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Current status of faunal diversity of Siju Cave, South Garo Hills, Meghalaya

Ilona Jacinta Kharkongor[1]*, Uttam Saikia[2], Dimos Khynriam[2] and Bhaskar Saikia[2]

[1]Arunachal Pradesh Regional Centre, Zoological Survey of India, Itanagar – 791111, Arunachal Pradesh, India; ilona.kharkongor@ymail.com

[2]North Eastern Regional Centre, Zoological Survey of India, Shillong – 793014, Meghalaya, India

Abstract

Siju Cave located in the South Garo Hills district of Meghalaya was extensively surveyed by the Zoological Survey of India team led by Stanley Kemp and B. Chopra in 1922 for documenting its faunal diversity. That study led to the documentation of a total of 102 species including descriptions of several new species. During the 2018-2020 period, multiple surveys were undertaken to reassess the present faunal composition of the cave. Our study records only 36 species belonging to 11 major faunal groups, including 11 new records of the Cave. Among the 36 species documented, three species belong to different threatened categories of the IUCN redlist.

Keywords: Biospeleology, *Do·bak Khol*, Karst Topography, Limestone Cave, Troglofauna

Introduction

The existence of the Siju *Do·bak Khol* (= Bat Cave, *in Garo*), popularly known as Siju Cave, is probably known to the local populace for a very long time, but it was not until the year 1922 that an attempt was made to scientifically explore, survey and document the fauna of the Cave. This pioneering work, the first of its kind in India, was carried out by Stanley Kemp and B. Chopra, the then Superintendent and Assistant Superintendent respectively, of the Zoological Survey of India, Calcutta (=Kolkata). Before their work, Indian caves in general, and those in Meghalaya in particular, were thought to be of limited biospeleological interest but that perception changed following the successful documentation of the fauna of Siju Cave that brought to the fore the myriad faunal diversity of the Cave with discoveries of a good number of species that were new to science. Their historical work resulted in the documentation of 102 species from the Cave that was published in several parts in the *Records of the Indian Museum* (Vol. 26) that dealt with Mammals, Fish, Molluscs, Decapod Crustacea, Isopod Crustacea, Tartarides, Araneae, Opiliones, Myriapoda, Orthoptera and Dermaptera, Rhyncota (=Hemiptera), Diptera, Lepidoptera, Coleoptera, Hymenoptera, Collembola and Oligochaeta. This monumental work remains the most comprehensive survey ever undertaken in an Indian cave and has since served as the basis for all biospeleological studies in Meghalaya, including the present document on the findings of our 2018-2020 resurvey of this Cave.

Before the exploration of Kemp and Chopra, T. D. La Touche, a famous geologist of the Geological Survey of India made a geological investigation into the cave in 1881 and mentioned the presence of large bat colonies inside the cave. He wrote about huge colonies of bats hanging out of the cave roof immediately to the entrance and limited only to the part penetrated by light. After the 1922 survey, there has been very little work done in Siju Cave. Except for Harries *et al.* (2020) who attempted a comparative analysis of the faunal composition of the Cave *vis-à-vis* that of 1922, the other subsequent works dealt with specific faunal groups only. While Pillai and Yazdani (1977) and Menon (1987) revisited the fish fauna adding three more species of fish (*Neolissochilus hexagonolepis, Tor tor* and *Schistura multifasciata*) and describing a new species, *Schistura sijuensis*, respectively, from the Cave, Sinha (1999) only documented the diversity and bionomics of the bat species inhabiting the cave.

To assess the present status and change in the faunal composition of the Cave over the decades, the Zoological

* *Author for correspondence*

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Survey of India, Shillong initiated a resurvey programme between 2018-2020. Our findings from this re-survey of Siju Cave have yielded a total of 36 species of both vertebrate and invertebrate fauna including 11 new records to the Cave. Although the present surveys lack the comprehensiveness of the milestone work of Kemp and Chopra, we could broadly establish a resemblance of faunal composition between these two surveys although predictably, a declining trend in faunal abundance in the Cave was noted during the present work.

Methodology

Study site: The Siju *Do·bak Khol* popularly known as the Siju Cave, is a limestone cave located in Siju village of South Garo Hills District in Meghalaya. Lying at 25°21.061'N and 90°41.006'E, the Cave can be accessed from the huge entrance situated on the vertical face of the cliff on the west bank of Simsang River (also known as Someswari River) at an altitude of about 119 m a.s.l. The 4,772 m long Siju Cave (Figure 1) is an underground river passage and owes its origin to the *Do·bak Khol* stream that originates from deep inside and flows down from it to join the Simsang River. Kemp and Chopra (1924) gave a detailed description of the Cave which is still largely true except for the lack of bat guano deposits and the smaller size of the rocks strewn on the floor of the Cave passages.

Siju Cave was resurveyed between 2018-2020 during which a total of four field visits [20-23 March 2018; 11-16 December 2018; 18-22 March 2019 and 2-11 January 2020] were made and several faunal elements were sampled and collected. Field visits were restricted to the dry periods (Dec.-Mar.) as the Cave is prone to heavy flooding during the monsoons. Previous literature about the fauna of Siju Cave was studied and a comparative study with the previous records *vis-a-vis* our current findings is made.

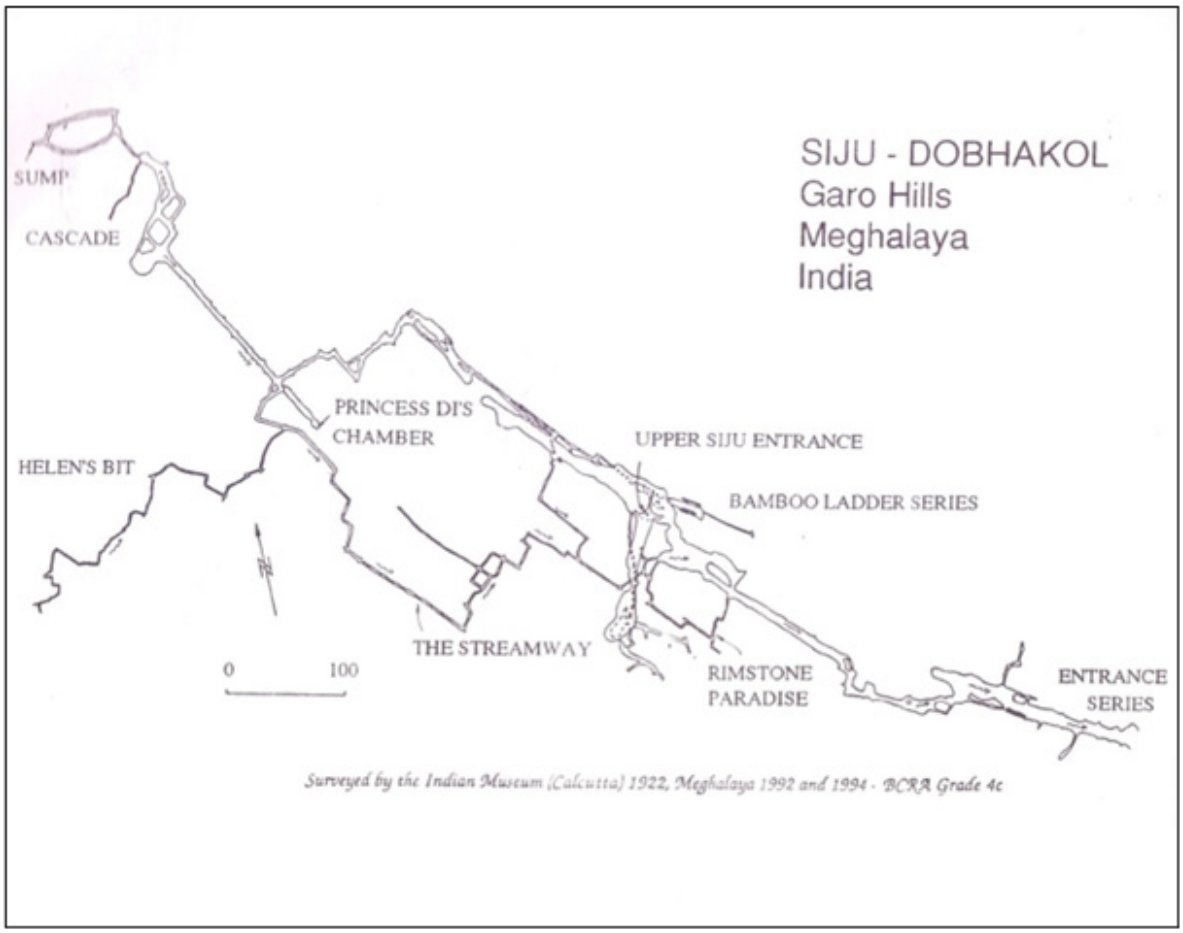

Figure 1. Map of Siju Cave showing the explored parts. (*Courtesy: Meghalaya Adventurers' Association, Shillong*).

