

Biospeleological Study of the Phuljhar Cave of Gariaband, Chhattisgarh, India

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Abstract:

Biospeleological status of the Indian cave is still less known. Till date, very few caves have been biologically explored in India. This study aims to document and categorize the different species found in a Talus cave in Gariabandh district, Chhattisgarh, India. In addition to most of the common cavernicolous species found inside the subterranean caves, we also identified some unique species that no other cave in India has ever recorded. This cave is also a sheltered place for some dreaded wild animals due to which high alertness is always required to visit this cave. Finally, on the basis of the identified species and other biotic substances found inside this cave, we have also prepared a tentative food pyramid that possibly operating inside this cave

Introduction

Caves that are developed underground are open to human exploration. In addition, by understanding the area's geological makeup, we can determine which areas of the land are secure for human habitation and which are not. There are many animals that call these caves their home; some of them are adapted to live in dim, subterranean environments and cannot be found outside of them. The study of fauna in caves, which rely partially or completely on the cave ecosystem for their life cycle, is called Biospeleology. The fauna that abides inside the caves are categorized into four main types (Vandel, 1965; Gunn, 2005; Balestra *et al.*, 2021, Culver, 1982, Culver & Pipan, 2009; Biswas, 2022). In a broad sense, those are of two major types; i) temporary residents other ii) obligatory or permanent residents. Temporary cave dwellers utilize caves for shelter, hibernation, roosting, reproduction, and feeding. They have to leave the cave from time to time. On the other hand, the obligatory cave dwellers are so adapted to cave life that they can't even survive outside the cave (Vandel, 1965; Gunn, 2005; Balestra *et al.*, 2021, Culver, 1982, Culver & Pipan, 2009; Biswas, 2022). Certain species have evolved to depend on cave habitats and cannot survive elsewhere. Furthermore, researchers have classified these two types into additional categories based on their cave life attachments (Sket, 2008; Vandel, 1965; Gunn, 2005; Balestra *et al.*, 2021, Culver, 1982, Culver & Pipan, 2009; Biswas, 2022).

In the present study, we have targeted a small cave located at the top of a hill named Phuljhar Cave which is situated in the dist Gariaband of Chhattisgarh for its Biospeleological study. tabulated all such faunas which are either temporarily or permanently abiding inside this cave and also tried to understand the possible ecological pyramid operating inside this cave.

