

**HUMAN-SNAKE INTERACTIONS IN UTTAR  
PRADESH, INDIA: PEOPLE PERCEPTION, ATTITUDE  
AND KNOWLEDGE ANALYSIS AND STUDY OF THE  
ASSOCIATED DETERMINANTS**

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## **SUMMARY:**

Snake populations have been declining in the recent years due to increasing cases of human-snake interactions and the negative perception and attitude of people towards snakes. This negative mindset leads to mortalities of snakes. The lack of knowledge in people regarding snakes and the snake-bite management and prevalence of myths and fraud influencers has also led to the mortalities of humans. We designed a cross-sectioned survey using a semi-structured questionnaire to check people's knowledge, perception and attitude towards snakes in Uttar Pradesh province of India. The questionnaire also checked the influence of snake-charmers and myths on people. There were 650 respondents who participated in our study. Majority of respondents (94.46%) respondents reported that they had encountered snakes in their area. 66.15% respondents reported that most snakes were encountered in bushes and forested areas. 60% respondents said that most snake encounters occurred in monsoon. Many people did not know the correct species identification and 56.15% respondents marked Indian Rat Snake (*Ptyas mucosa*) as venomous. 17.23% people knew at least one snake-bite victim and most people did not know the correct first-aid methods and they adopted methods such as using a torque or making a cut on the bite-spot with a blade. Our results show that near to 85% of respondents were not interested in snake charmers and their shows. According to the respondents, on an average they have witnessed 47.60% downfall in the population of snake-charmers from 2010-21. We identified 31 myths as suggested by the respondents. 253 (38.92%) respondents stated that they do not like snakes. Despite the fear, 550 (84.62%) respondents said that snakes are important for ecosystem and nature. 244 respondents reported that they contact forest department on encountering snakes out of which 221 (34.07%) respondents reported that it responds on time only sometimes, 112 (17.26%) respondents reported that the department does not respond on time. It is hence suggested that snake-bite management and species identification must be taught to students as a part of their syllabus. Awareness campaigns must be done regularly. Medical facilities must be cost-efficient and easily accessible especially for rural population and must also have well-trained staff. Forest department must have well trained rescue staff and should be more vigilant and active in taking up rescue calls.

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Worm Snake ( <i>Indotyphlops braminus</i> ) and four venomous species – Spectacled Cobra ( <i>Naja naja</i> ), Russell’s Viper ( <i>Daboia russelii</i> ), Saw-Scaled Viper ( <i>Echis carinatus</i> ), Common Krait ( <i>Bungarus caeruleus</i> ). (n=650).....	14
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# 1. INTRODUCTION

Increasing populations of human, climate change, development and rapid urbanization has led to the sharp declining of wildlife populations and their habitats at an alarming rate (Kinnaird et al. 2003; Root et al. 2003; Carrete et al. 2007; Gusset et al. 2009). Due to the conversion and degradation of natural habitat, the wildlife is shifting into the human settlements, causing the human-wildlife interactions to increase. These interactions often occur due to the ecosystem services provided by human habitation (Soulsbury and White 2016; Jadhav et al. 2018; Maller and Farahani 2018) which attracts wildlife into urban areas. Wildlife populations get attracted to human settlements, urban or rural, mostly due to improved shelter, poor waste management, recreational gardening, favorable land cover and recreational water bodies which are also capable to maintain some wildlife populations (Ackley et al. 2015). Consequent human-wildlife interactions, if not managed properly on time, may lead to conflict. Conflict may be defined as the interactions between humans and wildlife that result out as negative impacts on the social, economic or cultural life of humans and also on the wildlife populations or environment (Anon, 2005). Among all wildlife, snakes are prime examples of wildlife, who have been getting negatively affected by increased urbanization and environmental degradation (Seigel and Mullin 2009; Bonnet et al. 2016).

## 1.1.IMPORTANCE OF SNAKES

Reptiles and amphibians are considered to be the key indicators of environmental changes (Schlaepfer and Gavin, 2001; Blaustein and Bancroft, 2007). Snakes provide services to the ecosystem in the form of predation (Alves and Filho 2007; Beaupre and Douglas 2009: 245; Herrel and van der Meijden 2014; Willson and Winne 2016). Because of the effectiveness of snakes in the predation of rodents (Pandey et al. 2016), snakes may be regarded as the keystone predators (Mills et al. 1993; Kotliar et al. 1999) especially in grassland and agricultural ecosystems. Snakes, thus provide benefits to humans by preying upon unwanted insects and rodents in food stores and crops (Magige 2012). The venom is used for biomedical research and producing life-saving antivenin along with other medicinal products (Magige 2012).

## 1.2.CO-EXISTENCE WITH HUMANS

Humans and snakes cohabitate rural as well as urban environments in many parts of the world (Butler et al. 2005; Gayen et al. 2017). Usually, the snake and human habitats are not delineated in developing countries due to increasing urbanization, migration of people, and hunting practices (Bitanyi et al. 2012). Residential areas however, are typically the most frequent sites of human-snake encounters (Purkayastha et al. 2011). Farms, forests and public places are some other locations for high human-snake encounters. In terms of human-snake conflict, there are many different outcomes in form of animal death, human death, injuries to people, injuries to snakes (Magige, 2012).

