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**ORIGINAL ARTICLE**

## **Serpentine Riches: An In-depth Analysis of Snake Species Diversity in Shivamogga Urban Ecosystem**

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### **ABSTRACT**

*India, one of 17 mega-diverse nations, encompasses 2.4% of the Earth's land area but harbors 7-8% of global species diversity. Across its ten bio-geographic regions, India boasts 91,000 animal species and 45,500 plant species, illustrating its significant biodiversity. However, biodiversity is currently declining globally at alarming rates. Throughout evolutionary history, reptiles, particularly snakes, have been prominent. Snakes, among the most widely distributed vertebrates globally, primarily favor arid zones in terms of diversity. Globally, fear about snakes often drive people to kill them upon encountering them, irrespective of the situation, contributing to their widespread persecution. Shivamogga is located in the Mid-Western Ghats and is home to a wide variety of flora and fauna. The primary aim of this study is to assess diversity of snake within the urban area of Shivamogga. The findings of this study indicate that a total of 29 snake species have been documented in Shivamogga City. Among these, 7 species are venomous, posing potential danger to human health, while the remaining 22 species are non-venomous. This suggests a considerable diversity of snake species within the urban area, with a notable presence of both venomous and non-venomous varieties. These results underscore the importance of understanding and managing snake diversity in urban environments to ensure human safety and coexistence with wildlife.*

**Keywords:** Snakes, Venomous, Non-Venomous, Western Ghats, Biodiversity, Conservation

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### **INTRODUCTION**

All living things on earth are included in the term biodiversity, which refers to their variety and variability. India is one of the world's 17 megadiverse countries, with 2.4% of the landscape mass and 7-8% of the world's species. Out of the 34 "global biodiversity hotspots" four of the hotspots exist in India [1]. Biodiversity has been declining at unprecedented rates throughout the world. The impacts of biodiversity loss on small organisms are mainly undefined due to a lack of baseline data [2]. In the history of biological evolution, reptiles have played a significant role. One of the most widespread and most successful living vertebrate species in the world is the snake [3]. The snakes are distributed in various kinds of habitats that include grasslands, wetlands, forests, scrublands, deserts, sea, agriculture fields and around the residential areas. The snakes are carnivorous in nature mostly feed on rodents, amphibians, birds, mammals, all reptiles, insects and eggs. It shows that these vertebrates have different patterns of food selection in nature. Hibernation and aestivation are well-known behaviors of snakes; it is possible due to their ability to survive without feeding for long duration [4].

The Indian Cobra, Common Krait, Russell's viper and Saw Scaled viper called as big four venomous snakes found in India. Snakes are considered as farmer's friends because these organisms naturally hunt harmful rodents and insects in agricultural areas, but in India the lack of awareness among the people in rural area and urban areas hundreds of snakes are killed by the people [5]. Venomous snakes have a venom apparatus in the mouth that includes a pair of fangs, which are a highly effective structure that helps the snakes to immobilize their prey [6]. There are many regional, local and common names of snakes

throughout India and the world but the scientific name doesn't change. Some species of snake may show little or major varied colour pattern with change in habitat. However, the body colouration, shape and size of scales on head, abdomen and dorsal body surface, shape of tail, presence of special features on the head region are some of the important features taken into account in differentiating the snake species and that has immense importance in the classification of snakes [7].

Most of the people fear and hate snakes all over the world and their complete lack of information about snakes leads people to kill them, no matter when and where they are encountered [8]. Due to human mistake of careless work in the agriculture fields without protection measures the snake bite happens. Without knowing the snake species as venomous or non-venomous it is killed [9]. Due to habitat destruction, scarcity of prey animals, pollution, road kills, collection of venom from snakes, animal trafficking, to pet the snakes, snake shows by charmers and use in black magic are the major threats for the survival of snakes.

Information on urban sites where snakes are more likely to be found is important not only for conservation, but also to help local citizens for better understand and live amongst snakes [10]. Therefore, it needs continuous monitoring on diversity and distribution of snakes in an ecosystem. Present study was aimed to determine the diversity of snake species in and around Shivamogga Urban area.