Survey and Faunal Sampling: The cave entrance is approached by a gradual ascend and a short descent. The wide and high entrance leads into a huge passage of about 100 m in length (Figures 2-7). The threshold zone up to which the daylight penetrates is about 50 m from the entrance, followed by the twilight zone that extends up to c. 110 m; beyond this, the dark zone of the cave begins. Faunal sampling was made to a depth of c. 3000 m inside the cave using improvised techniques appropriate for sampling within the darkness and confines of the cave environment. Because of the absence of natural light inside the Cave, standard faunal sampling methods as used in outside environments were improvised. The length of the Cave was surveyed by active search method under rocks, stones, and organic debris with the help of artificial lights of headlamps or torch lights. Hand-held

Figure 2. The cave entrance of Siju.

Figure 3. The cave passage of Siju.

Figure 4. The collection spot of *Amolops* frogs.

Figure 5. A cave pillar of Siju c. 1000 m from entrance.

Figure 6. Insect collection inside Siju c. 1200 m from entrance.

Figure 7. The main cave stream of *Do·bak Khol*, c. 1500 m from entrance.

water nets were employed for aquatic fauna sampling, whereas manual/hand-picking method using wet brushes and/or forceps was largely used for terrestrial fauna sampling. The specimens were preserved in 70% alcohol along with labels for further taxonomic studies. Surveys inside the Cave were mostly carried out between 8.00-15.00 hrs., except for bats which were mostly caught at the entrance during evening employing mist nets.

A total of 289 specimens of various faunal elements were collected out of which 288 specimens were identified into 36 species under 11 faunal groups. One specimen of earthworm was not in identifiable condition.

The classification scheme in the text follows Saikia (2018) for Mammalia (Chiroptera), while for amphibia, Frost (2020) was followed. For the identification of fish Day (1889), Talwar and Jhingran (1991), Jayaram (1999), Kottelat (2012), Sen and Khynriam (2014) and FishBase (https://fishbase.in/) were followed. For the invertebrate groups, the classification followed is after Andrewes (1924); Bal and Basu (1998); Cai and Ng (2002); **ChiloBase 2.0 (**https://chilobase.biologia.unipd.it/**); Chopra (1924); Collinge (1916);** Cockroach Species File 5.0 (http://cockroach.speciesfile.org/); Desutter-Grandcolas and Jaiswara (2012); Mukhopadhyay (2015); WoRMS database (http://www.marinespecies.org/) and World Spider Catalog 21.5 (https://wsc.nmbe.ch/). The new records of Siju Cave are marked with (*).

Results

Systematic List

Phylum: CHORDATA

Class: MAMMALIA

Order: CHIROPTERA

Family: PRETOPODIDAE

1. ***Rousettus leschenaulti*** (Desmarest, 1820)
2. ***Eonycteris spelaea*** (Dobson, 1871)

Family: HIPPOSIDERIDAE

1. ***Hipposideros lankadiva*** Kelaart, 1850
2. ***Hipposideros*** cf. ***larvatus*** (Horsfield, 1823)*

Family: RHINOLOPHIDAE

1. ***Rhinolophus lepidus*** Blyth, 1844

Family: VESPERTILIONIDAE

1. ***Myotis*** cf. ***montivagus*** (Dobson, 1874)*

Family: MINIOPTERIDAE

1. ***Miniopterus magnater*** Sanborn, 1931

Class: AMPHIBIA

Order: ANURA

Family: DICROGLOSSIDAE

1. ***Ingerana boralis*** (Annandale, 1912)*
2. ***Minervarya pierrei*** (Dubois, 1975)*

Family: MEGOPHRYIDAE

1. ***Megophrys megacephala*** Mahony, Sengupta, Kamei, and Biju, 2011*

Family: RANIDAE

1. ***Amolops siju*** Saikia, Sinha, Shabnam, and Dinesh, 2023.*

Class: ACTINOPTERYGII

Order: CYPRINIFORMES

Family: CYPRINIDAE

1. ***Neolissochilus hexastichus*** (McClelland, 1839)
2. ***Garra gotyla*** (Gray, 1832)*

Family: NEMACHEILIDAE

3. ***Schistura sijuensis*** (Menon, 1987)

Order: SILURIFORMES

Family: AMBLYCIPITIDAE

4. ***Amblyceps mangois*** (Hamilton, 1822)*

Family: SISORIDAE

5. ***Glyptothorax cavia*** (Hamilton, 1822)*

Phylum: ARTHROPODA

Class: MALACOSTRACA

Order: ISOPODA

Family: PHILOSCIIDAE

6. ***Philoscia dobakholi*** Chopra, 1924

Family: ARMADILLIDAE

7. ***Cubaris cavernosus*** Collinge, 1916

Family: PORCELLIONIDAE

8. ***Porcellio assamensis*** Chopra, 1924

Order: DECAPODA

Family: GECARCINUCIDAE

9. ***Maydelliathelphusa falcidigitis*** (Alcock, 1909)

Family: PALAEMONIDAE

10. ***Macrobrachium hendersoni*** (De Man, 1906)

11. ***Macrobrachium cavernicola*** (Kemp, 1924)

12. ***Macrobrachium assamense assamense*** (Tiwari, 1955)*

Class: ARACHNIDA

Order: OPILIONES

Family: ASSAMIIDAE

13. ***Metassamia septemdentata*** Roewer, 1924

Order: ARANEAE

Family: THERIDIIDAE

14. ***Nesticodes rufipes*** (Lucas, 1846)

Family: SPARASSIDAE

15. ***Heteropoda robusta*** Fage, 1924

Class: CHILOPODA

Order: SCUTIGEROMORPHA

Family: SCUTIGERIDAE

16. ***Thereuopoda*** cf. ***longicornis*** (Fabricius, 1793)

17. ***Scutigera*** sp.

Order: GEOPHILOMORPHA

Family: MECISTOCEPHALIDAE

18. ***Mecistocephalus*** cf. ***diversions*** (Silvestri, 1919)

Class: INSECTA

Order: BLATTODEA

Family: NOCTICOLIDAE

19. ***Typhloblatta caeca*** (Chopard, 1921)

Order: ORTHOPTERA

Family: PHALANGOPSIDAE

20. ***Kempiola longipes*** (Chopard, 1924)

Order: HEMIPTERA

Family: GERRIDAE

21. ***Metrocoris nigrofasciatus*** Distant, 1903

Order: COLEOPTERA

Family: GYRINIDAE

22. ***Orectochilus*** (***Patrus***) ***oblongiusculus*** Régimbart, 1886*

Family: CARABIDAE

23. ***Tachys micraulax*** Andrewes, 1924

Phylum: MOLLUSCA

Class: GASTROPODA

Order: CAENOGASTROPODA (unassigned)

Family: THIARIDAE

24. ***Melanoides tuberculata*** (Müller, 1774)

Family: PALUDOMIDAE

25. ***Paludomus blandfordiana*** Nevill, 1877

Systematic Account

Phylum : CHORDATA

Class : MAMMALIA

Order : CHIROPTERA

Family : PRETOPODIDAE

1. ***Rousettus leschenaulti*** (Desmarest, 1820)

1820. *Pteropus leschanaulti* Desmarest, *Encycl. Meth. Mammal* L: 110 (Environments of Pondicherry, India)

Material examined: 1 ♀ (juvenile), entrance of Siju cave, 24.09.2018, D. Khynriam and party, V/M/ERS/496

Remarks: This individual was collected opportunistically near the cave entrance during the daytime in late September. Sinha (1999) reported a large series of specimens consisting of adult females and suckling from Siju Cave collected during August in the early nineties. However, during two surveys conducted by the authors in March 2018 and 2019, no colonies of this bat in the cave were recorded although *Eo. spelaea* was found to be common. It is possible that this species uses the Cave during the breeding period and females form maternity colonies as reported elsewhere by Krishna and Dominic (1985). The present population status remains uncertain.

2. ***Eonycteris spelaea*** (Dobson, 1871)

1871. *Macroglossus spelaeus* Dobson, *Proc. Asiat. Soc. Bengal*: 105 (Farm caves, Moulmein, Burma)

Material examined: Nil

Remarks: This species was observed in the cave both during the March 2018 and 2019 surveys. An estimated 100-150 individuals of this species were seen roosting in the ceiling of the cave at about 150 m inside. This place is the same location where "myriads" of fruit bats were recorded during the earlier intensive exploration (Kemp and Chopra, 1924). From the bat surveys in the early nineties, a large number of specimens of this bat were reported from Siju Cave and in probability this bat was a very common inhabitant of the cave (Sinha, 1999). However subsequent visits to the cave did document an appreciable decline in bat populations inside the Cave (Harries *et al*., 2020). From our surveys also, we noticed a serious numerical decline of this species in Siju Cave.

Family: HIPPOSIDERIDAE

3. ***Hipposideros lankadiva*** Kelaart, 1850

1850. *Hipposideros lankadiva* Kelaart, *J. Ceylon Brch. R. Asiat. Soc*., 2:216.

