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HERPETOFAUNA IN THE CAVES OF THE ANDAMAN ISLANDS: AN APPEAL FOR CONSERVATION MEASURES

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Abstract

As incidental inhabitants, amphibians and reptiles actively exploit subterranean ecosystems. In the Indian context, knowledge of cave-dwelling herpetofauna is scarce. This paper compiles information about the amphibians and reptiles encountered during multiple visits to the caves of the most significant cave complexes of the Andaman Islands on Baratang Island, Chalis-Ek on North Andaman Island, and Interview Island in the North and Middle Andaman Islands between 2018 and 2020, and 2024 and 2025. We encountered herpetofauna in all cave zones and added 14 species to the existing list of cave-dwelling herpetofauna. We reported four species of amphibians and twelve species of reptiles actively using the cave for roosting or foraging. Of the reported species, four amphibians; three (Chakrapani's narrow-mouthed Frog, Andaman wart frog, and Andaman bush toad) are endemic to the Andaman Islands. Among reptiles, three species are endemic to the Andaman Islands (Andaman Grass Skink, Andaman Bent-toed Gecko, and Anderson's Pit Viper), and the Nicobar Forest Dragon is distributed across the Andaman and Nicobar Islands. The study reports the presence of herpetofauna within the tropical caves of the Andaman Islands and highlights the importance of subterranean habitats for their conservation. Further detailed studies are recommended to understand habitat usage and behavior of herpetofauna within cave ecosystems.

INTRODUCTION

Amphibians and reptiles, collectively known as herpetofauna, serve as key indicator taxa for assessing habitat alteration and climate change globally (Sheridan and Olson, 2003; Olson and Saenz, 2013). Their sensitivity to environmental changes has precipitated an unprecedented decline in their populations (Harikrishnan et al., 2022). This is particularly severe on islands, where populations are at high risk of extinction due to limited distribution ranges and the presence of invasive species (Harikrishnan et al., 2022).

In light of these challenges in terrestrial habitats, subterranean environments offer essential refuge for many species from natural and anthropogenic disturbances (Biswas, 2014). Subterranean habitats serve multiple functions, including providing thermal protection (Uhrin and Lesinsky, 1997; Fenolio et al., 2005), providing shelter to evade predation (Manenti et al., 2009), serving as feeding habitats (Baumgart, 1981; Uhrin and Lesinsky, 1997), and acting as breeding grounds (Culver and Pipan, 2019). Several studies have documented all three living orders within the class Amphibia in cave habitats: Anura (frogs and toads), Caudata (salamanders), and Gymnophiona (caecilians) (Bonini et al., 1999; Bressi and Dolce, 1999; Biswas et al., 2011). In the Palearctic and Neotropical regions, amphibians are relatively prevalent in caves (Rosa and Penado, 2013); however, cave salamanders have commonly been the focus of scientific explorations (Sequeira et al., 2001; Kami, 2004; Lanza et al., 2006; Romero, 2009; Ianc et al., 2012). Previously, Olm *Proteus anguinus* Laurenti, 1768, was the only known obligate cave-dweller. However, based on Recknagel and Trontelj (2022), 14 cave-obligate species, all plethodontid and proteid salamanders, are known, and 11 salamander species or subspecies exhibit troglomorphism (Romero, 2009).

Reptiles also significantly utilize cave habitats (Gunn, 2004; Manchi and Sankaran, 2009; Pauwels et al., 2019). Of the four reptile orders, Squamata (snakes and lizards) (Pauwels et al., 2019), Testudines (turtles) (Milstead, 1956; Acuña-Mesen, 1994; Tuberville et al., 2005; Kawalkar et al., 2024), and Crocodilia (crocodiles) (Somaweera et al., 2020; Wynne et al., 2023) have been documented utilizing caves. Many of these taxa have been recorded using these caves as feeding grounds (Gunn, 2004; Manchi and Sankaran, 2009; Shirley et al., 2017)

Though herpetofauna are known to inhabit caves worldwide, little is known about India's cave-dwelling species, apart from sporadic reports of their occurrence (supplementary material). While exploring the limestone caves in the Andaman Islands between 2018 and 2020, and again in 2024 and 2025, we encountered 16 species of amphibians and reptiles. This document discusses the occurrence of herpetofauna in caves of the Andaman Islands and highlights the significance of these subterranean habitats with a brief review of the existing related knowledge.