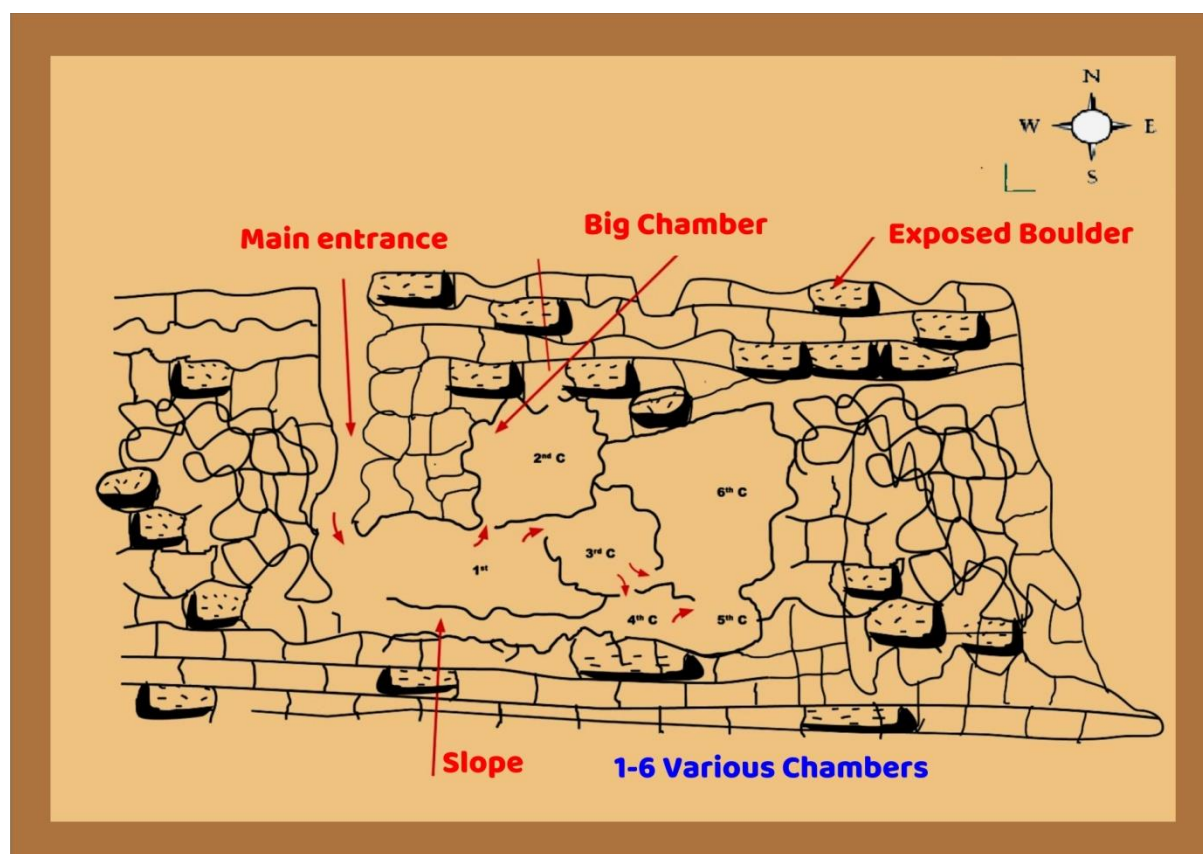
Materials and Methods

Study area: For this study, we target a small talus cave which is situated at a top of a hill nearer to the village named Phuljhar (Lat. 20.251°N; Long 82.230° E; Elevation- 660.64 ASL). The village comes under the Mainpur Tehsil of district Gariaband. It is located 55 KM towards South of the District headquarters Gariaband, Chhattisgarh.

The village Phuljhar is surrounded by Gariaband district towards the South-East, Deobhog Tehsil towards the West, Nagri Tehsil towards East, the state Odisha. And most of these rural and forest areas are under the threat of wild animals especially, Bear and Elephants.

Reaching the entrance of this cave is not easy as it is about 250 mt height from the ground level. And the way is full of threats from wildlife and other physical obstacles.

A tentative map was drawn which would be helpful to understand the points where the environmental parameters were noted.



Map: Tentative **layout** of the Phuljhar Cave, various chambers denoting where environmental parameters were noted

Methodology:

This study was an attempt to understand the living status of the fauna abiding inside the Phuljhar cave i.e., the biodiversity along with understanding the food chain operating inside it. This study was carried out by qualitative collections based on direct or indirect evidence of animals making use of this cave. In the initial phase of this study, a tentative layout of the cave was mapped with the help of measuring tape and a compass where all the opening including blow holes which connects the cave to the outer surface were carefully noted.

A careful survey was done for the entire cave to identify and note all sorts of small and spacious habitats that could be used by any animal/organism. The observations were made at every one-month gap continuous for a span of two years. During each field visit every nook and corner of the cave was carefully observed to document the direct /indirect evidence(s) of any fauna that used the cave for any purpose like shelter/ feeding/ reproduction/ escape from predators/ summer heat/ rain/ winter cold etc. Sheds of evidence were photographed and identified by the relevant taxonomist till the genus level. Attempts were also made to know the role of each visitor and/or permanent inhabitant inside the cave, in their particular zone of occurrence. A speculative food pyramid was drawn that may be operating within the cave (Figure-1).

Observations and Results

Vertebrates

The fan-throated lizard

| | |
|-----------------------|------------------------|
| Phylum: | Chordata |
| Class: | Reptilia |
| Order: | Squamata |
| Suborder: | Iguania |
| Family: | Agamidae |
| Genus: | <i>Sitana</i> |
| Species: | <i>S. ponticeriana</i> |
| Cavernicolous status: | Frequent visitor |



Plate -1: Lizard, *Sitana ponticeriana* found in the entrance and twilight zone of the cave

Sitana ponticeriana is a very common lizard we always encountered in the entrance zone of the Phuljhar cave, sometimes it was found to encroach even the twilight zone of the cave. This lizard is commonly referred to as the fan-throated dragon and is very common throughout the Indian subcontinent and even in Sri Lanka.