Material examined: 2 ♂, cave entrance, Siju cave, 21.03.2018, U. Saikia & party V/M/ERS/463, 464; 1 ♂, 1 ♀, cave entrance, Siju cave, 19.03.2019, U. Saikia & party, V/M/ERS/557, 561

Remarks: A comparatively common bat in Siju cave and roost in the cave year-round. However, they are mostly restricted up to about 300 m inside the Cave where they roost in the high ceilings wherever available. From the evening emergence count on 19th March 2019, their population was estimated to be around 150 individuals. However, this number is nowhere near the "incredible numbers" of *Hipposideros* bats reported during the 1922 survey and in the early nineties (Kemp and Chopra, 1924; Sinha, 1999).

4. ***Hipposideros*** cf. ***larvatus*** (Horsfield, 1823) [Figure 8A]

1823. *Rhinolophus larvatus* Horsfield, *Zoological researches in Java*, pt.6 (Java)

Material examined: 1 ♂, cave entrance, Siju cave, 21.03.2018, U. Saikia & party V/M/ERS/462; 1 ♂, 100 m inside from the cave entrance, Siju cave, 19.03.2019, U. Saikia & party V/M/ERS/562.

Remarks: A relatively common bat in Siju cave was observed deep inside the cave up to a length of about 400 m from the entrance. The estimated population size during March 2018 is less than 200 individuals. Mostly roost in small groups of ≤ 10 individuals along the main passage and some side passages and are least worried about human presence nearby.

Family: RHINOLOPHIDAE

5. ***Rhinolophus lepidus*** Blyth, 1844 [Figure 8B]

1844. *Rhinolophus lepidus* Blyth, *J. Asiat. Soc. Bengal*, 13:486?

Material examined: 1 ♂, c. 50 m from the cave entrance, Siju cave, 19.03.2019, U. Saikia & party V/M/ERS/547

Remarks: A lone male individual was caught roosting in a small side passage. This is the only *Rhinolophus* species recorded during the present surveys and possibly uncommon in Siju cave, although two other species *Rh. subbadius* and *Rh. pusillus* were recorded earlier (Sinha, 1999).

Family: VESPERTILIONIDAE

6. ***Myotis*** cf. ***montivagus*** (Dobson, 1874) [Figure 8C]

1874. *Vespertilio montivagus* Dobson, *J. Asiat. Soc. Bengal*, 43(2): 237.

Material examined: 1 ♂, cave entrance, Siju cave, 21.03.2018, U. Saikia & party V/M/ERS/457

Remarks: An adult male specimen was collected in a mist net from near the entrance of Siju Cave on the 21st of March 2018. This individual had a forearm length of 42.9mm. It had a dark brown dorsum with a lighter venter which was quite discernible in flight. The individual dorsal hairs were dark throughout while ventral hairs were beige or copper brown at the tip and dark brown at the base. The wing membranes were dark brown and attached to the base of the toes. Ears were relatively short with a rounded tip and the tragus was less than half the length of the ear. The tragus was moderately curved and the posterior edge was mildly serrated.

The braincase of the Meghalaya specimen was distinctly domed with well-developed frontal depression. This is in contrast to the more flattened cranial profile of *My. annectans* which has similar external morphology and overlapping measurements with *My. federates* (Görföl *et al*., 2013).

The present specimen from Siju cave constitutes the first report of this species from Meghalaya State and only the second record from India.

Family: MINIOPTERIDAE

7. ***Miniopterus magnater*** Sanborn, 1931 [Figure 8D]

1931. *Miniopterus magnater* Sanborn, *Field Mus. Nat. Hist. Publ., Zool.* Ser.18: 26.

Material Examined: 1♀, cave entrance, Siju cave, 21.03.2018, U. Saikia & party V/M/ERS/460;1 ♂, cave entrance, Siju cave, 22.03.2018, U. Saikia & party V/M/ERS/478 1 ♂, ♂, c. 100 m. inside the cave passage, Siju cave, 19.03.2019, U. Saikia & party V/M/ERS/561; 1 ♂, c. 50 m. inside the cave entrance, Siju cave, 04.01.2020, I. J. Kharkongor & party V/M/ERS/606.

Remarks: During the 1922 explorations, there was no mention of this species and it is unlikely that this species could have escaped the notice of the explorers. However, Sinha (1999) collected a large series of these species from the Siju cave and erroneously reported them as *Miniopterus schneibersii* (=*fuliginosus*) (Saikia *et al*., 2018). This species is a recent introduction to Siju Cave. It has also been found to be widespread in other caves of Meghalaya and has also been reported from Ukhrul district of Manipur recently (Saikia *et al*., 2018; Saikia *et al*., 2020).

Class : AMPHIBIA

Order : ANURA

Family : DICROGLOSSIDAE

8. ***Ingerana borealis*** (Annandale, 1912)

1912. *Micrixalus borealis* Annandale, *Rec. Indian Mus*., **8**: 10

Material examined: 1 ex., INDIA: Meghalaya, South Garo Hills, Siju Cave Entry Point, N 25°22.9333; E 90°41.171,14. xii.2018, Coll. I. J. Kharkongor & party, Reg. No. V/A/NERC/1461.

Remark: IUCN has assigned its status as Vulnerable. During another visit to this cave on 3rd January 2020, we spotted three individuals of this species, about 50 m inside the entrance, swimming in the Cave stream that flows out of the cave.

9. ***Minervarya pierrei*** (Dubois, 1975)

1975. *Rana pierrei* Dubois, *C. R. Acad. Sc.,* Paris, t. (D) 281: 1720.

Material examined: 1 ex., INDIA: Meghalaya, South Garo Hills, Siju Cave Entry Point, N 25°22.9333; E 90°41.171,14. xii.2018, Coll. I. J. Kharkongor & party, Reg. No. V/A/NERC/1460.

Remark: A single specimen was collected at the cave entrance of Siju. This species is widely distributed and is adapted to a range of terrestrial habitats.

Family: MEGOPHRYIDAE

10. ***Megophrys megacephala*** Mahony, Sengupta, Kamei, and Biju, 2011 [Figure 8E]

2011. *Megophrys megacephala* Mahony, Sengupta, Kamei and Biju, *Zootaxa,* 3059: 37.

Material examined: 1 ex., INDIA: Meghalaya, South Garo Hills, inside Siju Cave (25° 21' 3.528" N; 90° 41' 0.168" E, 92 m asl), 22. iii.2018, Coll. Dr. Uttam Saikia & party, V/A/NERC/1501.

Remark: A lone individual was spotted about 400m from the cave entrance. The frog was found in the main cave passage on the rocky wall near the stream of water flowing out from inside the cave. The collection spot was far away from the threshold zone of the cave and completely dark.

It is very untypical for megophrid frogs to take refuge in such a dark, resource-scarred cave habitat. However, Kemp and Chopra (1924) reported the presence of tadpoles of *Megophrys* sp. from inside Siju Cave, which could probably be the tadpoles of *M. megacephala*. This raises the possibility of this megophryid species adapting to the cave environment.

Nevertheless, this collection is the first report of this species from inside a cave, besides, extending its altitudinal range downward to 92 m asl from the previously known altitude of 145 m (type locality; Mahony *et al*., 2011).

Family: RANIDAE

11. ***Amolops siju Saikia*** (Sinha, Shabnam, and Dinesh, 2023).

2023. *Amolops siju* Saikia, Sinha, Shabnam, and Dinesh, *J. Anim. Diversity*, **5**: 43

Material examined: 4 ex., INDIA: Meghalaya, South Garo Hills, inside Siju Cave (25° 21.061' N; 90° 41.006 E, 119 m asl), 03.i.2020, Coll. I. J. Kharkongor & party, V/A/NERC/1620.