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METHODS

Study Area

The Andaman and Nicobar Islands (10°14′20.40″ N, 93°13′48.00″ E, Fig. 1) are an island archipelago that extends into the Bay of Bengal (Andrews and Sankaran, 2002). These islands are a part of both the Indo-Burma and Sundaland biodiversity hotspots (Myers et al., 2000). The Andaman and Nicobar Islands experience a tropical to subtropical climate, characterized by humidity levels of 79%–89% and temperatures ranging from 21 to 33 °C (Saldanha, 1989; Rajendran et al., 2008). Due to the northeast and southwest monsoon, these islands receive substantial (300–350 cm) rainfall annually (Chakravarthy et al., 1987).

About 395 caves are known from 37 islands in the Andaman Nicobar Archipelago (Sankaran, 1998; Manchi and Sankaran, 2014). The random visual encounters of the herpetofauna (reptiles and amphibians) discussed here are from the archipelago's most significant cave complexes: Wraffter's Creek on Baratang Island, Interview Island, and Chalis-Ek on North Andaman Island. Baratang Island (12°05′ N, 92°45′E) features more than 175 caves spread across 0.77 km^2 (Sankaran, 2001; Manchi and Sankaran, 2014), with a unique karst forest (Mane et al., 2019), primarily dominated by calciphiles, comprising Andaman tropical evergreen and Andaman semi-evergreen forests (Champion and Seth, 2005). Chalis-Ek on North Andaman Island is a limestone hillock with 28 caves. Pal and Bhattacharya (2010) provided a detailed account of the metamorphic rocks belonging to the ophiolite series. Champion and Seth (2005) classified the vegetation of North Andaman into Andaman tropical evergreen, Andaman semi-evergreen, Andaman moist deciduous, mangroves, and littoral forest. Interview Island (12°56′17″ N and 92°42′31″ E) is the westernmost simple carbonate island (Kawalkar and Manchi, 2020). It has 34 known limestone caves and is the largest Wildlife Sanctuary (133.40 km^2) in the archipelago (Manchi and Sankaran, 2014; Vijayamma et al., 2021). Interview Island belongs to the Archipelago series, composed of soft limestone formed from coral and shell, soft calcareous sandstones, and soft white clays, with occasional bands of conglomerates (Oldham, 1885).

The fauna of the Andaman Islands exhibits affinities with the South-East Asian fauna, with some species restricted to a few islands in the archipelago (Rahmani et al., 2016). India is home to approximately 472 amphibian species, of which around half are endemic (Gosavi et al., 2020). In these islands, both amphibians and reptiles are distinct, with 21 species of amphibians (Harikrishnan and Vasudevan, 2018; Garg et al., 2022b) and 76 reptile species, of which 24 are endemic (https://forest.and.nic.in/).

Data Collection

The surveys were conducted between 2018 and 2020 and again between 2024 and 2025. We used a visual encounter survey (dos Santos et al., 2022), where three observers recorded the presence of herpetofauna across different parts of the caves. While surveying, we observed the animal's location (walls, floor, speleothems, etc.), behavior (e.g., roosting, feeding, and mating), cave zone (entrance, twilight, and dark), and the types of microhabitats (leaf litter, guano, crevices, etc.). We photographed the animals for further identification.

RESULTS

The present study adds 14 species (Fig. 2) to the existing list of 29 herpetofauna species reported from caves in India (supplementary material). During the present study, we recorded four amphibian and 12 reptile species from caves at Chalis-Ek, Baratang Island, and Interview Island (Fig. 3). The herpetofauna were recorded across the various microhabitats within caves for foraging and roosting (Table 1). Among the study sites, species diversity was highest in the caves at Baratang Island, followed by Chalis-Ek and Interview Island.

