2017.

Table 1: List of amphibians and reptiles reported from study sites during this survey.

SPECIES / LOCALITY	SH	CB	KH	BC	RW	JF	UK	BB	TK	SS
CLASS: AMPHIBIA										
ORDER: ANURA										
FAMILY: BUFONIDAE										
1. <i>Duttaphrynus melanostictus</i>	X	X	X	X	X	X	X	X	X	X
FAMILY: DICROGLOSSIDAE										
2. <i>Euphlyctis cyanophlyctis</i>	X	X	X	X	X	X	X	X	X	X
3. <i>Euphlyctis</i> cf. <i>hexadactylus</i>									X	
4. <i>Euphlyctis</i> sp. 1		X				X	X			X
5. <i>Fejervarya</i> sp. 1		X			X	X	X		X	X
6. <i>Fejervarya</i> sp. 2	X				X	X				X
7. <i>Fejervarya</i> sp. 3				X				X		
8. <i>Hoplobatrachus tigerinus</i>	X	X	X	X	X	X	X	X	X	X
9. <i>Ingerana</i> sp.				X			X			
FAMILY: MEGOPHRYIDAE										
10. <i>Leptobrachium</i> cf. <i>smithi</i>		X				X	X			X
11. <i>Megophrys</i> sp. 1				X	X	X		X		
12. <i>Megophrys</i> sp. 2							X			X
FAMILY: MICROHYLIDAE										
13. <i>Kaloula pulchra</i>		X		X	X	X	X		X	X
14. <i>Microhyla berdmorei</i>		X		X	X	X	X	X	X	X
15. <i>Microhyla ornata</i>	X	X	X	X	X	X	X	X		X
16. <i>Microhyla</i> sp. 1		X								
FAMILY: RANIDAE										
17. <i>Amolops</i> cf. <i>assamensis</i>				X						
18. <i>Clinotarsus</i> cf. <i>alticola</i>		X		X			X			X
19. <i>Hylarana taipehensis</i>		X								
20. <i>Hylarana</i> sp. 1		X		X	X	X	X	X	X	X
21. <i>Hylarana</i> sp. 2							X			
FAMILY: RHACOPHORIDAE										
22. <i>Chiromantis</i> cf. <i>doriae</i>				X						X
23. <i>Kurixalus</i> sp.				X						
24. <i>Philautus</i> sp.				X						
25. <i>Polypedates leucomystax</i>				X			X			
26. <i>Polypedates</i> sp. 1	X	X		X	X	X		X	X	X
27. <i>Polypedates</i> sp. 2							X			
ORDER: GYMNOPIHONA										
FAMILY: ICHTHYOPHIIDAE										
28. <i>Ichthyophis</i> cf. <i>khumzi</i>				X						

Species / Locality	SH	CB	KH	BC	RW	JF	UK	BB	TK	SS
CLASS: REPTILIA										
FAMILY: GEKKONIDAE										
1. <i>Cyrtodactylus</i> sp.				X	X	X	X	X	X	X
2. <i>Hemidactylus platyurus</i>		X		X	X	X	X	X	X	X
3. <i>Hemidactylus</i> cf. <i>frenatus</i>	X	X	X	X	X	X	X	X	X	X
4. <i>Hemidactylus aquilonius</i>				X						
5. <i>Hemidactylus</i> sp.										
6. <i>Gekko gekko</i>		X		X	X	X	X	X	X	X
FAMILY: AGAMIDAE										
7. <i>Calotes emma</i>				X			X			X
8. <i>Calotes</i> cf. <i>irawadi</i>		X		X	X	X	X	X	X	X
9. <i>Calotes</i> sp.					X					
10. <i>Japalura</i> sp.				X						
FAMILY: SCINCIDAE										
11. <i>Eutropis</i> cf. <i>macularia</i>		X			X	X	X	X	X	X
12. <i>Eutropis</i> sp.							X	X		
13. <i>Lygosoma albopunctata</i>								X		
14. <i>Sphenomorphus</i> sp.								X		
FAMILY: LACERTIDAE										
15. <i>Takydromus</i> sp.				X						
FAMILY: VARANIDAE										
16. <i>Varanus bengalensis</i>				X						
FAMILY: INDOTYPHLOPIDAE										
17. <i>Indotyphlops</i> sp. 1						X				
18. <i>Indotyphlops</i> sp. 2								X		
FAMILY: COLUBRIDAE										
19. <i>Lycodon zawi</i>				X						
20. <i>Lycodon</i> sp.									X	
21. <i>Oligodon</i> cf. <i>albocinctus</i>							X			
22. <i>Boiga ochracea</i>				X						
23. <i>Dendrelaphis</i> cf. <i>pictus</i>										X
24. <i>Ptyas korros</i>										
25. <i>Xenochrophis</i> sp.	X	X	X	X		X	X	X	X	X
26. <i>Hebius xenura</i>				X			X			
FAMILY: LAMPROPHIIDAE										
27. <i>Psammodynastes</i> cf. <i>pulverulentus</i>										X
FAMILY: VIPERIDAE										
28. <i>Trimeresurus erythrurus</i>				X	X				X	X

SH – Satramia Howr, CB – Churaibari, KH – Kurti Howr, BC – Belianchip, RW – Rowa Wildlife Sanctuary, JF – Juri Reserve Forest, UK – Unakoti, BB – Bidyabil, TK – Tulashikhar, SS – Subalsingh

Appendix I

Annotated checklist of amphibians from biodiversity hotspots in Tripura.