## 1.3. SCENARIO OF SNAKE-BITES AT GLOBAL AND LOCAL SCALE

Snakes are responsible for a numerous bites and deaths as well as cases of permanent physical handicap (Nonga and Haruna 2015). Incidences of snake-bite vary on a geographical and temporal scale, as a result of the interaction of anthropic (Harrison et al., 2009; Mise et al., 2016) and environmental (Chaves et al., 2015, Ferreira et al., 2020) drivers. Snake bite incidences are among the cause of morbidity and mortality among pastoralists, farmers, children and hunters and are typically common in rural areas (Maregesi et al., 2013). Snakebite envenoming is a public health problem which affects more than 2.5 million people globally (Malhotra et al. 2021) of which, up to 2 million people are envenomed by snakes each year in Asia itself (WHO 2021). Although, the statistical scenario on mortality and envenomation by snakebite in India has remained imprecise since long (Rai et al. 2021), it is estimated by WHO that India has the highest snake bite mortality in the world (Singh & Singh, 2013). India experiences an average of 58,000 snakebite cases annually (Suraweera et al. 2020). In Uttar Pradesh, 359 people lost their lives to snake bite in 2018. Snake bite was first recognized as a neglected tropical disease in 2009 by the World Health Organization (WHO, 2010). Venomous snakes have been divided into two categories by WHO; Category one includes snakes of highest medical importance, including common and/or widespread highly venomous snakes, that cause numerous snakebites that result in death or disability (WHO, 2018). Category two includes secondary medically important snakes; These include snakes that can cause morbidity, death, or disability, but the exact epidemiological or clinical data is lacking for them and/or because of their behavior, activity cycles, remote locations, habitat preferences or small range sizes are less implicated in snakebite. Approximately 5.80 billion people live within the range of Category one species, while 5.53 billion people live within

the range of Category two species (Malhotra et al. 2021). An ambitious goal of reducing the incidence of death and disability from snakebite by 50% by 2030 by the World Health Organization.

#### 1.4. THREATS TO SNAKE CONSERVATION

Despite their importance for humans and ecosystem, some species of snakes are facing threat. A total of 185 snake species are listed in the IUCN red list of threatened species (IUCN 2013). Killing of snakes for food, out of fear or for use in traditional medicine are the various reasons for the enlistment of certain snake species in the IUCN red list (Conant and Collins 1998; Soewu 2008; Pandey et al. 2016; IUCN 2018). Destruction of habitats or anthropogenic habitat fragmentation (Gibbons et al. 2000) and intentional killing of snakes contribute to the declining snake population (Godley and Moler 2013; Whitaker and Shine 2000). Due to inadequate survey research especially in developing countries, there is poor awareness of the conservation status of snakes (Pandey et al. 2016). Many local as well as international laws have been enacted in order to protect wildlife. However, these laws lack in protecting snakes in their natural environments (Czech et al. 1998; Trouwborst et al. 2017). Zoos and wildlife parks conserve only a small population (Conway 2011) and few species of snakes. Snakes have been listed as scheduled species in Indian Wildlife Protection Act 1972 which is administered by the Forest Department (Roshnath et al. 2018).

#### 1.5. EFFECTS OF CULTURE AND MYTHS SNAKE CONSERVATION

Snakes are generally avoided by humans, yet they bear an importance, extending beyond survival, into the realm of culture (Nonga and Harun, 2015). Despite being considered to be symbols of power and worthy of worship worldwide by humans, snakes still remain to be one of the most misunderstood, mistreated, feared or killed animals (Miller 1970; Gordon 1905; Sasaki et al. 2010). Besides being exhibited as performing animals by traditional snake charmers, snakes are used for reverence and worship in some areas (WHO, 2010). Protection of snake populations in the wild gets hampered due to cultural beliefs, especially myths, as well as due to the poor knowledge of snake classification based on venomosity and that of the laws for their conservation (Prokop et al. 2009; Ballouard et al. 2013). Being afraid of snakes is a natural human behavior (Nonga and Haruna 2015). Some of the factors that contribute to the negative perception of snakes by man are the unappealing skin coloration of snakes and the innate, protective, evolutionary adaptation of the human brain, which influences the basic human emotions (Prokop and

Fancovicova 2013; Prokop and Randler 2018; Prokop et al. 2018). One of the major contributing factors for the negative impact of snakes in human mind is the fear of getting bitten by them.

In this study, we aim to highlight the perception and attitude of people towards snakes, the possible determinants of people's attitude and the effects of people's perception on the lives of snakes and their conservation. With this study, we aim at providing suggestions to develop a positive perception for snakes among public by pointing out the aspects which need to be highlighted and emphasized upon while conducting awareness programs. The study would also be helpful in identifying the need of awareness in different sectors of public and the underlying or hidden aspects which need to be clarified for public so that they do not cause an ill-perception in the minds of people. Also, the study would aid in achieving a better framework to gradually subside and eventually mitigate the human-snake conflict, such that neither the humans, nor the snakes are harmed from each other.



## 2. MATERIALS AND METHODS

### 2.1. STUDY AREA

The study was carried out in the Uttar Pradesh province (28.207609° N and 79.826660° E) of India. Having a total area of 240,928 square kilometers (93,023 square miles), Uttar Pradesh is the fourth-largest state in terms of land area covering around 7.3% of total land cover of India. It is situated in the northern spout of India and shares an international boundary with Nepal and Himalayas border at northern edge. Most of the state area is covered by Indo-Gangetic plains. The southern side of the state has smaller Vindhya range and plateau region. Uttar Pradesh has a hard rock strata and a varied topography of hills, plains, valleys and plateaus. The state has a forest cover of 6.1% of total state area along with cultivable area of 82% of total geographic area but net sown area covers only 68.5% of cultivable area (NITI Aayog 2021).