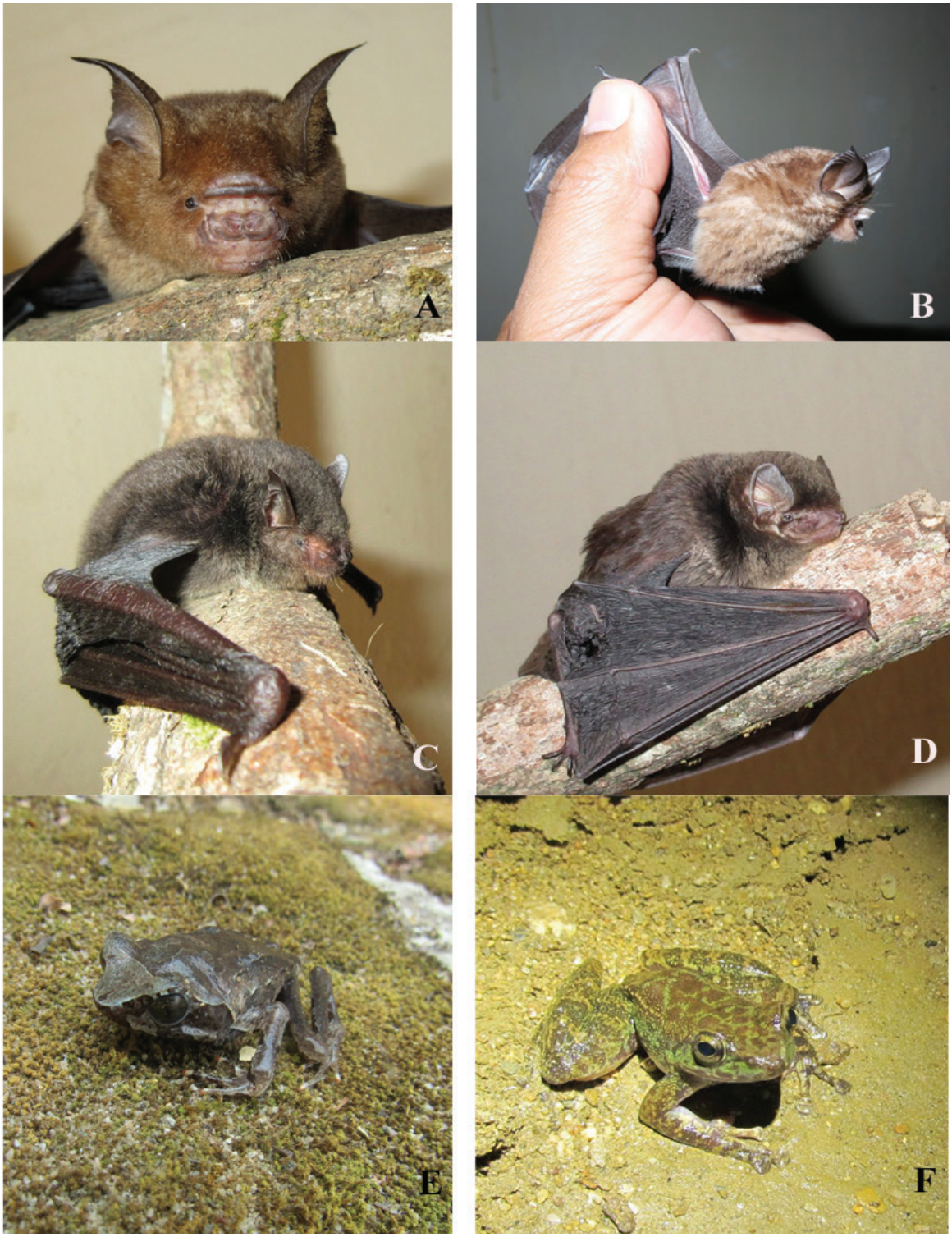

Figure 8. Fauna of Siju Cave. **A.** *Hipposideros cf. larvatus*, **B.** *Rhinolophus lepidus* **C.** *Myotis cf. montivagus* **D.** *Miniopterus magnater* **E.** *Megophrys megacephala* **F.** *Amolops siju.*

These above specimens collected from Siju were described as a new species (Saikia et al.., 2023) to science recently.

Class: ACTINOPTERYGII

Order: CYPRINIFORMES

Family: CYPRINIDAE

12. ***Neolissochilus hexastichus*** (McClelland, 1839)

1839. *Barbus hexastichus* McClelland, *Asiat. Res.,* 19(2): 269, 333, pl. 39, Fig. 2 (Type locality: Great Rivers in the plains of India).

Material examined: 1 ex., 24.IX.2018. Reg. No. V/F/NERC/ZSI/4538, (alt.- 70m; N: 25°21'03.72" E: 091°40'59.57"), Coll. D. Khynriam & party; 3 ex., 22.III.2018. Reg. No.V/F/NERC/ZSI/4542, (N: 25.35098°; E: 90.68338°), Coll. U. Saikia & party. 5 ex., 12.XII.2018. Reg.No. V/F/NERC/ZSI/4930, 3 ex., 03.I.2020. Reg. No. V/F/NERC/ZSI/4934, (alt.- 119m; N: 25°21.061'; E: 90°41.006), Coll. I.J. Kharkongor & party.

IUCN Status: Near Threatened (NT).

13. ***Garra gotyla*** (Gray, 1832)

1832. *Cyprinus gotyla* Gray, *Illustr. Indian Zool.,* 1: pl. 88, Figs. 3, 3a (Type locality: Northern India).

Material examined: 1 ex., 21.III.2018. Reg. No. V/F/NERC/ZSI/4543, (N: 25.35098°; E: 90.68338°), 2 ex., 22.III.2018. Reg. No. V/F/NERC/ZSI/4544, (N: 25.35098°; E: 90.68338°), Coll. U. Saikia & party.

IUCN Status: Least Concern (LC).

Family: NEMACHEILIDAE

14. ***Schistura sijuensis*** (Menon, 1987)

1987. *Noemacheilus sijuensis* Menon, *Fauna of India,* Pisces, 4: 175, pl. 6, Fig. 2 (Type locality: Siju cave, Garo Hills, Meghalaya).

Material examined: 6 ex., 24.IX.2018. Reg. No. V/F/NERC/ZSI/4539, (alt.- 70m; N: 25°21'03.72" E: 091°40'59.57"), Coll. D. Khynriam & party; 1 ex., 23.III.2018. Reg. No.V/F/NERC/ZSI/4541, 1 ex., 22.III.2018. Reg. No.V/F/NERC/ZSI/4545, 1 ex., 19.III.2019. Reg. No. V/F/NERC/ZSI/5049, (alt.- 60m; N: 25.35098°; E: 90.68338°), Coll. U. Saikia & party. 1 ex., 12.XII.2018. Reg.No.V/F/NERC/ZSI/4931, 2 ex., 03.I.2020. Reg. No. V/F/NERC/ZSI/4933, (alt. 119m;N: 25°21.061'; E: 90°41.006), Coll. I.J. Kharkongor & party.

Remarks: As per IUCN, its status is endangered (EN). Endemic to North East India.

Order: SILURIFORMES

Family: AMBLYCIPITIDAE

15. ***Amblyceps mangois*** (Hamilton, 1822)

1822. *Pimelodus mangois* Hamilton, *Fishes of Ganges*: 199, 379 (type locality: Northern Bihar).

Material examined: 1 ex., 24.IX.2018. Reg.No. V/F/NERC/ZSI/4537, (alt.- 70m; N: 25°21'03.72" E: 091°40'59.57"), Coll. D. Khynriam & party.

Remarks: As per IUCN (2013), its status is least concern (LC).

Family: SISORIDAE

16. ***Glyptothorax cavia*** (Hamilton, 1822)

1822. *Pimelodus cavia* Hamilton, *Fishes of Ganges*: 188, 378 (type locality: rivers of north Bengal).

Material examined: 5 ex., 12.XII.2018. Reg. No. V/F/NERC/ZSI/4932, (alt.- 119m;N: 25°21.061'; E: 90°41.006), Coll. I.J. Kharkongor & party.2 ex., 24.IX.2018. Reg. No. V/F/NERC/ZSI/4536, (alt.- 70m; N: 25°21'03.72" E: 091°40'59.57"), Coll. D. Khynriam & party; 2 ex., 19.III.2019. Reg. No. V/F/NERC/ZSI/5050, (alt.- 60m; N: 25.35098°; E: 90.68338°), 6 ex., 23.III.2018. Reg. No. V/F/NERC/ZSI/4540, (N: 25.35098°; E: 90.68338°), Coll. U. Saikia & party.

IUCN Status: Least Concern (LC).

Phylum: ARTHROPODA

Class: MALACOSTRACA

Order: ISOPODA

Family: PHILOSCIIDAE

17. ***Philoscia dobakholi*** Chopra, 1924

1924. *Philoscia dobakholi* Chopra, *Rec. Ind. Mus*., XXVI, pp. 54-57, Figs. 3 & 4.

Material examined: 2 ex. Siju Cave (~450 -550m), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 4.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-589.

Remarks: Till 2008, the species was known from Siju Cave only. Now it has been reported from other caves located in the EKH and EJH districts of Meghalaya (Harries *et al*.,

2008; Kharkongor & Saikia, 2018). The species appears to have a low tolerance to dry environmental conditions as it can be found only in wet cave passages, particularly where there are deposits of decaying organic debris. The species was found inside the Cave in locations similar to that reported in 1922, but appear to be fewer in numbers now. Chilton (1929) reported this species from the Dark Cave of Malaysia, but it is doubtful as subsequent studies carried out by other workers (McClure *et al*., 1967; Moseley *et al*., 2012) do not include the species in the faunal list of the Malaysian caves. The species is probably endemic to the karstic region of Meghalaya.

Family: ARMADILLIDAE

18. ***Cubaris cavernosus*** Collinge, 1916 [Fig. 9G]

1916. *Cubaris cavernosus* Collinge, *Rec. Ind. Mus*., XII, pp. 123,124, pl. xvi, Figs. 1-9.

Material examined: 3 ex. Siju Cave (~500m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 4.i.2020, coll. I. J .Kharkongor & party, Reg. No. IV/CRU/ERS-588; 15 ex. Siju Cave (~850 m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-592; 2 ex. Siju Cave (~300m from Cave entrance), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-608; 1 ex. Siju Cave (~200 m from the Cave entrance), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 4.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-609; 23 ex. Siju Cave, Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-611.