We recorded anurans from three families (Bufonidae, Microhylidae, and Dicroglossidae), further classified into four genera (*Duttaphrynus*, *Blythophryne*, *Microhyla*, and *Minervarya*) (Fig. 4). The Common Asian Toad (*Duttaphrynus melanostictus*), Andaman Bush Toad (*Blythophryne beryet*), Chakrapani's Narrow-mouthed Frog (*Microhyla chakrapanii*), and Andaman Wart Frog (*Minervarya cf. andamanensis*) (Fig. 5).

Among squamates, we recorded species from four families (Gekkonidae, Agamidae, Scincidae, and Varanidae), further classified into eight genera (Cyrtodactylus, Hemidactylus, Coryphophylax, Calotes, Sphenomorphus, Eutropis, Subdoluseps, and Varanus) (Fig. 6). The species observed were the Andaman Bent-toed Gecko (*Cyrtodactylus rubidus*), Flat-tailed House Gecko (*Hemidactylus platyurus*), Nicobar Forest Dragon (*Coryphophylax subcristatus*), Changeable Lizard (*Calotes versicolor*), Spotted Forest Skink (*Sphenomorphus maculatus*), Andaman Grass Skink (*Eutropis andamanensis*), Christmas Island Grass skink (*Subdoluseps bowringii*), and Common Water Monitor (*Varanus salvator*) (Fig. 6). Additionally, we recorded snakes from three families (Viperidae and Colubridae), including four genera (Trimeresurus, Gonyosoma, Lycodon, and Coelognathus). The species observed were Anderson's Pit Viper (*Trimeresurus andersonii*), Red-tailed Racer (*Gonyosoma oxycephalum*), Andaman Wolf Snake (*Lycodon hypsirhinoides*), and Yellow-striped Trinket Snake (*Coelognathus flavolineatus*) (Fig. 7).