#### 2.1.1. Climate

The climate of the state is humid subtropical climate. Winter tends to start with commencement of October with retreating monsoon, and reaches to its peak in January and February. Summer starts from March and lasts till May and monsoon arrives in June and starts retreating by the end of September. Temperature in summers can reach up to 50°C and can fall below the freezing point in winters; average annual rainfall can vary from 170 cm in hilly areas to 84 cm in the western Uttar Pradesh (NRI Department, Government of Uttar Pradesh 2021).

#### 2.1.2. Flora:

The state provides habitat for 4.2% of all Algae, 6.4% of Fungi, 6.0% of Lichens, 2.9% of Bryophytes, 3.3% of Pteridophytes, 8.7% of Gymnosperms and 8.1% of Angiosperms (UPSBB 2019).

#### 2.1.3. Fauna:

Uttar Pradesh provides ecosystem services that attract a diverse wildlife population. This mechanism is described as synanthropization (Falinski 2000; Zawadzka and Zawadzki 2014). Most common birds of the state are doves, peafowl (*Pavo cristatus*), red junglefowl (*Gallus gallus*), black petridges, house sparrow (*Passer domesticus*), vultures (Lepage 2022) parakeets, quails, bulbuls, kingfishers, etc. Mammals such as Royal Bengal Tiger (*Panthera tigris tigris*), Leopard (*Panthera pardus*), Asian Elephant (*Elephas maximus*), Indian One-horned Rhinoceros

(*Rhinoceros unicornis*), Sloth Bear (*Ursus ursinus*), Gangetic Dolphin (*Platanista gangetica*), Spotted deer (*Axis axis*), Sambhar deer (*Rusa unicolor*), Swamp deer (*Rucervus duvaucelii*), several species of smaller mammals such as Indian crested porcupine (*Hystrix indica*), mongoose, civets, hares, etc. also add to the faunal biodiversity (Sinha 1994). The state is a home for diverse reptilian and amphibian fauna as well which includes several species of snakes, lizards, toads, turtles, Mugger (*Crocodylus palustris*) and Gharial (*Gavialis gangeticus*) (Kannaujia et al. 2017). The fauna of the state also covers several insect species and provides an attraction for the butterfly enthusiasts.

#### 2.1.4. People:

Uttar Pradesh is divided into 18 divisions and 75 districts with the state capital being Lucknow. Total population of the state is 231,502,578 as of 2022 making it the most populated state of India (India Census 2022). The state also has the largest number of people living below the poverty line.

## 2.2. METHODS

We conducted a cross-sectional study to determine the basic knowledge, perception and attitude of people towards snakes and the various determinants of the people's knowledge and perception, in Uttar Pradesh from 1<sup>st</sup> October 2021 to 31<sup>st</sup> December. The study also highlights the level of knowledge of people about snake bite management, identification of species and effect of myths and superstitions on sampled population.

The research was done by conducting a random survey across the state by using a closed-ended, semi-structured questionnaire (APPENDIX-1). The research was conducted on a total of 650 respondents. The socio-economic and demographic variables included: Sex, Age, Education, Locality, Higher Education in Biology or any related field and Occupation. A pre-designed, pre-tested questionnaire was developed in English language. Understanding that majority of the rural population would find difficulty reading English, a copy of the questionnaire was developed in Hindi language as well, which is also the 'state language of Uttar Pradesh'. The efficiency of the questionnaire was tested by a pilot study on 10 people. The questionnaire consisted of five parts:

- Section A – consisting of questions to study the socio-economic and demographic variables of the sampled population, human-snake encounter scenario and knowledge of the respondents regarding snakes and identification of species. Based on our knowledge of rescues conducted across the study area, eleven species of snakes were observed as commonly found snake species in close proximity to humans. Pictures of these species

were used to check people's ability of identifying the venomous and non-venomous species of snakes. The list consisted of: seven non-venomous species – Indian Rat Snake (*Ptyas mucosa*), Checkered Keelback (*Xenochrophis piscator*), Indian Rock Python (*Python molurus molurus*), Common Wolf Snake (*Lycodon capucinus*), Common Sand Boa (*Gongylophis conicus*), Red Sand Boa (*Eryx johnii*), Brahminy Worm Snake (*Indotyphlops braminus*) and four venomous species – Spectacled Cobra (*Naja naja*), Russell's Viper (*Daboia russelii*), Saw Scaled Viper (*Echis carinatus*), Common krait (*Bungarus caeruleus*).

- Section B – consisting of questions to determine the snake-bite scenario and people's knowledge on snake-bite management.
- Section C – contained knowledge questionnaire to determine the myths associated with snakes. The myths were classified into three categories depending upon the number of respondents who marked a certain myth as true. The myths that were marked as true by less than 5% respondents were classified as 'Less Prevalent Myths', >5% and <15% respondents as 'Moderately Prevalent Myths' and >15% respondents as 'Highly Prevalent Myths'.
- Section D – consisting of questions to determine the scenario of people tolerance and snake-charmers in the study area. The mean of the percentage downfall in the population of snake-charmers was calculated by the formula:  $\text{Mean} = \frac{\sum f x}{\sum f}$  where  $x = \frac{(n_1 + n_2)}{2}$ ,  $f$  is the number of respondents ( $n_1$  is the upper limit of the percentage group and  $n_2$  is the lower limit of the percentage group).
- Section E – containing knowledge questionnaire to determine the perception of people towards snake conservation and management of human – snake interactions.