Order: Anura

Family: Bufonidae

1. *Duttaphrynus melanostictus* (Schneider 1799)

Family: Dicroglossidae

2. *Euphlyctis cyanophlyctis* (Schneider, 1799)
3. *Euphlyctis* cf. *hexadactylus* (Lesson, 1834)
4. *Euphlyctis* sp. 1
5. *Fejervarya* sp. 1
6. *Fejervarya* sp. 2
7. *Fejervarya* sp. 3
8. *Hoplobatrachus tigerinus* (Daudin, 1803)
9. *Ingerana* sp.

Family: Megophryidae

10. *Leptobrachium* cf. *smithi*
11. *Megophrys* sp. 1
12. *Megophrys* sp. 2

Family: Microhylidae

13. *Kaloula pulchra* Gray, 1831
14. *Microhyla berdmorei* (Blyth, 1856)
15. *Microhyla ornata* (Dumeril and Bibron, 1841)
16. *Microhyla* sp.

Family: Ranidae

17. *Amolops* cf. *assamensis*
18. *Clinotarsus* cf. *alticola*
19. *Hylarana taipehensis* (van Denburgh, 1909)
20. *Hylarana* sp. 1
21. *Hylarana* sp. 2

Family: Rhacophoridae

22. *Chiromantis* cf. *doriae*
23. *Kurixalus* sp. 1
24. *Philautus* sp. 1
25. *Polypedates leucomystax* (Gravenhorst, 1829)
26. *Polypedates* sp. 1
27. *Polypedates* sp. 2

Order: Gymnophiona

Family: Ichthyophiidae

28. *Ichthyophis* sp. 1

Appendix II

Annotated checklist of reptiles from biodiversity hotspots in Tripura.

Order: Squamata

Family: Gekkonidae

1. *Cyrtodactylus* sp.
2. *Hemidactylus platyurus* (Schneider, 1797)
3. *Hemidactylus* cf. *frenatus*
4. *Hemidactylus aquilonius* Zug & Mcmahan, 2007
5. *Hemidactylus* sp.
6. *Gekko gecko* (Linnaeus, 1758)

Family: Agamidae

7. *Calotes emma* Gray, 1845
8. *Calotes irawadi* Zug, Brown, Schulte & Vindum, 2006
9. *Calotes* sp.
10. *Japalura* sp.

Family: Scincidae

11. *Eutropis* cf. *macularia*
12. *Eutropis* sp.
13. *Lygosoma albopunctata* (Gray, 1846)
14. *Sphenomorphus maculatus* (Blyth, 1853)
15. *Tropidophorus assamensis* Annandale, 1912

Family: Lacertidae

16. *Takydromus* sp.

Family: Varanidae

17. *Varanus bengalensis* (Daudin, 1802)

Family: Indotyphlopidae

18. *Indotyphlops* sp. 1
19. *Indotyphlops* sp. 2

Family: Colubridae

20. *Lycodon zawi* Slowinski, Pawar, Win, Thin, Gyi, Oo & Tun, 2001
21. *Lycodon* sp.
22. *Oligodon* cf. *albocinctus* (Cantor, 1839)
23. *Boiga ochracea* (Theobald, 1868)
24. *Boiga* sp.
25. *Dendrelaphis* cf. *pictus* (Gmelin, 1789)
26. *Chrysopelea ornata* (Shaw, 1802)
27. *Ptyas mucosa* (Linnaeus, 1758)
28. *Ptyas korros* (Schelegel, 1837)
29. *Xenochrophis piscator* (Schneider, 1799)
30. *Xenochrophis* sp.
31. *Amphiesma stalatum* (Linnaeus, 1758)
32. *Rhabdophis himalayanus* (Gunther, 1864)
33. *Hebius xenura* (Wall, 1907)