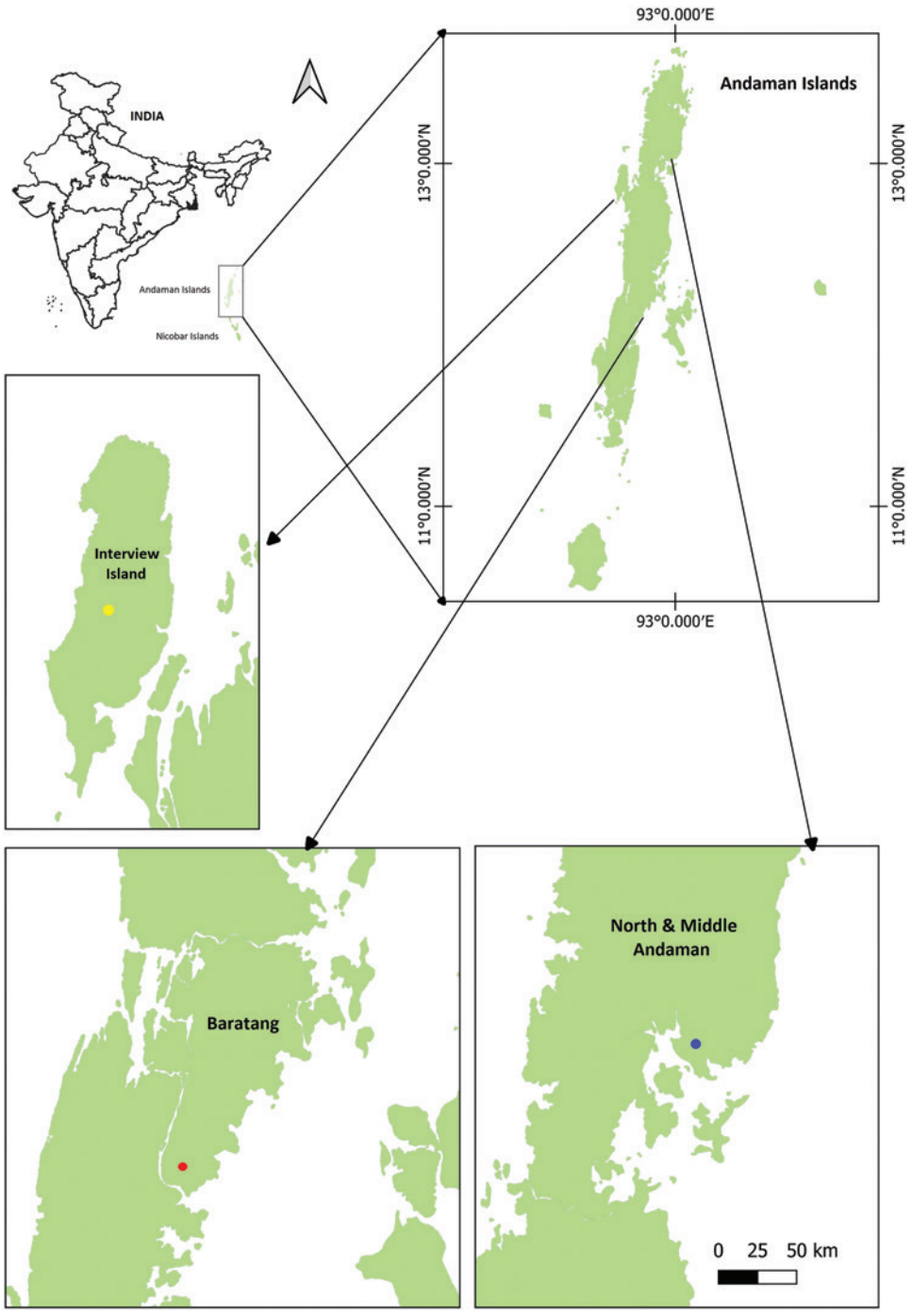


Figure 1. The geographical location of Baratang, Interview Island, and North Andaman (Chalis-Ek) Islands.

DISCUSSION

Amphibians and reptiles use caves with different rock types and environments; however, their ecological reasons are still scarcely explored (dos Santos et al., 2022). Similarly, the present study also recorded herpetofauna across various cave microhabitats for breeding, roosting, and foraging activities. Five amphibian and twelve reptile species were observed actively using the limestone caves in the Andaman Islands. Among amphibians, the common Asian toad, a widely distributed species across diverse habitats (Dutta et al., 2009), was first recorded in a subterranean habitat of the Siju Cave, Meghalaya (Sinha, 1999). Hence, its presence inside the caves of the Andaman Islands is apparent. Biswas et al. (2011) encountered this species in caves during the rainy seasons. Though we did not observe any breeding activity, finding it in the same places on repeated visits suggests they return to these spots regularly, using the caves as safe places for shelter, food, and maybe breeding.

The Andaman Bush Toad (Chandramouli et al., 2016) is another species recorded in the caves of Baratang Island. We encountered the species under the leaf litter in the cave entrance zone during February–March and November. In the twilight zone, the species was seen roosting in crevices of the cave wall, speleothems, and on the cave floor. Similarly, a species of arboreal toad, *Sigalegalephrynus mandailinguensis*, in Indonesia is documented to use both troglodytic and arboreal habitats, at 2 m above the cave floor (Smart et al., 2017). Hence, detailed cave exploration as a significant habitat for toads is vital. Moreover, the Andaman Bush Toad, which is "vulnerable" with a severely fragmented population in the islands (IUCN, 2023), requires an urgent, detailed understanding of its presence in cave habitats to develop conservation measures.