The participants were made aware of the purpose and nature of the study. The respondents were assured of the anonymity and confidentiality of the information provided by them and that the obtained data would be used solely for academic purposes.

### 2.3. DATA ANALYSIS:

The data was compiled using Microsoft® Excel® 2016 MSO (16.0.4266.1001) 64-bit.

### 3. RESULTS AND DISCUSSION

#### 3.1. DEMOGRAPHIC CHARACTERISTICS, HUMAN-SNAKE ENCOUNTERS AND KNOWLEDGE OF RESPONDENTS ABOUT SNAKES

A total of 650 respondents were involved in the study. Number of male respondents (60.00%) outweighed that of female respondents. It was noted that majority of respondents (56.77%) were between the age range 21-40 years and least number of respondents (0.62%) were above 80 years of age. Majority of respondents (53.69%) had received education up to graduation level and least number of respondents (1.24%) had education below high-school. Among them, 57.38% respondents had studied biology as a subject in higher education. More than half of the respondents (56.62%) were students. Except this, most of the respondents (67.38%) were from urban sector and only 32.62% respondents were from rural sector (Table 1). Recent studies revealed that females were less tolerant of snakes than males (Pinheiro et al. 2016; Liordos et al. 2017, 2018) probably due to the complexity of biological and evolutionary roles of natural selection. The immunity to snake venom is found to be higher in the initial age groups, mostly below 25 years of age and the older population i.e., above 65 years of age has been found to be least immune to snake venom (Feitosa et al. 2015). Such examples explain why the demographic study and obtaining a steady outline of the local population is necessary especially for the hospitals and administration, in order to manage snake-bite cases more efficiently.

*Table 1. Demographic characteristics of respondents (n=650)*

DEMOGRAPHIC PARAMETER	CATEGORY	NUMBER(% ) OF RESPONDENTS
Sex	Male	390 (60.00%)
	Female	260 (40.00%)
Age Ranges	20yrs. or below	176 (27.08%)
	21-40yrs.	369 (56.77%)
	41-60yrs.	93 (14.31%)
	61-80yrs.	8 (1.23%)
	Above 80yrs.	4 (0.62%)
Education Level	Below High-school	8 (1.23%)
	High-school	16 (2.46%)
	Intermediate	56 (8.62%)
	Graduation	349 (53.69%)

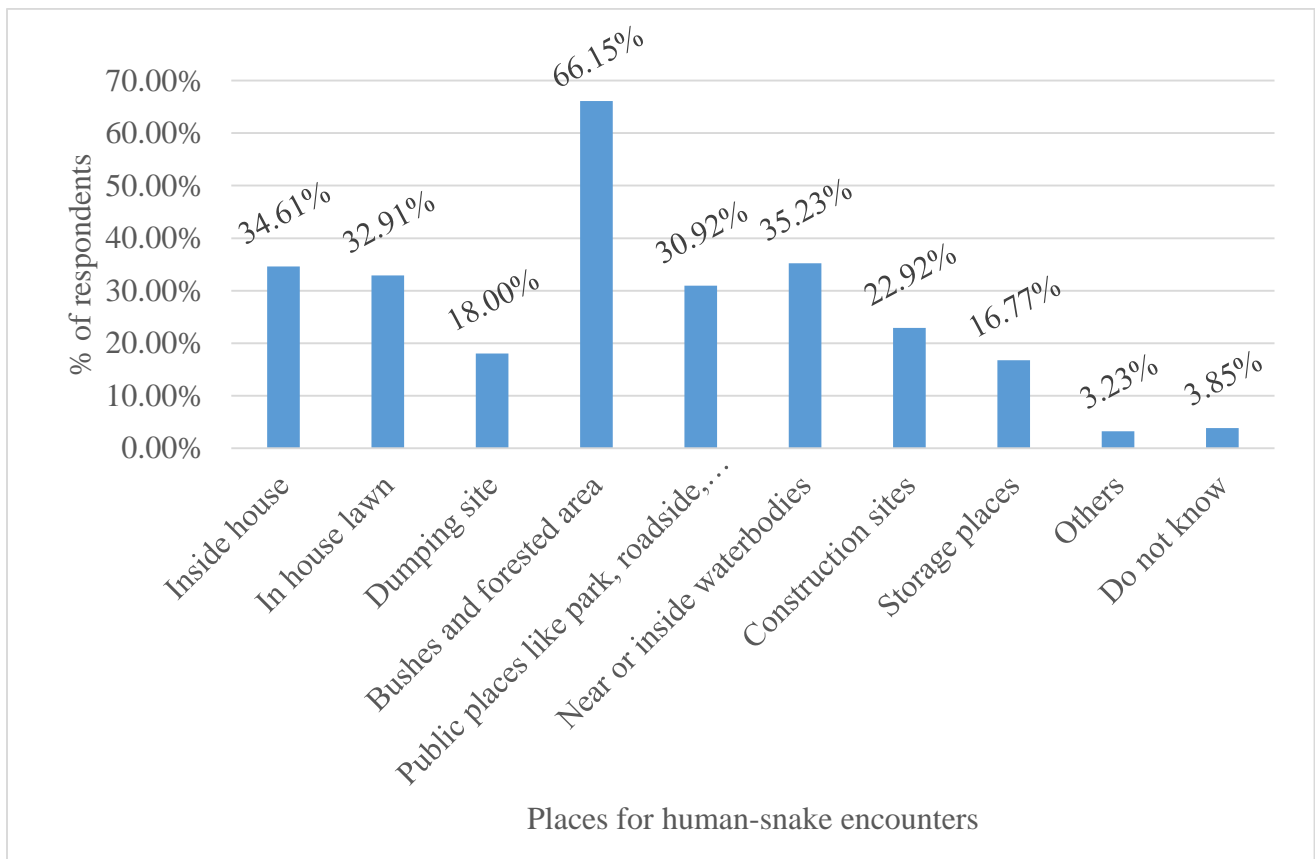
	Post-graduation	177 (27.23%)
	Above Post-graduation	44 (6.77%)
Locality	Urban	438 (67.38%)
	Rural	212 (32.62%)
Occupation	Student	368 (56.62%)
	Educator	23 (3.54%)
	Government service	69 (10.62%)
	Private sector	24 (3.69%)
	Self-employed	44 (6.77%)
	Researcher	24 (3.69%)
	Doctor	20 (3.08%)
	Engineer	30 (4.62%)
	Business	30 (4.62%)
	Farmer	28 (4.31%)
Studied Biology in higher education	Yes	373 (57.38%)
	No	277 (42.62%)