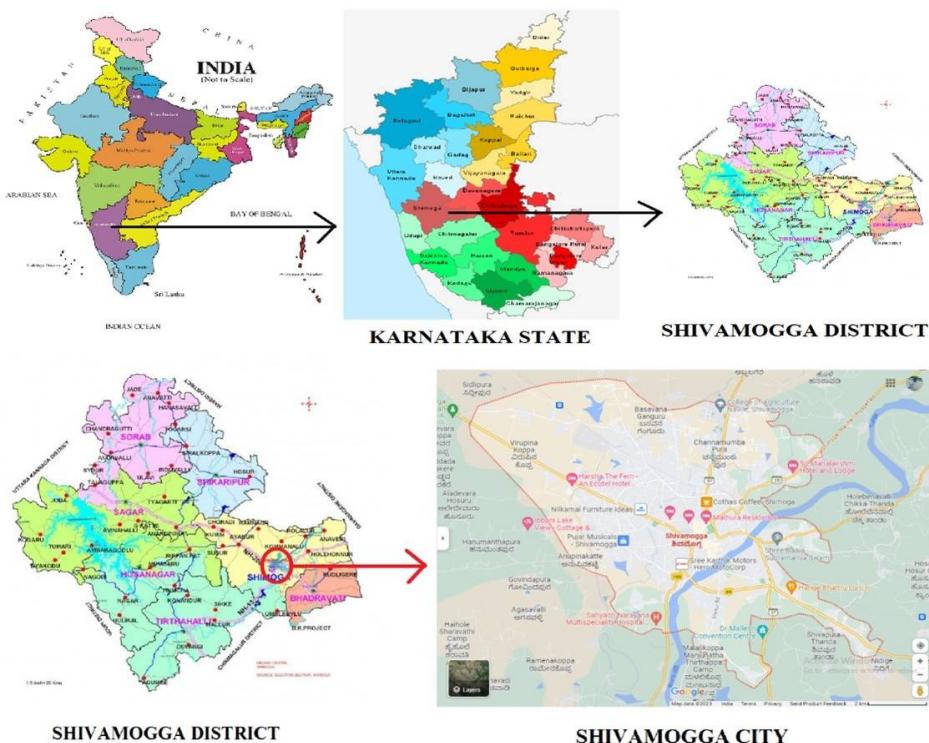
## MATERIAL AND METHODS

### Study Area

Shivamogga district is an integral part of the Malnad region of Karnataka and it is also named as the "Gateway to Malnad". Shivamogga is located in the Mid-Western Ghats and is home to a wide variety of flora and fauna. It is situated on the banks of the Tunga River and about 571m above sea level. According to the Shivamogga City Municipal Corporation, the city has a total area of about 50 square kilometers (Figure 1).

The climate is tropical wet, dry and summer average temperature 20°C–35°C. This means that the winter and the early part of summer are typically dry periods. The majority of the rainfall occurs between June and early October. April is the warmest month with an average high temperature of 35.5°C. Coldest months are July, August, November and December with average high temperature of 27°C. In summer (April–May), temperature crosses 36°C at Shivamogga.

**Figure 1. Map showing study area, Shivamogga urban area.**



## Sampling Methodology

The presence of snake diversity was actively observed for a complete annual cycle from November 2021 to November 2023, covering all the seasons. The observations were made by Visual Encounter Survey through randomized walk along with an active searching method. Snake species observed and identified during rescue attempts will also be included in the data compilation process. The visualized specimens are identified using standard literature. After identification and necessary measurements, they were released back to their natural habitat.

## RESULT AND DISCUSSION

The urban ecosystem of Shivamogga boasts a diverse array of snake species, representing various families and ecological niches. Among the species inhabiting this region are the *Ramphotyphlops braminus*, known as the Brahminy Worm Snake, characterized by its small size, non-venomous nature, and subterranean lifestyle, primarily feeding on insects and larvae. Elliot's Shieldtail, scientifically named *Uropeltis ellioti*, is another notable resident, distinguished by its burrowing habits and shield-like tail structure, with a diet primarily comprising earthworms. The Indian Rock Python (*Python molurus*), a member of the Pythonidae family, represents one of the largest non-venomous constrictor snakes, commonly found across the Indian subcontinent, preying on mammals, birds, and occasionally reptiles. The Bamboo Pit Viper, Malabar Pit Viper, and Hump-nosed Pit Viper were found in our study area, though they are traditionally endemic to forests. Their presence in the study area is due to habitat loss, fragmentation, and urban encroachment, forcing them to seek food and shelter in cities. Additionally, climate change, prey availability, and urban green spaces attract these snakes, creating suitable habitats in urban environments.

Red Sand Boas (*Eryx jhonii*) are also present, recognized for their heavy bodies and striking red coloration, typically inhabiting sandy habitats and feeding predominantly on rodents. Additionally, a variety of colubridae snakes populate the area, including the Indian Rat Snake (*Ptyas mucosa*), Russell's Kukri (*Oligodon taeniolatus*), Common Banded Kukri (*Oligodon arnensis*) and Common Bronzeback Tree Snake (*Dendrelaphis tristis*), each with distinct characteristics and dietary preferences ranging from rodents and birds to lizards and frogs. These diverse snake species contribute to the ecological balance of the Shivamogga urban ecosystem, playing vital roles in controlling prey populations and maintaining biodiversity (Table 1 and Figure 2).