The presence of toads and frogs is considered incidental and common in the subterranean environments (Bressi and Dolce, 1999; Lunghi et al., 2018). Among the frogs observed are the Andaman Wart Frog (*Minervarya cf. andamanensis*) by Garg et al. (2022a) and Chakrapani's Narrow-mouthed Frog (*Microhyla chakrapanii*). The Andaman Wart Frog was observed in microhabitats such as crevices, eroded walls, bat or swiftlet guano deposits, soil, leaf litter, and areas where organic debris washed in from sinkholes during the monsoon (April–July). The occurrence of both species in the moist

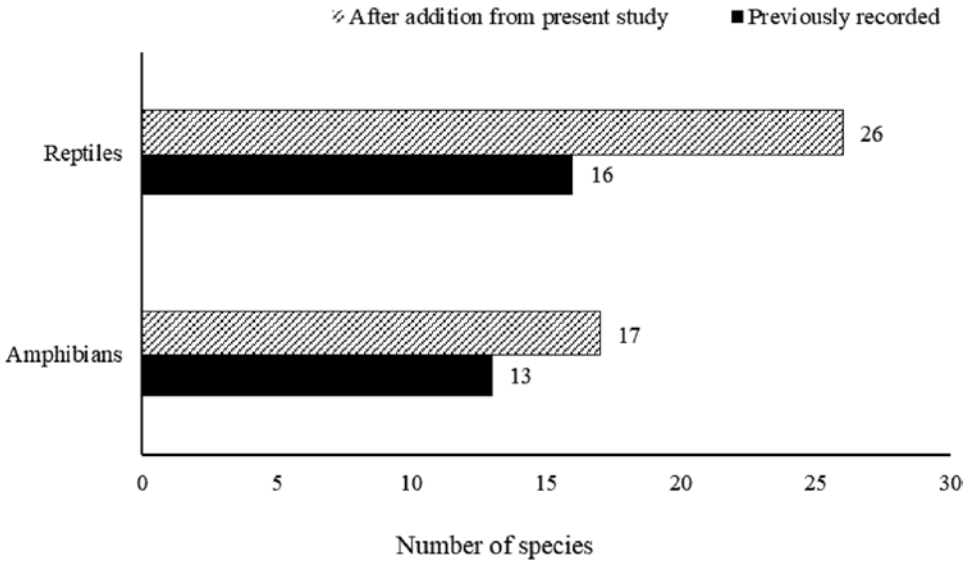


Figure 2. Comparative overview of India's cave-dwelling herpetofauna, showing species previously known from caves and those newly documented through the present surveys.

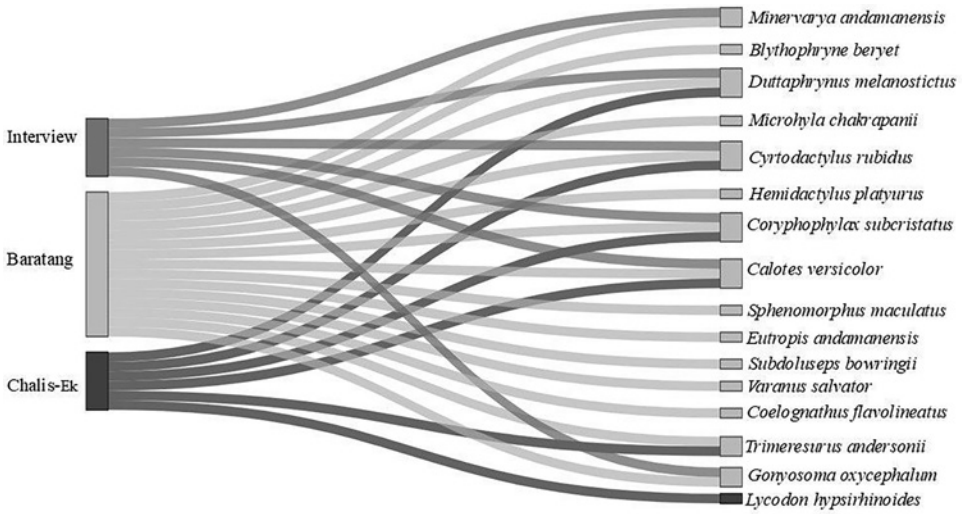


Figure 3. The presence of herpetofauna species across the study sites.

twilight and dark zones adds a new dimension to their ecological range, indicating a wider habitat plasticity than previously documented. Further detailed studies will help in understanding the habitat requirements and ecology of these frogs in caves.