Our study found out that despite of having studied biology in higher education, most people carried wrong knowledge about snakes and have negative perception. This may indicate that school or college studies are not enough to educate people about the much needed and critical aspects of animal science and conservation and the education system also lacks in rationalizing the beliefs and misconceptions in the minds of people, as well as in developing the right mentality and attitude towards conservation.

Majority of the respondents (614; 94.46%) reported that they have encountered snake and 36 respondents (5.54%) reported that they had never encountered snake. Only 36 respondents (5.54%) reported that people encounter snakes very often in their area and 128 respondents (19.69%) reported people encounter snakes less often in their area. However, 262 respondents (40.31%) reported people rarely encounter snakes and, 176 (27.07%) and 48 (7.38%) respondents claimed that people very rarely and never encountered snakes in their area, subsequently.

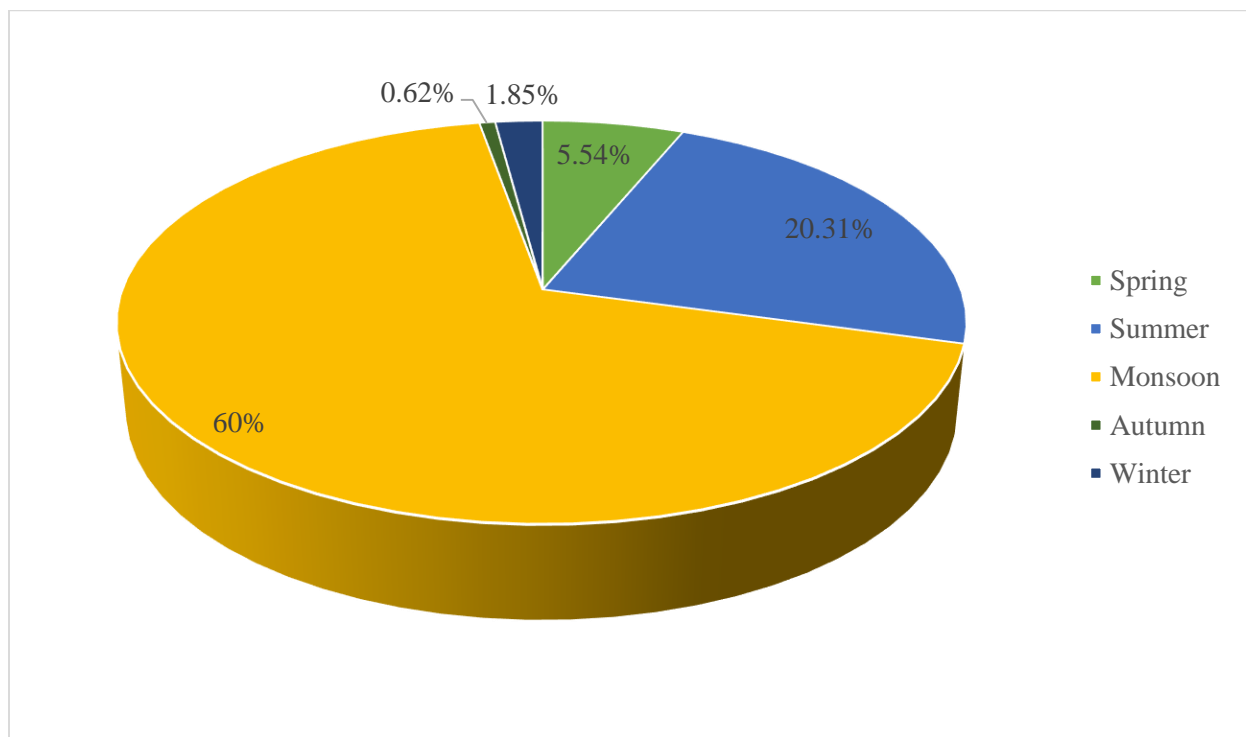
Majority of respondents (66.15%) reported that most of the snake encounters in their area occur in bushes or forested areas. 3.23% respondents encountered snakes at other places (Figure 1), which supports previous research about inter-connection of snake's activity pattern and movement to