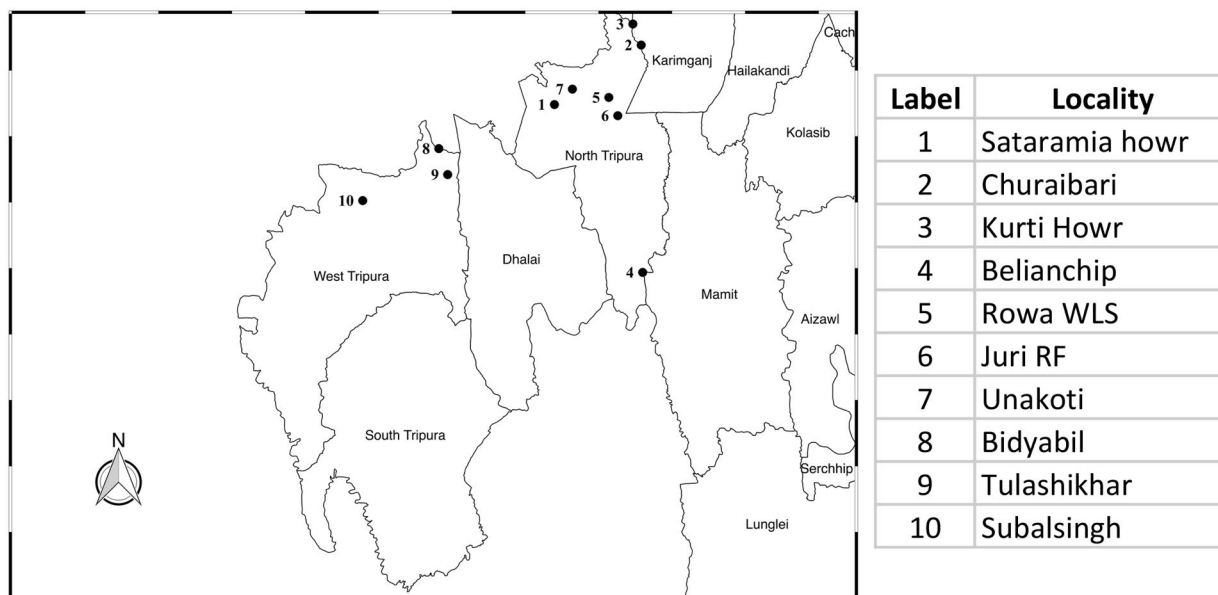
Family: Lamprophiidae

34. *Psammodynastes* cf. *pulverulentus* (Boie, 1827)

Family: Viperidae

35. *Trimeresurus erythrurus* (Cantor, 1839)

Map and habitat of the hotspots surveyd during second phase



Appendix III – Images of amphibians from Tripura



Leptobrachium cf. smithi



Megophrys sp. 1



Megophrys sp. 2



Kaloula pulchra



Microhyla berdmorei



Microhyla sp. 1



Amolops cf. assamensis



Clinotarsus cf. alticola



Appendix III – Images of reptiles from Tripura



Cyrtodactylus sp.



Hemidactylus platyurus



Hemidactylus cf. *frenatus*



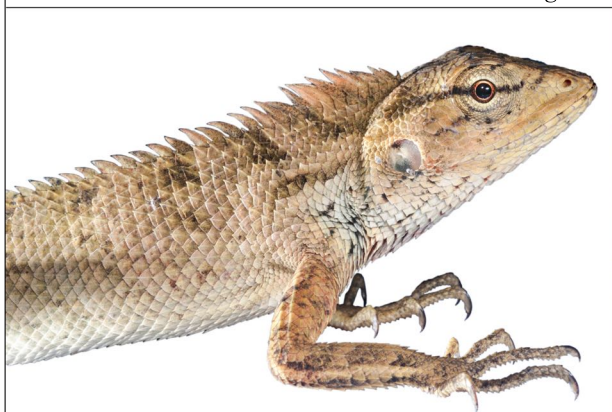
Hemidactylus aquilonius



Gekko gecko











Calotes emma


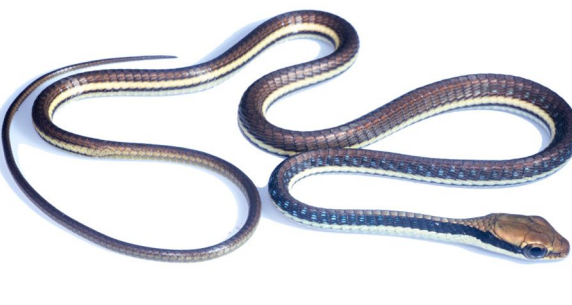


Calotes cf. *irawadi*



Japalura sp.

	
<p><i>Eutropis cf. macularia</i></p>	<p><i>Eutropis</i> sp.</p>
	
<p><i>Lygosoma albopunctata</i></p>	<p><i>Takydromus</i> sp.</p>
	
<p><i>Eutropis</i> sp.</p>	<p><i>Varanus bengalensis</i></p>
	
<p><i>Indotyphlops</i> sp. 1</p>	<p><i>Indotyphlops</i> sp. 2</p>

	
<p><i>Lycodon zawi</i></p>	<p><i>Lycodon</i> sp.</p>
	
<p><i>Oligodon</i> cf. <i>albocinctus</i></p>	<p><i>Boiga ochracea</i></p>
	
<p><i>Dendrelaphis</i> cf. <i>pictus</i></p>	<p><i>Xenochrophis</i> sp.</p>
	
<p><i>Hebius xenura</i></p>	<p><i>Trimeresurus erythrurus</i></p>