Reptiles utilize various cave microhabitats (e.g., cave walls, crevices, and groundwater) for roosting and foraging (Poulton, 2004; Maglangit et al., 2021). We encountered several species of snakes. Both the Anderson's Pit Viper and the Red-tailed Racer were observed from the entrance zone to deep inside the caves, mostly beneath colonies of bats and swiftlets. At the entrances, they exhibit a sit-and-wait hunting posture. Inside the caves, they were observed under active bat roosts and swiftlet nests, likely waiting to ambush prey. Additionally, a Yellow-striped Trinket snake and an Andaman Wolf Snake were observed in the holes on the cave floor, suggesting that caves also serve as temporary refuges for these species. According to Turbanov et al. (2019), snakes occupy both inland and coastal caves and are usually observed using clastic sediments (small extraneous debris, fallen rocks, and boulders) in all three zones.

Snakes are recognized predators of lizards and geckos in terrestrial habitats (Landová et al., 2016); this trophic interaction is now also confirmed within the cave ecosystems of the Andaman Islands. We encountered geckos and lizards in a variety of microhabitats (walls, ceiling, and floor, including speleothems, cracks, and crevices) throughout the cave. The Andaman Bent-toed Gecko, a ground-dwelling species, is vespertine (active at dusk) and often found in the lower parts of the trunks of native trees (Mohan et al., 2020). We encountered this species between April and July in the dark parts of various cave zones, specifically in cracks and crevices on the walls. Not much is known about the species' breeding season. However, members of *Cyrtodactylus* in Malaysia are known to breed until April (Quah et al., 2021), which may also be the case with the Andaman Bent-toed Gecko. We encountered gecko eggs adhering to the crevices of the cave walls and to the dry parts of the stalagmites. However, we did not find any hatchlings or juveniles in the cave, and we are not certain about the species of the eggs encountered. Mostly, the isolated individuals were encountered. Only in one cave did we record five geckos together in the twilight zone.

Besides the Andaman Bent-toed Gecko, only the Flat-tailed House Gecko was seen on two separate occasions in a cave on Baratang Island. This species has an extensive geographic distribution, with its range centered in Southeast Asia (Mahony and Ali Reza, 2007). It has also been reported from the Andaman and Nicobar Islands. While primarily considered synanthropic species, there are growing reports of *Hemidactylus* species utilizing subterranean habitats across their range. For example, in the Zagros Mountains of Iran, multiple *Hemidactylus* species, including *H. persicus*, have been documented

Table 1. Herpetofauna recorded from the caves of North and Middle Andaman Islands.

Sr. No.	Species Name	IUCN Global Assessment	Wildlife Protection Act, 1972 Status	Study Sites			Zone	Micro-habitat	Activity	Endemicity	Abundance/ Population Trend (Based on IUCN Red List)
				Baratang Island	Interview Island	Chalis-Ek					
				Family: Bufonidae							
1	Common Asian toad (*Duttaphrynus melanostictus*)	Least concern	Not mentioned	✓	✓	✓	Entrance twilight dark	Speleothems, Bat and Bird guano	R, F	Non-endemic	Common/ stable
2	Andaman bush toad (*Blythophryne beryet*)	Vulnerable	Not mentioned	✓	X	X	Entrance twilight	Leaf litter, Boulder	R	Endemic	Common/ stable
				Family: Dicroglossidae							
3	Andaman wart frog (*Minervarya andamanensis*)	Least concern	Not mentioned	✓	✓	X	Dark	Cave wall/rock	R	Endemic	Common/ stable
				Family: Microhylidae							
4	Chakrapani's narrow-mouthed frog (*Microhyla chakrapanii*)	Least concern	Not mentioned	✓	X	X	Dark	Speleothems with flowing water	R	Endemic	Stable
				Reptiles							
				Family: Gekkonidae							
5	Andaman bent-toed gecko (*Cyrtodactylus rubidus*)	Least concern	Not mentioned	✓	✓	✓	Twilight dark	Crevices, Speleothems	R	Endemic	Common/ stable
6	Flat-tailed house gecko (*Hemidactylus platyurus*)	Least concern	Not mentioned	✓	X	X	Dark	Crevices, walls and speleothems	R	Non-endemic	Increasing
				Family: Agamidae							
7	Nicobar forest dragon (*Coryphophylax subcristatus*)	Least concern	Not mentioned	✓	✓	✓	Entrance	Cave floor	R, F	Endemic	Common/ stable
8	Changeable lizard (*Calotes versicolor*)	Least concern	Not mentioned	✓	✓	✓	Entrance	Cave floor	R, F	Non-endemic	Common/ stable
				Family: Scincidae							
9	Spotted forest skink (*Sphenomorphus maculatus*)	Least concern	Not mentioned	✓	X	X	Twilight dark	Speleothem	R	Non-endemic	Common/ stable
10	Andaman grass skink (*Eutropis andamanensis*)	Least concern	Not mentioned	✓	X	X	Twilight	Leaf litter, fallen branches, rock debris	R	Endemic	Stable
11	Christmas Island grass-skink (*Subdoluseps bowringii*)	Least concerned	Not mentioned	✓	X	X	Twilight	Leaf litter, fallen branches, rock debris	R	Non-endemic	Stable