season, weather and landscape variables (Yue et al. 2019). Our survey noted that snakes encountered outside forested areas and close to the human settlements are more likely to be killed by humans which supports the findings of Pandey et al. 2016; Shankar et al. 2013 and Marshall et al. 2018. It was also found that houses, house gardens, waterbodies, public places like parks, roadsides, fields, etc. are areas where snakes are encountered to humans often but their presence usually goes unnoticed (Magige 2012). Snakes may even prefer areas with human activity over their true natural habitats in some cases (Shine and Fitzgerald 1996; Clemann et al. 2004; Maller and Farahani 2018). This usually happens due to the ecosystem services provided by humans and their habitation (Soulsbury and White 2016; Jadhav et al. 2018; Maller and Farahani 2018) that tend to attract wildlife to urban areas. Recreational gardening, improved shelter, poor waste management, recreational water bodies and favourable land cover are main feature which attracts and maintains wildlife populations in urban area (Ackley et al. 2015). Dumping sites, construction sites and storage place are places of lesser but evident human-snake encounters.



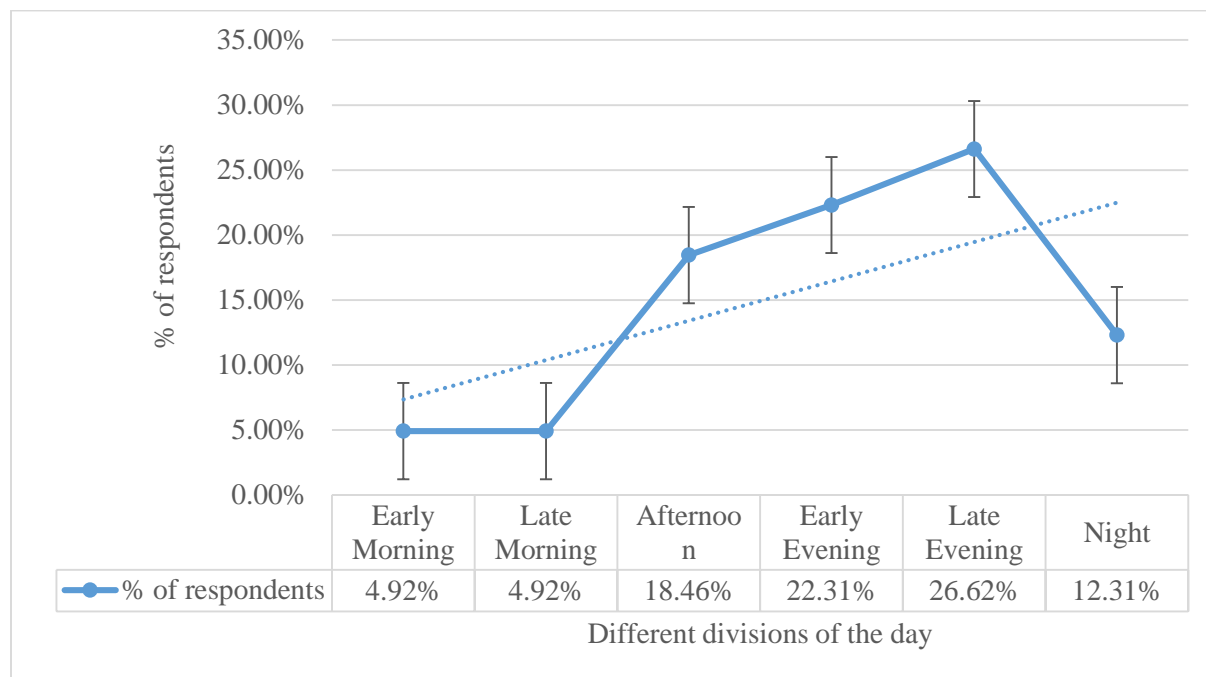
**Figure 1.** Graph shows pattern of snake encounter in different place (n=650)

Monsoon was found to be the season of maximum snake-encounters with 60% of the responses. Autumn was observed as the season of least human-snake encounters (Figure 2). 76 (11.69%) respondents did not have any idea about the season with maximum human-snake encounters in their area. As indicated in Figure 2 the human snake encounters start to rise with spring season followed by summers when they start entering houses usually in search of food during dry season (Nonga and Haruna 2015) whereas during the peak of monsoons because during long rainy season, unable to tolerate extreme cold and wet conditions, snakes enter houses to get warm and dry environment (WHO, 2010). Similar results were found in the studies of Akani et al. (2013) and Sani et al. (2013) who found that maximum snake encounters take place in the months of summer and monsoon. The high incidences of human-snake encounters in monsoons might be as a result of heavy rains flooding of the habitats and residences of the snakes, which forces them to seek shelter in warmer human residences (Babalola et al. 2020). However, there have been incidences reported that human-snake encounters do take place in cold season as well, though not at a high frequency. The snakes encountered in cold season are mostly inside houses or storage places, wherever they can find a good place to hide for brumation.



**Figure 2.** Human-Snake Interactions in different seasons (n=650)

Most of the respondents (26.62%) claimed that they encountered snakes mostly in late evening hours and least number of respondents claimed that they mostly encountered snakes in early morning and late morning hours with only 32 (4.92%) (Figure 3). Snakes are mostly nocturnal predators, and since, at night most people are sleeping, they do not get to witness any snake movement, therefore late evening hours are the hours of most snake-encounters. Since, the morning hours are cold and most predators to snakes are active in the morning hours, hence snakes avoid movement in the morning hours causing less human-snake encounters. The encounters increase when snakes start coming out for basking in the late morning hours and early evening hours (Mukherjee et al. 2018). However, the studies of Spawls et al. 2001 suggest that snakes are typically more active during the warmer months and hours of the day and during cool periods they generally aestivate in burrows, holes, under heaps, etc.