Blanford's rock agama

| | |
|-----------------------|--|
| Phylum: | Chordata |
| Class: | Reptilia |
| Order: | Squamata |
| Suborder: | Iguania |
| Family: | Agamidae |
| Genus: | <i>Psammophilus</i> |
| Species: | <i>P. blanfordanus</i> |
| Synonyms: | <i>Charasia blanfordana</i> , Stoliczka, 1871 <i>Charasia blanfordiana</i> [sic] Boulenger, 1885 <i>Psammophilus blanfordanus</i> M.A. Smith, 1935 |
| Cavernicolous status: | Frequent visitor |



Plate -2: Lizard, *Psammophilus blanfordanus* found in the entrance and twilight zone of the cave

Blanford's rock agama, scientifically known as *Psammophilus blanfordanus*, is a species of agamid lizard found in the Middle East and parts of Central Asia. We have often encountered it in the cave's entrance to the Twilight Zone. They are primarily found in rocky habitats, such as cliffs, boulders, and rock formations. They are adapted to living in arid or semi-arid environments.

Horseshoe bat

| | |
|-----------------------|-----------------------------------|
| Phylum: | Chordata |
| Class: | Mammalia |
| Order: | Chiroptera |
| Family: | Rhinolophidae Gray, 1825 |
| Subfamily: | Rhinolophinae Gray, 1825 |
| Genus: | <i>Rhinolophus</i> Lacépède, 1799 |
| Cavernicolous status: | Regular visitors |



Plate -3: Horseshoebat, *Rhinolophus* sp. found in almost all the zones of the cave

A few colonies of the microchiropterans bats from *Rhinolophus* genus, commonly called horseshoe bats are abiding in this cave. The shape of the nose of this group of bats resembles a horseshoe, which helps to easily identify them. *Rhinolophus* species exhibit a wide distribution across diverse habitats, encompassing forests, caves, and other roosting sites. The genus *Rhinolophus* species are the small to medium-sized range of bats. This particular bat's body length spans from 4 to 10 centimetres and its wingspan measures approximately 20 to 40 centimetres. Our one was of bat's body length spans ~6 cm, wingspan measures ~25 cm.

Invertebrates

Cricket

Phylum: Arthropoda
 Class: Insecta
 Order: Orthoptera
 Suborder: Ensifera
 Family: Phalangopsidae
 Subfamily: Cachoplistinae
 Tribe: Homoeogryllini
 Genus: *Meloimorpha* Walker, 1870
 Cavernicolous status: Permanent dweller



Plate -4: Cricket, *Meloimorpha* sp. found in the entire zones of this cave

This particular species could be easily observed from the twilight zone to the deep zone of Phuljhar cave. Indeed the *Meloimorpha* Walker, 1870 species are mostly cave-adapted and found in most of the Chhattisgarh cave (Jaiswara *et al.*, 2018; Biswas, 2022) bearing long antennae. Cricket always serves as the major energy source of the cave inhabitants in most of the caves (Biswas & Shrotriya, 2011).

During our study we noticed nymph during December-January, it shows that the reproduction period of this particular species is the monsoon period.

In the fickle matter of bats, we found several undigested parts of this particular species which shows it is one of the major sources of diet for the existing bats of Phuljhar cave.

Centipede

Phylum: Arthropoda
 Subphylum: Myriapoda
 Class: Chilopoda

Order: Scutigeromorpha
Family: Scutigeridae
Genus: *Scutigera* Lamarck, 1801
Cavernicolous status: Permanent dweller



Plate -5: Centipede, *Scutigera* found in the entire zones of the cave

Several taxonomic characteristics testify to the *Scutigera* sp. as the house centipede. The physical morphology of these centipedes is characterised by a body that is elongated and flattened. It is usually seen in Phuljhar cave concealed under rocks right from twilight to the deeper zones. These organisms exhibit segmentation, comprising numerous body segments referred to as somites or diplosomites. It is commonly found in Indian and even in Chhattisgarh's cave (Harries et al., 2011; Biswas, 2010).

Their hunting behaviour is reported to be predominantly nocturnal (Imms, 1910), exhibiting a preference for activities during the nighttime hours. Their rapid locomotion and aptitude for capturing and consuming diminutive invertebrates are widely recognised.

Solpugid (Camel spider?)