Remarks: Cubaris cavernosus was described in 1916 from specimen(s) collected by R. Friel from an unspecified "caves near Cherrapunji, Assam, ca. 4000ft". There are several caves in the 'Cherrapunji' (a more popular name for Sohra) area in erstwhile Assam (now Meghalaya), but only two caves, *Krem* Mawsmai and *Krem* Mawkhyrdop ('*Krem*' is the Khasi word for 'cave'), are located at an altitude close to 4000 ft. Taking into consideration the habitat preference of the species for dry cave passages, it is extrapolated that the type locality of the species is very likely *Krem* Mawsmai located in Mawsmai village about 6 km south of Sohra proper, EKH District, Meghalaya. After its description, the species was reported for a second time in 1924 from Siju Cave in South Garo Hills District, Meghalaya, extending its distribution range westwards. Since then, it has been found to occur in most of the caves in Meghalaya (Harries *et al*., 2008; Kharkongor & Saikia, 2018). Chopra (1924) reported the occurrence of the species from 300 ft. to 3800 ft. (approx. 91.44m – 1158.24m) inside the Siju Cave. During the resurvey of the Cave, we found specimens of the species in drier parts of the Cave from about 200m to 850m from the cave entrance. The species is probably endemic to the karstic region of Meghalaya.

Family: PORCELLIONIDAE

19. ***Porcellio assamensis*** Chopra, 1924

1924. *Porcellio assamensis* Chopra, *Rec. Ind. Mus*., XXVI, pp. 51-53, Figs.1 & 2.

Material examined: 8 ex. Siju Cave (~100m from the Cave entrance), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12. xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-610.

Remarks: Chopra (1924) described the species from specimens collected from just 400ft inside Siju Cave and commented that they do not extend far into the Cave. Resurvey of the cave reiterates this statement as specimens of the species were encountered within 100m from the entrance with none seen in deeper parts of the Cave. Since its description the species has been reported from different parts of India (Ramakrishna, 1995), making it the most widespread isopod in India.

Order: DECAPODA

Family: GECARCINUCIDAE

20. ***Maydelliathelphusa falcidigitis*** (Alcock, 1909)

1909. *Potamon lugubre* var. *falcidigitis* Alcock, *Rec. Indian Mus*., 3 (3): 248.

Material examined: 2 males & 1 female, Siju cave, South Garo Hills district, Meghalaya, India (25.351° N, 90.683° E; altitude 83 m), 19 March 2019, coll. Uttam Saikia &Party, Reg. No. ZSI-NERC 42699.

Remark: The same species was also reported from Siju Cave by Kemp (1924). The only other crab species reported from Siju cave is *Maydelliathelphusa lugubris* (Wood-Mason, 1871) by Ghosh and Ghatak (1999).

Family: PALAEMONIDAE

21. ***Macrobrachium hendersoni*** (De Man, 1906)

1906. *Palaemon (Parapalaemon) hendersoni* de Man, *Am. Mag. Nat. Hist*., 7(17):400-406.

Material examined: 23 ex. Siju Cave (from 5 10 m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No.IV/CRU/ERS-535; 2 ex. Siju Cave, Siju village, South Garo Hills District, Meghalaya, 25°21'03.72"N, 90°40'59.57"E, 70m, 24.ix.2018, D. Khynriam & party, Reg. No. IV/CRU/ERS-542; 30 ex. Siju Cave (from 5m-90m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-594.

Remarks: Kemp (1924) documented this species from 300ft – 350ft inside the Cave and commented that deeper inside the Cave "*it occurred more sparingly; it was found in some numbers in the main channel between 600 and 1300 ft. and was taken in the streams at 1700 and 2000 ft. A single individual was captured at 3200ft*." We found this species only within the twilight zone of the Siju Cave, though they are abundant in the stream outside the Cave.

22. ***Macrobrachium cavernicola*** (Kemp, 1924)

1924. *Palaemon cavernicola* Kemp, *Rec. Ind. Mus.*XXVI, p. 42, pl. iii, Figs.1-4.

Material examined: 6 ex. Siju Cave (~1000m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 19.iii.2019, coll. Uttam Saikia & party, Reg. No. IV/CRU/ERS-533; 4 ex. Siju Cave (~1200-1500m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 4.i.2020, coll. I. J. Kharkongor & party, Reg. No.IV/CRU/ERS-596.

Remarks: Kemp (1924) remarked that the species occurs from 550ft to '*nearly three-quarters of a mile from the mouth*' of Siju Cave. Besides the main cave passage, the specimens were "*found abundantly in small streams at depths of 2000 to 3600 ft. and in practically all the still pools in the section between 2200 and 3000 ft. Several were discovered in isolated pot-holes little more than 2 ½ ft. broad*". During the resurvey of the Cave, we observed that the species can be found only in the deeper parts of the Cave (~1200m from the entrance and beyond) and their numbers have dwindled immensely from that reported in 1924. *Macrobrachium cavernicola* is an important component of the cavernicolous fauna of Meghalaya and is reported to be found in most of the river caves of the State. The species shows marked troglomorphism and is, so far, the only known troglobytic shrimp in India. The species is probably endemic to the karstic region of Meghalaya.

23. ***Macrobrachium assamense assamense*** (Tiwari, 1955)*

1955. *Palaemon assamensis assamensis* Tiwari, *Rec. Ind. Mus*., 53: 297-298.

Material examined: 5 ex. Siju Cave (from 5-10 m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/CRU/ERS-536; 1 ex. Siju Cave, Siju village, South Garo Hills District, Meghalaya, 25°21'03.72"N, 90°40'59.57"E, 70m, 24.ix.2018, D. Khynriam & party, Reg. No.IV/CRU/ERS-543.

Remarks: Macrobrachium assamense assamense is widely distributed in Meghalaya, especially in the lower altitude streams and rivers. This species is scarce inside the Siju Cave though it is abundant in the *Do·bak khol* stream that flows down from the Cave to join the Simsang River. This species is recorded for the first time from Siju Cave.

Class: ARACHNIDA

Order: OPILIONES

Family: ASSAMIIDAE

24. ***Metassamia septemdentata*** Roewer, 1924 [Fig. 9H]

1924. *Metassamia septemdentata* Roewer, *Rec. Ind. Mus.*XXVI, p. 69-70, Fig.1.

Material examined: 6 ex. Siju Cave (~250-300m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/ARA/ERS-71; 13 ex. Siju Cave (~350-500m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No.IV/ARA/ERS-74.

Remarks: Roewer (1924) described this species from Siju Cave based on 18 specimens (♂ + ♀) collected from "*400*

to 500 ft. and 800 – 1200 ft. from entrance". Our current specimens were collected from approximately 250 – 300m inside the Cave. A sizeable population is observed around the outer bat chamber. To date, there is no record of this species from other caves in Meghalaya or elsewhere.

Order: ARANEAE

Family: THERIDIIDAE

Genus: *Nesticodes* Archer, 1950

25. ***Nesticodes rufipes*** (Lucas, 1846)

1846. *Theridion rufipes* Lucas, *Hist. nat. des anim. Art. Exploration Scient. De l'Algérie. Zoologie*, 1: 89-271.

Material examined: 1 ex. Siju Cave (~250-350m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/ARA/ERS-72; 1 ex. Siju Cave (~450-500m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No.IV/ARA/ERS-73; 8 ex. Siju Cave (~60-80m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No.IV/ARA/ERS-77.

Remarks: Fage (1924) reported this species from locations at 100ft., 300ft., 400ft., 450ft. and 500ft. from the cave entrance. Our current report is based on specimens collected from 60m to 500m inside the cave. It was observed that their numbers were higher at locations close to the cave entrance rather than deeper inside the cave. Being a cosmopolitan species, *Nesticodes rufipes* is widely distributed in almost all continents of the world. They are epigean species and their occurrence inside the cave (a hypogean environment) would have been described as opportunistic if not for the fact that they have colonized Siju Cave having been found there since 1922-24 when the Cave was first surveyed. Having established viable populations within the cave environment they may be considered as an important component of the cavernicolous fauna of Siju Cave even though they do not exhibit visible troglomorphy.

Family: SPARASSIDAE

26. ***Heteropoda robusta*** Fage, 1924 [Fig. 9I]

1924. *Heteropoda robusta* Fage, *Rec. Indian Mus.* 26(1): 66.

Material examined: 4 ex. Siju Cave (~160-200m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/ARA/ERS-75; 1 ex. Siju Cave (~60-80m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/ARA/ERS-76; 3 ex. Siju Cave (~1200m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 19.iii.2019, coll. Uttam Saikia & party, Reg. No. IV/ARA/ERS-78; 3 ex. Siju Cave (~100-150m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 19.iii.2019, coll. Uttam Saikia & party, Reg. No.IV/ARA/ERS-79.

Remarks: Fage (1924) described *Heteropoda robusta* based on a female specimen collected from about 2400ft inside the Siju Cave. The male of the species is still unknown, as our report too is based on two specimens of adult females and three juveniles. Jäger (2005) when describing *Heteropoda Fischer*, a new cave-dwelling spider from the caves of Jaiñtia Hills in Meghalaya, had confined the distribution of *H. robusta* to the caves of the Garo Hills area of Meghalaya with *H. fischeri* dominating the caves in the Khasi and Jaiñtia Hills area of the State. The report of *H. robusta* from Kanha National Park, Madhya Pradesh by Sethi & Tikader (1988) is probably a case of misidentification (World Spider Catalog, 2020) as members of the species are largely cave-dwellers.