**Figure 3.** Human-Snake encounters at different times of day (n=650)

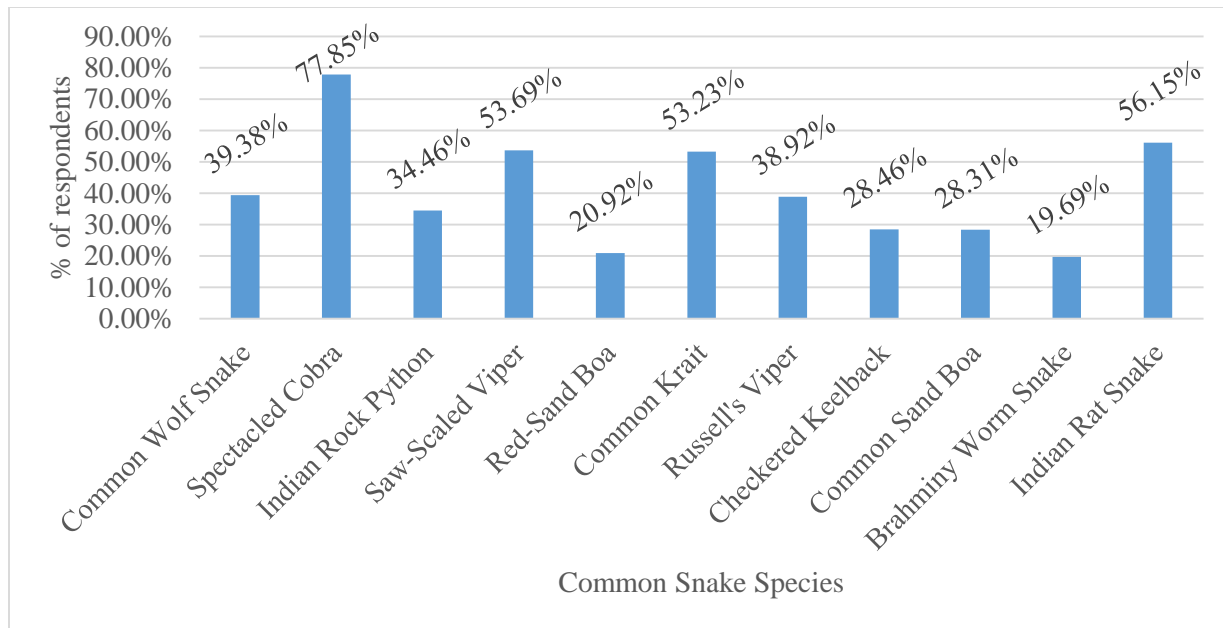
96 (14.77%) respondents believed that all the snakes found in their area were venomous and 554 (85.23%) believed that not all the snakes found in their area were venomous.

Our study clearly found out that people do not have a clear knowledge, as they confuse with similar looking species, which forms another reason for the improper action taken during snake encounter. The poor knowledge of people about species identification can be understood better by Figure 4.



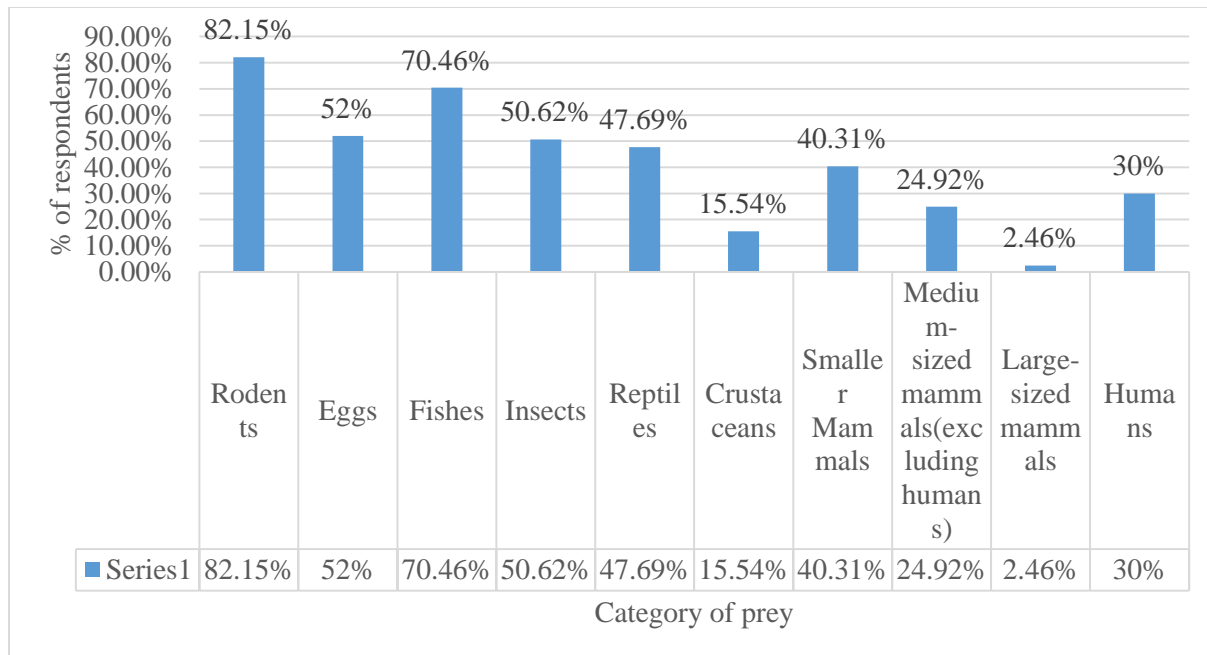
Among the snake species taken as the sample for the survey, people mostly got confused between Spectacled Cobra (*Naja naja*) and Indian Rat Snake (*Ptyas mucosa*), Common Krait (*Bungarus caeruleas*) and Common Wolf Snake (*Lycodon capucinus*), Russell's Viper (*Daboia russelii*) and Indian Rock Python (*Python molurus molurus*) and Common Sand Boa (*Gongylophis conicus*). It was surprising to know that only 253 (38.92%) respondents marked Russell's Viper (*Daboia russelii*) as venomous and only 224 (34.46%) respondents marked Saw-Scaled Viper (*Echis carinatus*) as venomous, however more than half of the respondents (56.15%) marked Indian Rat Snake (*Ptyas mucosa*) as venomous (Figure 4).