Phylum: Arthropoda
Subphylum: Chelicerata
Class: Arachnida
Order: Solifugae
Family: Galeodidae
Genus: *Galeodes*
Cavernicolous status: Permanent dweller



Plate -6: Solpugid, *Galeodes* sp. found in the entire zones of the cave

Galeodes sp. is not certain whether to place it in the spider or in scorpion group. Thus it has been kept in the Solifugae order which is neither true spider nor scorpion. These arachnids are not the common cave inhabitant. It remains concealed in dry environments with brown or tan colouring. These species are nocturnal. It has typical body structures; a long, segmented opisthosoma and a huge cephalothorax (prosoma). The united cephalothorax has four legs and two huge jaws. Its longer chelicerae are to catch small prey. It has eight legs—four pairs of strong, fast-moving legs. Segmented legs with sharp spines and claws capture and grip prey. They use their legs to move quickly. Sensory pedipalps are usually lengthy. They sense touch, manipulate prey, and reproduce.

Opiliones

Phylum: Arthropoda
 Subphylum: Chelicerata
 Class: Arachnida
 Order: Araneae
 Infraorder: Araneomorphae
 Family: Pholcidae
 Cavernicolous status: Permanent dwellers

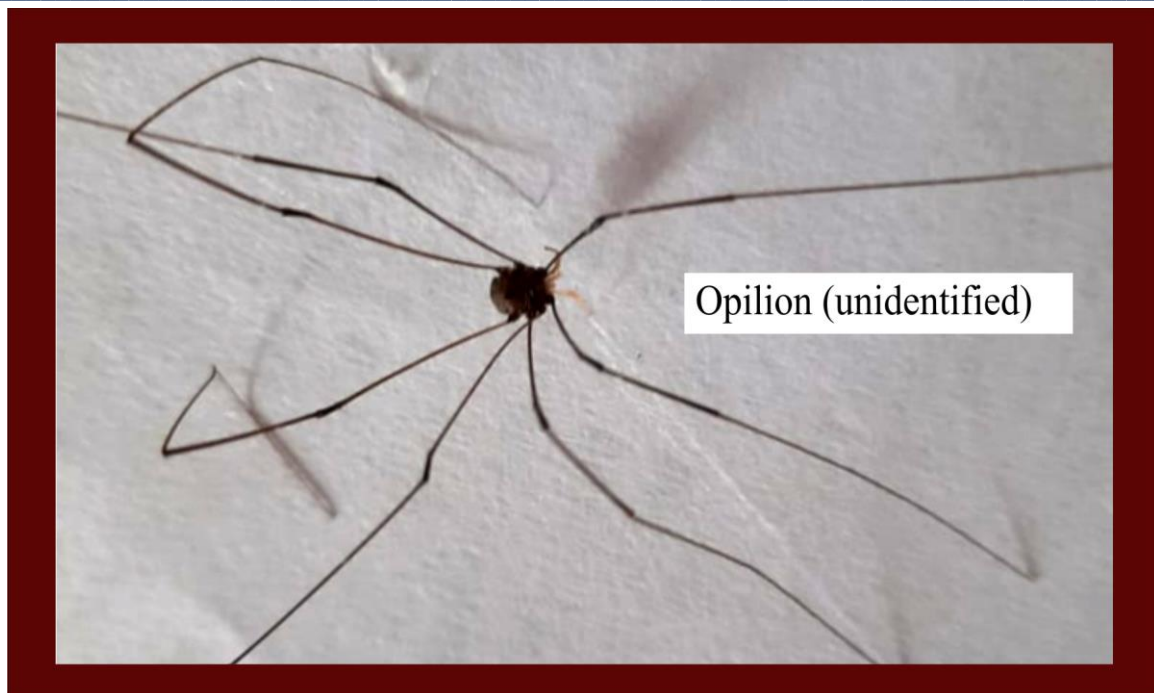


Plate -7: Opilion sp. found in the entire zones of the cave

Usually in the entrance or even in the Twilight zones in many of the Indian caves these opiliones are found in clusters (Harries et al., 2008; Biswas & Harries, 2011; Biswas, 2022; Kumar et al., 2023). But, in Phuljher cave a species of unidentified Opiliones was seen always to move in a solitary manner.