Continued

Table 2. *Continued*

					Family: Varanidae							
12	Water monitor lizard (*Varanus salvator*)		Schedule I	✓	X	X	Twilight, Entrance	NA	F	Subspecies-Endemic	Common/unknown
					Family: Viperidae							
13	Anderson's pit viper (*Trimeresurus andersonii*)	Least concern	Schedule II	✓	X	✓	Entrance	Crevice	R, F	Endemic	Common/stable
					Family: Colubridae							
14	Red-tailed racer (*Gonyosoma oxycephalum*)	Least concern	Not mentioned	✓	✓	X	Entrance, twilight	Cave wall	F, R	Non-endemic	Common/decreasing
15	Andaman wolf snake (*Lycodon hypsirhinoides*)	Least concern	Not mentioned	X	X	✓	Entrance	Cave wall/rock	R	Endemic	Common/unknown
16	Yellow-striped trinket snake (*Coelognathus flavolineatus*)	Least concern	Not mentioned	✓	X	X	Dark	Crevice	R	Non-endemic	Stable

Figure 4. Amphibian species recorded from limestone caves of the Andaman Islands: (a) Common Asian toad (*Duttaphrynus melanostictus*), (b) Andaman bush toad (*Blythophryne beryet*), and (c) Chakrapani's narrow-mouthed frog (*Microhyla chakrapanii*).

within 15 different caves alongside other cave-adapted geckonids and phyllodactylids, emphasizing the genus's ecological flexibility and tendency to exploit sheltered cave-like environments (Esmaeili-Rineh et al., 2016). Similarly, cave-associated populations of *H. lemurinus* have been recorded in coastal cliff habitats such as the "Marneef Cave" in Dhofar, Oman, where individuals were observed using rock crevices and moist cavities influenced by marine spray, reinforcing their adaptation to dim, humid environments that mimic subterranean conditions (Quah et al., 2021). Although the flat-tailed house gecko is not generally considered a troglophile, its presence in the caves of Baratang Island suggests occasional subterranean refuge-seeking behavior, likely driven by humidity, prey availability, or microclimatic stability.

Among the Agamidae, the Nicobar Forest Dragon and the Changeable Lizard are often sighted in the entrance and twilight zones of the caves on Baratang Island. These sympatric species are generally arboreal and occur primarily in the rainforest. The Nicobar Forest Dragon is abundant on the islands and comprises the major lizard biomass in the rainforest (Harikrishnan et al., 2012). In the Philippines, lizards are documented to use cave habitats for breeding, foraging, and roosting (Maglangit et al., 2021). However, we did not record lizards breeding in the caves in the Andaman Islands, but it is probable. Detailed exploration is required to determine whether the lizards use the cave habitats for breeding.

A camera trap captured a Common Water Monitor lizard repeatedly visiting a cave over three days, and browsing, indicating the occasional use of subterranean habitats for foraging or refuge. This was the only observation of the family Varanidae made during this study. Other parts of Southeast Asia, such as Batu Caves, have documented the water monitor and four other lizard species using subterranean habitats (Teo et al., 2023).