Class: CHILOPODA

Order: SCUTIGEROMORPHA

Family: SCUTIGERIDAE

27. ***Thereuopoda*** cf**. *longicornis*** (Fabricius, 1793)

1793. *Scolopendra longicornis* Fabricius, *Entomologia Systematica emendata et aucta - Hafniae*, 2: 390.

Material examined: 1 ex. Siju Cave (~1000m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 19.iii.2019, coll. Uttam Saikia & party, Reg. No. IV/MY/ERS-124.

Remarks: Silvestri (1924) reported this species from Siju Cave, describing it as a new species that he named *Thereuonema reconditum*.

28. ***Scutigera*** sp.

Material examined: 1 ex. Siju Cave (~100-200m inside the Cave), Siju village, South Garo Hills District, Meghalaya,

25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/MY/ERS-125; 1 ex. Siju Cave (~220-300m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 3.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/MY/ERS-126.

Remarks: The specific identity of the specimens could not be established as both specimens are not in good condition (one is an immature specimen and the other has its posterior half broken off).

Order: GEOPHILOMORPHA

Family: MECISTOCEPHALIDAE

29. ***Mecistocephalus*** cf. ***diversidens*** (Silvestri, 1919)

1919. *Lamnonyx diversidens* Silvestri, *Rec. Ind. Mus.,* 16:76-78, Fig. xx.

Material examined: 1 ex. Siju Cave (at the entrance of the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No. IV/MY/ERS-127.

Remarks: The yellow-coloured specimen with a dark reddish-brown head was found crawling on a moss-covered rock at the Cave entrance. It has a close affinity with *Lamnonyx diversidens* as described by Silvestri (1919), but fresh collections are needed to confirm it. Silvestri (1924) has reported the species (as *Lamnonyx diversidens*) between 350-500ft. from the entrance of the Siju Cave.

Class: INSECTA

Order: BLATTODEA

Family: NOCTICOLIDAE

30. ***Typhloblatta caeca*** (Chopard, 1921)* [Figure 9J]

1921. *Spelaeoblatta caeca* Chopard, *Rec. Ind. Mus*., 22: 511-514, pl. 21, Figs. 1-11; pl. 22, Figs. 12-14.

Material examined: 1 ex. ♂. Siju Cave (~450-750m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 04.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/NERC/ZSI-327.

Remarks: *Typhloblatta caeca* is a troglomorphic cockroach that was described by Chopard (1921) from Rupmath Cave (local name is *Krem* Syndai), a 970m long cave located in Syndai village, West Jaiñtia Hills District, Meghalaya. It exhibits troglomorphism in being depigmented, anopthalmic and in possession of unusually long antennae, legs and cerci. This cave-adapted cockroach has been reported from several caves in the Jaiñtia Hills area of Meghalaya (Harries *et al*., 2008) with an unverified record from a cave in the West Khasi Hills District of the State. Harries *et al.* (*in press*) had conferred a similar-looking specimen of oftroglobytic cockroaches found in Siju Cave to this species. Our specimen is a confirmed identification of this species. The current record extends its distribution range further west into the Garo Hills area of the State.

Order: ORTHOPTERA

Family: PHALANGOPSIDAE

31. ***Kempiola longipes*** (Chopard, 1924) [Fig. 9K]

1924. *Kempiella longipes* Chopard, *Rec. Ind. Mus*, 26: 87-89, pl. 5, Figs. 22-34.

Material examined: 4♀, 2♂, 2 juveniles. Siju Cave (~450-950m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No.IV/ORTH/ERS-23; 1♀, 1♂, 2 juveniles. Siju Cave (~150-350m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 04.i.2020, coll. I. J. Kharkongor & party, Reg. No.IV/ORTH/ERS-24; 1♀.Siju Cave (~150-200m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I.J.Kharkongor & party, Reg. No.IV/ORTH/ERS-25; 12♀, 7♂.Siju Cave (~350-400m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 12.xii.2018, coll. I. J. Kharkongor & party, Reg. No.IV/ORTH/ERS-26.

Remarks: *Kempiola longipes* was first described from Siju Cave by Chopard (1924), based on one male and one female specimen collected by S. Kemp and B. Chopra from 1600-2000ft inside the Cave. The cotypes include specimens collected from the same cave at distances from 200-3600ft. from the cave entrance. Harries *et al.* (2008) record the presence of 'orthoptera sp. 3' that "approximates to the published description of *Kempiola longipes*" that dominates the caves in the West Khasi Hills area of Meghalaya, making theirs the first record of this species from outside its Type locality and extending its distribution range to the eastern part of the State. The

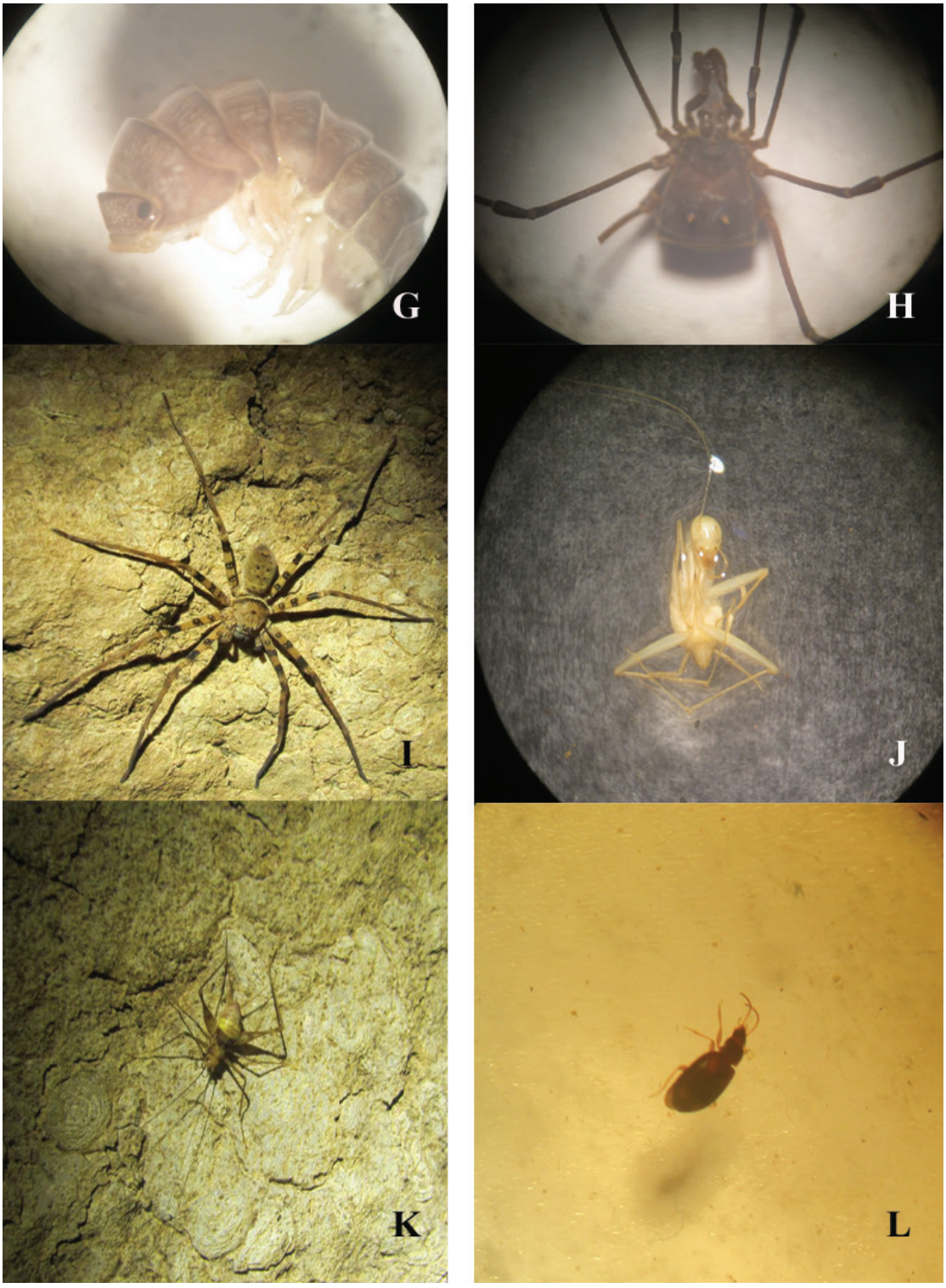

Figure 9. Fauna of Siju Cave. **G.** *Cubaris cavernosus*, **H.** *Metassamia septemdentata,* **I.** *Heteropoda robusta,* **J.** *Typhloblatta caeca,* **K.** *Kempiola longipes* and **L.** *Tachys micraulax.*

present report is based on collections made from locations about 150 – 950m from the entrance of Siju Cave during 2018-2020. To date, this species is not known to occur outside the caves of Meghalaya and the distributional record of the species from Assam by Vasanth (1995) is erroneous as it is probably based on published accounts of Chopard (1924, 1969) that showed the distribution of the species as Siju Cave, Garo Hills, Assam (now Meghalaya). The corrected distribution range of this species is South Garo Hills and West Khasi Hills of Meghalaya.