The faunas identified on the basis of direct sightings in the Phuljhar cave:

Black rat : *Rattus rattus*

It is a common rat, in India, it is referred to as a domestic rat and is a dangerous rodent for our grain and other domestic stuff. It has a long tail and is nocturnal in nature. Earlier it has been noted from a few caves of Meghalaya too (Harries et al., 2008), and is mostly abide in Asian caves (Price, 2014).

During our study, we always visited this cave in the daytime and due to this we never noticed it inside the cave directly. But, most of the time we found its fickle matter (dropping in the cave, right from the entrance to the dark zone which testifies that this rat is a permanent dweller in this cave.



Plate -8: faeces of rats found in the entrance and twilight zone of the cave

Indian crested porcupine : *Hystrix indica*

On each of our visits, we found the quills of this *H. indica* scattered here and there at every nook and corner of this cave. Possibly this species regularly visit this cave to take shelter, to escape from predator and even in search of food. They enter this cave from the main entrance only as we found more numbers of quills in the entrance.

Some suspected passages also exist in the inner chamber which appears to be used by this porcupine species to enter this cave.



Plate -9: Quills of the porcupines found in the entrance and twilight zone of the cave

Sloth Bear: *Melursus ursinus*

During our summer visits, we encountered with Sloth Bear two times. Unfortunately, due to the nervous and threatened situation, we failed to photograph its presence. However, we found its hair on the wall of the entrance location, which was collected and photographed by us.

The villagers who live nearer to this location testified that the Sloth Bear is a common wild animal usually seen adjacent to the cave during the summer season. However, the occurrence of bears in caves is a very common phenomenon all over the world (Vandel, 1965; Gunn, 2005; Biswas, 2022). In various caves of Meghalaya, shreds of evidence of abiding bears are available (Harries et al., 2008; Biswas, 2022).



Plate -10: Body hair of sloth bear found in the entrance and twilight zone of the cave

Ecological Pyramid

On the basis of direct observation of fauna and the relevant organic matter inside the Phuljhar Cave, a tentative Ecological Pyramid has been prepared, possibly operating inside the Phuljhar Cave.

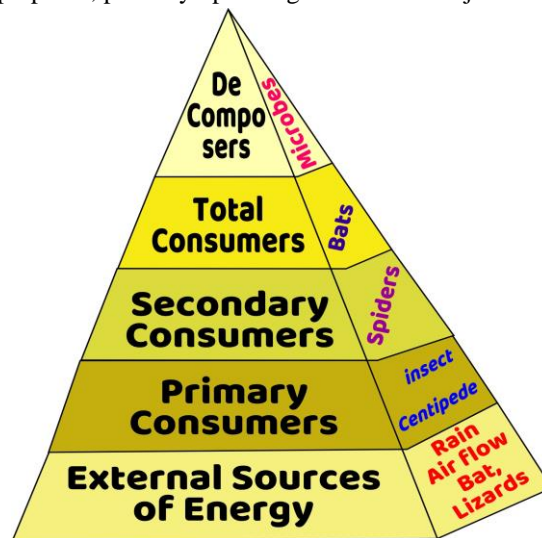


Figure 1: Based on our observations and identification of species inside the Phuljhar cave, the possible ecological pyramid operating inside the Phuljhar cave

Conclusion

For any species to establish a population inside any cave is really very challenging. Due to typical geophysical conditions, energy crises always exist inside the cave. Thus, a high degree of biological adjustment is required to grow inside the cave.

To date, the adaptations of the cave organisms inside the cave have been explained by supporting various theories viz., Darwinism, Lamarckism, Neo Lamarckism etc. (Sket, 2008; Biswas, 2010; Biswas, 2022). Among these, the Preadaptation theory is the most accepted one for cave organisms. The preadaptation hypothesis suggests that the ancestors of cave-adapted animals which exist or are extinct and basically abide in the open natural habitat were pre-adapted to darkness by already leading semi-nocturnal or nocturnal lifestyles in environments with low-light penetration, simplifying their transition to life in caves (Racovitza 1907; Vandel 1965; Gunn 2004).

In our study, most of the fauna we identified are common cave fauna universally. However, the lizards we found inside the cave till twilight zones are found to be habitual visitors perhaps entering the cave for shelter and food.

In addition, a *Galeodes* sp. which was seen always inside is an exceptional that has not noted yet from any cave.

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