**Table 1: List of snake diversity observed in the study area during study period**

Sl.No	Scientific Name	Common Name
<b>Family: Typhlopidae</b>		
1.	<i>Ramphotyphlops braminus</i>	Brahminy Worm Snake
<b>Family: Uropeltidae</b>		
2.	<i>Uropeltis ellioti</i>	Elliot's Shieldtail
<b>Family: Pythonidae</b>		
3.	<i>Python molurus</i>	Indian Rock Python
<b>Family: Boidae</b>		
4.	<i>Eryx jhonii</i>	Red Sand Boa
<b>Family: Colubridae</b>		
5.	<i>Coelognathus helena monticollaris</i>	Montane Trinket
6.	<i>Coelognathus helena Helena</i>	Common Indian Trinket
7.	<i>Ptyas mucosa</i>	Indian Rat Snake
8.	<i>Oligodon taeniolatus</i>	Russell's Kukri
9.	<i>Oligodon arnensis</i>	Common Banded Kukri
10.	<i>Dendrelaphis tristis</i>	Common Bronzeback Tree Snake
11.	<i>Lycodon striatus</i>	Barred Wolf Snake
12.	<i>Lycodon aulicus</i>	Common Wolf Snake
13.	<i>Sibynophis subpunctatus</i>	Dumeril's Black-headed Snake
14.	<i>Fowlea piscator</i>	Checkered Keelback
15.	<i>Amphiesma stolatum</i>	Buff Striped Keelback
16.	<i>Amphiesma beddomei</i>	Beddome's Keelback
17.	<i>Marcopisthodon plumbicolor</i>	Green Keelback
18.	<i>Boiga ceylonensis</i>	Ceylon Cat Snake

19.	<i>Boiga beddomei</i>	Beddome's Cat Snake
20.	<i>Boiga forsteni</i>	Forsten's Cat Snake
21.	<i>Ahaetulla farnsworthi</i>	Common Green Vine Snake
22.	<i>Ahaetulla sahyadrensis</i>	Brown Vine Snake
<b>Family: Elapidae</b>		
23.	<i>Bungarus caeruleus</i>	Common Krait
24.	<i>Naja naja</i>	Spectacled Cobra
<b>Family: Viperidae</b>		
25.	<i>Daboia russelii</i>	Russell's Viper
26.	<i>Echis carinatus</i>	Saw Scaled Viper
27.	<i>Hypnale hypnale</i>	Hump Nosed Pit Viper
28.	<i>Trimeresurus malabaricus</i>	Malabar Pit Viper
29.	<i>Trimeresurus strigatus</i>	Bamboo Pit Viper



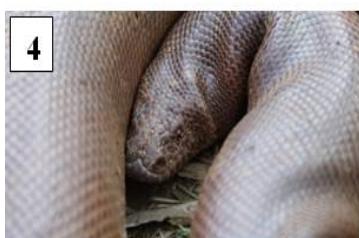
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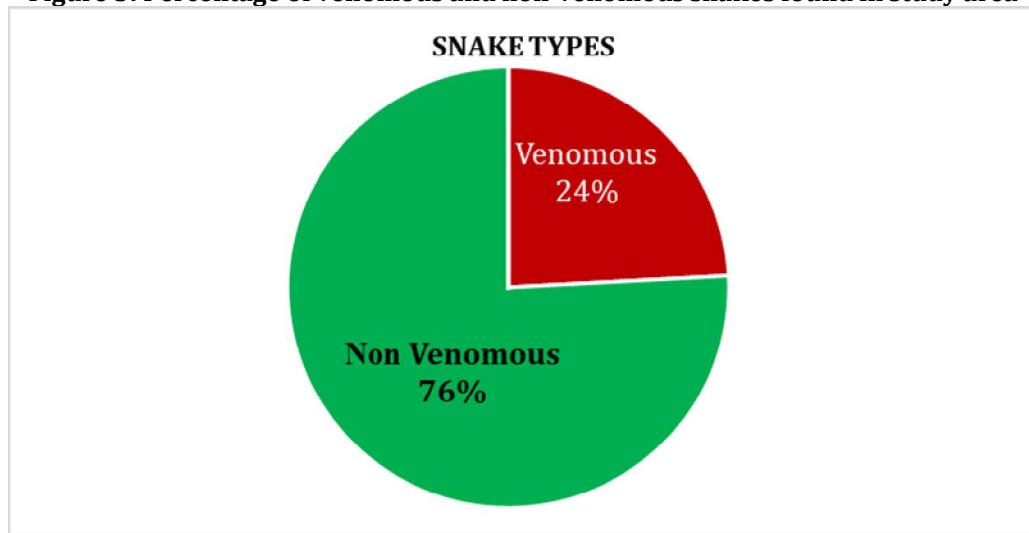