Figure 5. Morphs of *Minervarya cf. andamanensis* observed during field surveys in the Andaman Islands. The morphs shown represent only a subset of the species' phenotypic variation.



Figure 6. Squamate reptiles recorded from limestone caves of the Andaman Islands: (a) Andaman bent-toed gecko (*Cyrtodactylus rubidus*), (b) Nicobar forest dragon (*Coryphophylax subcristatus*), (c) Changeable lizard (*Calotes versicolor*), (d) Spotted forest skink (*Sphenomorphus maculatus*), (e) Andaman grass skink (*Eutropis andamanensis*), and (f) Common water monitor lizard (*Varanus salvator andamanensis*).

The Spotted Forest Skink was observed in the entrance and twilight zones, crawling on various features within the limestone caves on Baratang Island. Later, between 2024 and 2025, the Andaman Grass Skink and Christmas Island Grass Skink were encountered in the Baratang caves. They were observed in the entrance and twilight zones amid leaf litter, broken twigs, and fallen branches. In the Hinophopan Cave in the Philippines (Maglangit et al., 2021), skinks were seen actively foraging inside caves. They were observed feeding on ants, crickets, and small arthropods near the entrance and twilight zone, and they often basked at the cave's opening (Maglangit et al., 2021).

CONCLUSION

This study is the first attempt to document the occurrence of herpetofauna in the limestone caves of the Andaman Islands.

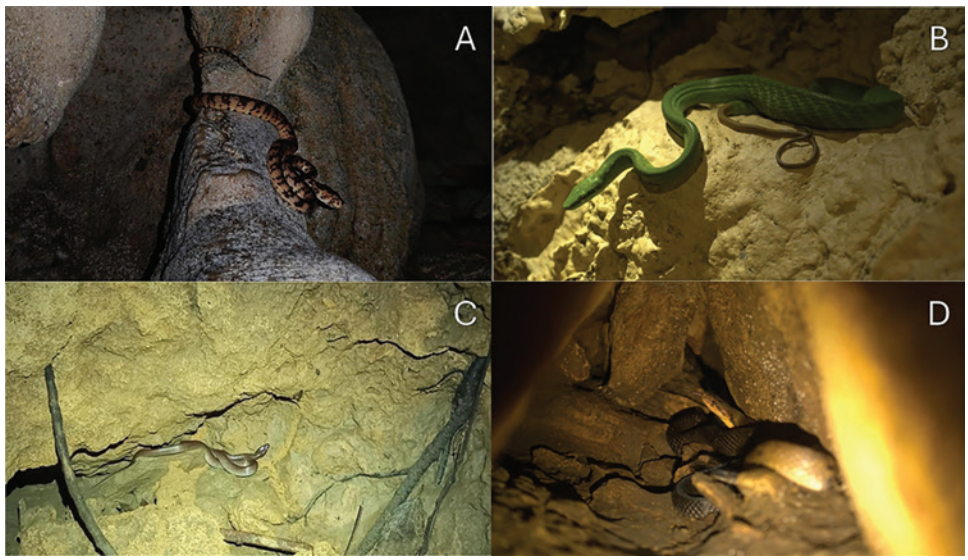


Figure 7. Snake species (Serpentes) recorded from limestone caves of the Andaman Islands: (a) Anderson's Pit Viper (*Trimeresurus andersonii*), (b) Red-tailed Racer (*Gonyosoma oxycephalum*), (c) Andaman Wolf Snake (*Lycodon hypsirhinoides*), and (d) Yellow-striped Trinket Snake (*Coelognathus flavolineatus*).

The caves are recognized as a significant habitat for the herpetofauna. The findings emphasize the subterranean habitats as a refuge for the herpetofauna of these unique tropical islands of India. We recommend conducting herpetofauna-focused cave studies, with special attention to the endemic species for targeted behavior and population abundance studies. We strongly appeal for conservation measures.

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