Order: HEMIPTERA

Family: GERRIDAE

32. ***Metrocoris nigrofasciatus*** Distant, 1903

1903. *Metrocoris nigrofasciatus* Distant, *Fascic. Malayenses*, Zool., 1: 257, pl.xv, Fig. 9.

Material examined: 2 ex. Siju Cave (~50-100m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/HEM/ERS-868.

Remarks: Kemp and China (1924) had recorded the occurrence of *Metrocoris nigrofasciatus* inside the Siju Cave based on collections made at 300ft., 400 ft. and 2000ft. from the cave entrance, and opined that it was a mere straggler and not a resident of the Cave. In the present study, only a few specimens of this species were observed well within the twilight zone of the Cave. Although they do not live or breed inside the cave, they do frequent the cave and utilize the limited food supply available there. The senior author has, on several occasions, observed the species in the caves of the East Jaiñtia Hills area besides Siju Cave and, though the species is not a cave resident, it should be considered a component of the fauna of the caves where they are found.

Order: COLEOPTERA

Family: GYRINIDAE

33. ***Orectochilus*** (***Patrus***) ***oblongiusculus*** Régimbart, 1886

1886. *Orectochilus oblongiusculus* Régimbart, *Ann. Soc. Ent. Fr.*, 6(6): 262.

Material examined: 5 ex. Siju Cave (~100m-150m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No. I/COL/NERC-219.

Remarks: The specimens were collected from about 100-150m inside the Cave. Though this is an epigean, its occurrence inside the Siju Cave forms the first record of an aquatic coleopteran from a cave ecosystem and the first record of the species from Siju Cave itself.

Family: CARABIDAE

34. ***Tachys micraulax*** Andrewes, 1924 [Fig. 9L]

1924. *Tachys micraulax* Andrewes, *Rec. In. Mus.*, 26: 115-116.

Material examined: 10 ex. Siju Cave (~100m-150m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No. I/COL/NERC-220.

Remarks: The species was described by Andrewes (1924), based on specimens collected by Kemp and Chopra from 300-400ft. inside Siju Cave. Our specimens, hence, represent topotypic materials.

Phylum: MOLLUSCA

Class: GASTROPODA

Order: CAENOGASTROPODA (unassigned)

Family: THIARIDAE

35. ***Melanoides tuberculata*** (Müller, 1774)

1774. *Nerita tuberculata* Müller, *Hist. Verm. Terr. Fluv.,* 2: 191.

Material examined: 1 ex. Siju Cave (~150-200m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/MOL/ERS-842.

Remarks: In the 1924 report, Annandale and Chopra mentioned that a single broken shell of the aquatic species *Melanoides pyramis* (Hutton) was found and another was collected at 350ft from the entrance. *Melanoides pyramis* is a synonym of *Melanoides tuberculata*, one of the most widely distributed freshwater Mollusca. Resurveys of the Cave carried out from 2018-2020 yielded only a single dead/empty and highly eroded shell of this species.

Family: PALUDOMIDAE

36. ***Paludomus blandfordiana*** Nevill, 1877

1877. *Paludomus blandfordiana* Nevill, *J. Asiat. Soc. Bengal*, 46(2): 37.

Material examined: 1 ex. Siju Cave (~150-200m inside the

Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 03.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/MOL/ERS-843; 4 ex. Siju Cave (~50-100m inside the Cave), Siju village, South Garo Hills District, Meghalaya, 25°21.061'N, 90°41.006'E, 119m, 04.i.2020, coll. I. J. Kharkongor & party, Reg. No. IV/MOL/ERS-844.

Remarks: Annandale and Chopra (1924) recorded this species in the stream at the entrance of the Siju Cave and 500ft. inside the Cave. The specimens we collected were close to the areas mentioned by Annandale and Chopra (1924). While the species is abundant at the *Do·bak Khol* stream that flows out of the Cave, they are fewer in number in the stretch of the stream that flows within it.

Discussion

The large entrance of Siju Cave allows the daylight to penetrate up to 46-50 m inside the Cave. This part of the Cave is designated as the threshold zone, where the ambient temperature and relative humidity are variable, depending on the season, and more or less similar to that outside of the cave. From this point up to about 100 m inside is the twilight zone of the Cave – a zone of transition from light to dark. The ambient temperature and humidity in this zone are intermediate between that of the threshold zone and the dark zone. Beyond 100-110 m from the entrance, the Cave is in complete darkness. This is the dark zone of the Cave where the ambient temperature and relative humidity of the Cave are more or less stable throughout the year. These different zones of the Cave are inhabited by different fauna.

During the extensive Kemp and Chopra-led biospeleological exploration of the cave in 1922, a total of 102 species, comprising 15 vertebrate and 87 invertebrate species, were documented from Siju Cave which was published in 1924 as a series of papers in volume 26 of the *Records of the Indian Museum*. In the intervening period between 1922 and 2020, a few studies were carried out in Siju Cave, but these were not comprehensive surveys as they were dedicated to specific faunal groups only. Worth mentioning are the studies carried out by Sinha in 1992-93 that had the objective of documenting the bat fauna, and that of Pillai and Yazdani (1977) and Menon (1987) that targeted the fish fauna of the Cave. Their work added eight species of bats and four species of fish to the faunal list of Siju Cave. In 2019, Harries *et al.* (2020) carried out systematic in-situ observation and photography of the cave fauna of Siju *vis-à-vis* the 1922 biospeleological studies of Kemp and Chopra (1924).

Based on the surveys and earlier collections, Sinha (1999) reported the presence of nine species of bats from the area *viz*. *Rousettus. l. leschenaulti*, *Eonycteris spelaea*, *C. s. sphinx*, *Rh. subbadius*, *Rh. pusillus*, *Hi. lankadiva*, *Myotis longipes*, *Miniopterus schreibersi fuliginosus* and *Kerivoula hardwickei*. Among these, *Cynopterus sphinx* was collected from outside the Cave in the gardens, so clearly this species is not present inside the cave as noted above. Sinha's specimens of *My. longipes* from Siju Cave have been examined presently and they were found to represent *My. laniger* with which the former was confused for a long time. All reports of *My. longipes* from Meghalaya represent *My. laniger* (Saikia *et al.*, *in prep.*). Again the specimens of *Mi. schreibersii fuliginosus* from Siju cave as reported by Sinha were also re-examined and found to represent the larger congener *Mi. magnater* which is widely distributed throughout the State (Ruedi *et al.*, 2012; Saikia *et al.*, 2020). Sinha (1999) mentioned *Ke. hardwickii* from Siju Cave based on a specimen supposedly in ZSI, Shillong. But this unregistered specimen could not be traced out currently. All *Kerivoula* species appear to forage in dense vegetation and roost in foliage or tree cavities (Kuo *et al.*, 2017), therefore, its presence inside the cave was possibly accidental and may not represent its cave-dwelling habit. During our recent surveys, we could record the existence of seven species of chiroptera belonging to five families. Out of these, three species namely *Ro. leschenaulti, Rh. lepidus* and *My.*cf *montivagus* were recorded based on single specimens each while *Hi. larvatus, Hi. armiger* and *Mi. magnater* were recorded on multiple occasions. Among these species, *My. montivagus* constitute the first record of this species from Meghalaya. Except for Chiroptera, no other mammalian groups could be recorded from the cave.

In comparison to the earlier records of mammals from the cave, significant changes both in diversity and abundance have been observed during the present study. The intensive surveys in 1922 recorded the presence of extensive pugmarks of small felid throughout the cave length. The report of Sinha (1999) finds no mention of any other mammals from the cave as it was solely directed at Chiropteran fauna trapped at the cave mouth and the cave passage was not surveyed. During our surveys also, we did not notice any sign of its presence in the Cave.

The reported abundant occurrence of *R. nitidus* during 1922 also could not be observed in our surveys. Another independent survey in 2019 also reported the absence of any felid and rodent species inside the cave (Harries *et al.*, 2020). This is a notable change possibly driven by frequent human visits (both tourists and locals) and consequent risks of hunting. Rodent species like *Leopoldamys edwardsii* have been observed in some caves of Jaintia Hills of Meghalaya (M. Ruedi, *pers. comm*). However, those caves were much more pristine with little human disturbances. The only permanent mammalian inhabitants of the cave, the bats also saw a very significant decline in populations over the years. The account of La Touche in 1881 as quoted by Kemp and Chopra (1924) "*The air was thick with bats, in such enormous numbers that it was with difficulty we made our way through them. The noise of their wings was deafening, like the roar of an express train, and the stench was simply appalling*" This is indicative of the huge bat populations existing at that time. Although no abundance of information was available in the intervening period between 1922 and the early 1990s, bat populations were possibly thriving till Sinha's survey period. This was also reflected in the large series of specimens he referred to from the Cave (Sinha, 1999). However, during our surveys, we noted a significant population decline for species like *Eo. spelaea, Hipposideros spp.* and *Mi. magnater*. Although we recorded only one specimen of *Ro. leschenaulti*, there is a possibility that this bat species uses this cave seasonally and we failed to record any roosting individuals, probably, because of the timings of our survey. Apart from increasing human activity in and around the Cave, another probable reason for this very perceptible decline in bat population could be the shifting of crop patterns in the surrounding areas. In the last 20 years or so, the natural vegetation in the nearby areas has been largely modified to make way for *Areca* plantations which might have caused a shortage of food for these bats (Harries *et al.*, 2020).