**Figure 2: Diversity of snakes in the study area (Photos taken by author)**

1-*Ramphotyphlops braminus*, 2- *Uropeltisellioti*, 3- *Python molurus*, 4- *Eryx jhonii*, 5- *Coelognathus helena monticollaris*, 6- *Coelognathus helena*, 7- *Ptyas mucosa*, 8- *Oligodon taeniolatus*, 9- *Oligodonarnensis*, 10- *Dendrelaphis tristis*, 11- *Lycodon striatus*, 12- *Lycodonaulicus*, 13- *Sibynophissubpunctatus*, 14- *Fowlea piscator*, 15- *Amphiesma stolatum*, 16- *Amphiesmabeddoe*, 17- *Marcopisthodonplumbicolor*, 18- *Boiga ceylonensis*, 19- *Boiga beddomei*, 20- *Boiga forsteni*, 21- *Ahaetulla farnsworthi*, 22- *Ahaetulla sahyadrensis*, 23- *Bungarus caeruleus*, 24- *Naja naja*, 25- *Daboia russelii*, 26- *Echis carinatus*, 27- *Hypnale hypnale*, 28- *Trimeresurus malabaricus*, 29- *Trimeresurus strigatus*,

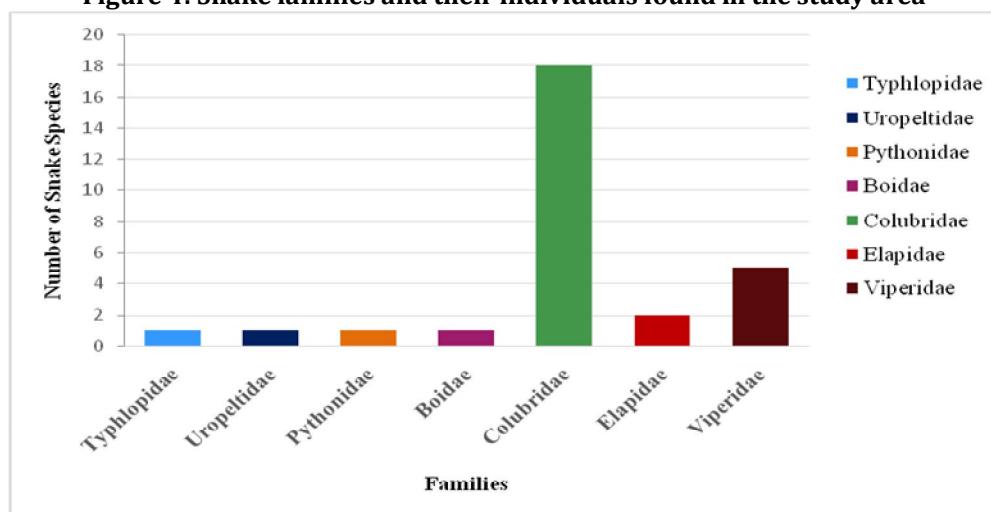
In the observed study area, venomous snakes account for 24% of the snake population, while non-venomous snakes comprise 76%. Venomous snakes possess specialized venom glands for hunting and defense, playing critical roles in regulating prey populations and ecosystem balance. Conversely, non-venomous snakes lack venom-producing glands and typically subdue prey through constriction or other means. Understanding this distribution is crucial for assessing ecological dynamics, human safety measures and conservation efforts in the studied ecosystem (Figure 3).

**Figure 3: Percentage of venomous and non-venomous snakes found in study area**



The study area exhibited a diverse array of snake families, with a single species each observed from Typhlopidae, Uropeltidae, Pythonidae, and Boidae. Additionally, a significant presence of Colubridae was noted, with 18 species observed, highlighting the family's prevalence and diversity. Furthermore, the study identified two species from Elapidae, a family known for its venomous members such as cobras and krait snakes, indicating the presence of venomous species in the area. Viperidae, another venomous snake family encompassing vipers and pit vipers, was represented by five species. This comprehensive survey underscores the richness of snake diversity within the study area, providing valuable insights into local ecosystems and informing conservation strategies (Figure 4).

**Figure 4: Snake families and their individuals found in the study area**



## CONCLUSION

India's significant biodiversity, with its rich array of animal and plant species across diverse biogeographic regions, underscores the importance of conservation efforts. The prominence of snakes, particularly in arid zones, highlights the need for understanding and mitigating human-snake conflicts to safeguard both species. The study in Shivamogga City emphasizes the urban wildlife diversity, particularly the presence of numerous snake species, including venomous ones. These findings emphasize the necessity of informed management strategies to ensure human safety while promoting coexistence with urban wildlife. Overall, this highlights the urgent need for comprehensive conservation measures to protect India's diverse ecosystems and the species that inhabit them.

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