Kemp and Chopra (1924) when documenting the fauna of Siju Cave briefly mentioned the presence of two frog species: *Rana (Hylorana) afghana* (=*Amolops afghanus*) and tadpoles of *Megalophrys* sp. (=*Megophrys* sp.) based on specimens they collected within 900ft. (~270m) from the cave entrance and which were determined by Nelson Annandale. Following this, there is no other record of amphibians from this Cave. In the present study, we recorded four species of frogs: *Ingerana borealis*, *Minervarya pierrei*, *Megophrys megacephala, Amolops siju* while the former two were recorded from close to the Cave entrance the latter two were found deeper inside in the dark zone of the Cave. Except few stray reports of amphibians from the caves of Meghalaya (Arbenz, 2012; Mukhim *et al.*, 2017; Saikia and Saikia, 2020), no targeted study on the cavernicolous affinity of this group of animals has been undertaken. Species of *Amolops* have frequently been encountered within the twilight zones of other caves in Meghalaya (*pers. obs.*), but their presence deeper inside the dark zones of the caves is recorded only during our recent survey in Siju Cave where specimens were encountered beyond 110m from the entrance. Whereas Kemp and Chopra (1924) reported the presence of tadpoles of *Megalophrys* (=*Megophrys*) from up to a distance of 350 ft. (~105m) from the cave entrance, during our study we found a lone individual of *M. megacephala* from about 400m inside the Cave. Considering the favoured habitat of the species is the forest leaf litter, its presence deep inside the Siju Cave is surprising and unexpected. However, taking into account the recent report of a healthy and thriving population of *I. borealis* from Lymput Cave, another limestone cave of Meghalaya (Saikia & Saikia, 2020), and the continued presence of *Megophrys* since 1922, the possibility exists that Siju Cave could harbour a viable population of *M. megacephala* within it. Some such species of frogs may have found a way to adapt to the cave environment without any noticeable troglobitic modifications.

Hora (1924) reported eight species of fish from Siju Cave: *Psilorhynchus sucatio, Barbus hexastichus* (= *Neolissochilus hexastichus*), *Barilius bendelisis, Barilius barna* (= *Opsarius barna*), *Danio aequipinnatus* (= *Devario aequipinnatus*), *Nemachilus* sp., *Ambassis nama* (= *Chanda nama*) and *Ophiocephalus gachua* (= *Channa gachua*). Pillai and Yazdani (1977) when documenting the Ichthyo fauna of Garo Hills recorded three more species of fish from the Cave: *Neolissochilus hexagonolepis, Tor tor* and *Schistura multifasciata*. Later, Menon (1987) described a new species of fish, *Schistura sijuensis,* based on specimens collected from Siju Cave, besides, conferring *Nemachilus* sp. reported by Hora (1924) to the newly erected fish taxon. However, during the re-survey of this Cave, we collected samples of five fish species [*Neolissochilus hexastichus, S. sijuensis, Garra gotyla, Amblyceps mangois* and *Glyptothorax cavia*] of which the last three are new records from the Cave. It is significant

to note that except for two species, *Nemachilus* sp.(=*S. sijuensis*) and *N. hexastichus*, the other species of fishes reported from Siju Cave were never recorded a second time in subsequent studies, whereas, there are new records of other fish species from the Cave each time, pointing to a constant change in Piscean diversity inside the Cave. The reason behind this marked change in diversity in less than a century is not known, but it is plausible that the fish species recorded from the Cave at different points of time were mere stragglers into the Cave having entered the cave environment from an epigean habitat probably during monsoon flooding of the Cave. Being largely surface dwellers, it is likely that barring a few species, most of these reported species were not able to sustain a viable population inside the Cave and, therefore, were not found again in subsequent studies. This would, to some extent, explain the repeated change in the fish diversity of the Cave with each subsequent study.

Of the 87 invertebrate species documented from Siju Cave in 1924, there were four species of Mollusca, seven species of Crustacea, 12 species of Arachnida (including four species of Acari), six species of Myriapoda, a species of Thysanura, four species of Collembola, four species of Orthoptera, three species of Dermaptera, four species of Rhyncota, 14 species of Diptera, three species of Lepidoptera, 17 species of Coleoptera, two species of Hymenoptera and five species of Oligochaeta. Since then, until the start of this current study, there have been no further studies on the invertebrate fauna of Siju Cave. Simultaneously, Harries *et al.* (2020) revised the relative abundance of the cave invertebrates bringing to light two significant changes observed *vis-à-vis* 1922: a decline in the bat guano-associated invertebrate fauna due to a reduction in bat guano and the abundance of the population of a troglobitic cockroach species that was not reported in 1922. The results of our re-survey study from 2018-2020, though quite similar to that of Harries *et al.* (2020), show a further decline in the invertebrate faunal composition of the Cave having documented two species of Mollusca (*Melanoides tuberculata* and *Paludomus blandfordiana*), seven species of Crustacea (*Philoscia dobakholi, Cubaris cavernosus, Porcellio assamensis, Maydelliathelphusa falcidigitis, Macrobrachium hendersoni, M. cavernicola* and *M. assamense assamense*), three species each of Arachnida (*Metassamia septemdentata, Nesticodes rufipes* and *Heteropoda robusta*), three species of Myriapoda (*Thereuopoda* cf. *longicornis, Scutigera* sp. and *Mecistocephalus* cf. *diversidens*), two species of Coleoptera (*Orectochilus* (*Patrus*) *oblongiusculus* and *Tachys micraulax*), one species each of Orthoptera (*Kempiola longipes*), Hemiptera (*Metrocoris nigrofasciatus*) and Blattodea (*Typhloblatta caeca*).

Kemp and Chopra (1924) noted that though the fauna was distributed throughout the explored length of the Cave, they were more abundant in sections where there were rich deposits of bat guano. We agree with Harries *et al.* (2020) that there has been a considerable decline in the diversity of the invertebrate fauna of the Cave with several species no longer found inside it. It would not be too far-fetched to associate this decline in the invertebrate faunal composition of the Cave with the depleting guano deposits inside it on account of its dwindling bat population.

Conclusion

Over ninety-six years have elapsed between the first biospeleological exploration of the Cave and the commencement of our study and in that duration of time, there is a high probability that like all-natural environments, the Cave, subjected to the vagaries of nature coupled with human activities, must have undergone considerable changes that could alter the environment inside it and exerting their effect on the fauna inhabiting therein. Siju Cave is a natural environment, and as such has the propensity to change under the influence of both natural and man-made factors. Natural factors like changing rainfall patterns, earthquakes, periods of drought, intense seasonal temperature fluctuations, strong winds, etc. can exert their influence by changing the topography of the Cave. For instance, the huge slabs of limestones and shale inside the Cave that Kemp and Chopra (1924) mentioned were not encountered by us in the magnitude that they had described. Probably, over the decades these huge slabs must have been eroded by the seasonal flooding of the Cave, or must have broken into smaller pieces through the natural weathering process and trampling feet or many may have been removed or carried out of the Cave by the flood waters or even humans. Some of the visible human-induced changes in the vicinity of the Cave include the replacement of native forests with areca nut plantations; the expansion of the human settlements along with the accompanying developmental activities, the development of the Cave into a show-cave with an approach road and paved footpath leading up to the cave entrance, etc. In a

resource-deficient ecosystem like the caves, even minor changes in its physical environment can have major impacts on its biotic components. It is plausible that all or some of these factors, directly or indirectly, must have set a chain of actions that led to the decline of the Cave biota. Of the 102 species documented in 1924, a mere 36 species have been accounted for in the current study.

This drastic decline in the faunal diversity of the Cave is a cause of concern as it is the type locality (and in certain cases, only known locality) for a few rare species, besides being home to some rare cave fauna. The new record of I. borealis from the Cave is encouraging, as it is a Vulnerable frog species as per IUCN (Lau *et al.*, 2004) as well as the continued record of *N. hexastichus* and *S. sijuensis*, which are Near Threatened and Endangered, respectively as per IUCN (Chaudhry and Barbhuiya, 2010; Vishwanath, 2010). Another encouraging sign is the record of a few species which were not previously known from the Cave, indicating that it can serve as a refuge for more faunal components of the area. Our findings have expanded the scope for further biospeleological research into the colonization of cave habitats through the replenishment of species from an epigean source that is manifested in the form of variation in the fish and decapod crustacean composition, the behavioural and/or physiological adaptations of amphibians to the cave environment, without any discernable troglobitic modification, and the inter-species relationship between the different components of the cave biota.

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