In case of a bite from a non-venomous snake, people might either die out of fear thinking that envenomation has taken place. Even if they could identify venomous bite, most of the respondents were unaware about the protocol to follow after the snake-bite. The studies conducted by Alves et al. (2014) and Pandey et al. (2016) who found that fear was the real cause that is hindering snake conservation. Fear of snakes is understandable since they are responsible for a number of bites and numerous deaths as well as cases of permanent physical handicap (Nonga and Haruna 2015). Studies of Devkota et al. 2021 suggest that people readily killed even non-venomous species, such as pythons (*Python spp.*), wolfsnakes (*Lycodon spp.*), and ratsnakes (*Ptyas mucosa*) which emphasized that most people kill snakes on encountering them, irrespective of the snake being venomous or not. Poor awareness in distinguishing venomous and non-venomous snakes might be a cause for this (Babalola et al. 2020).



**Figure 4.** Identification of venomous species among commonly found snake species: seven non-venomous species - Indian Rat Snake (*Ptyas mucosa*), Checkered Keelback (*Xenochrophis piscator*), Indian Rock Python (*Python molurus molurus*), Common Wolf Snake (*Lycodon capucinus*), Common Sand Boa (*Gongylophis conicus*), Red Sand Boa (*Eryx johnii*), Brahminy Worm Snake (*Indotyphlops braminus*) and four venomous species – Spectacled Cobra (*Naja naja*), Russell's Viper (*Daboia russelii*), Saw-Scaled Viper (*Echis carinatus*), Common Krait (*Bungarus caeruleus*). (n=650)

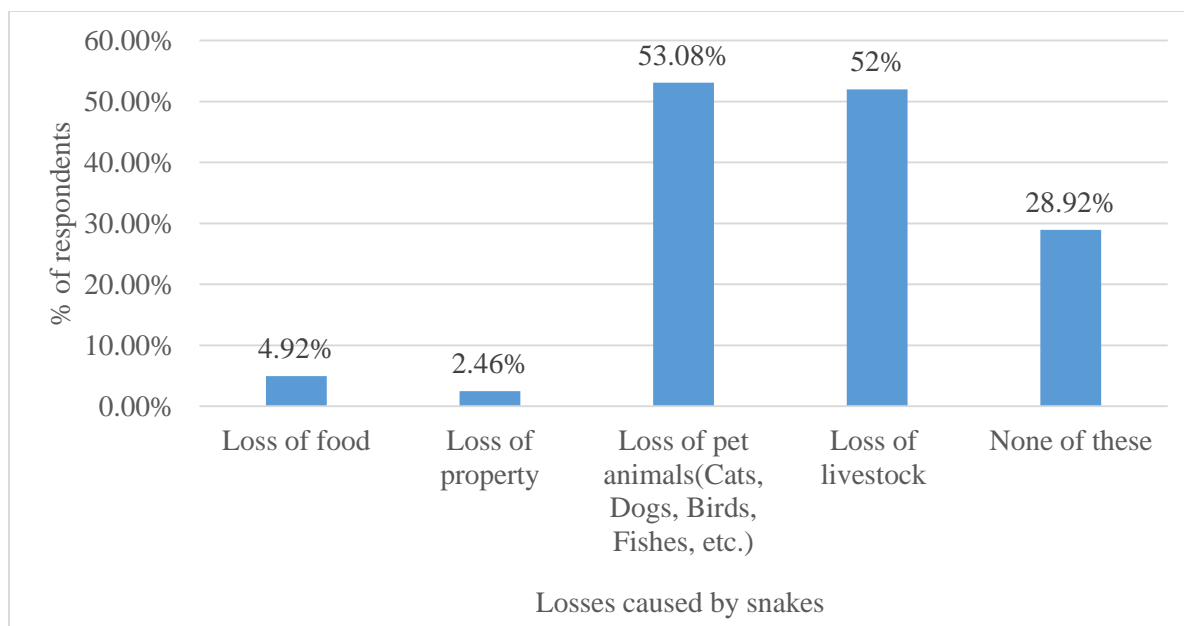
Figure 5 shows that people knew about the diet range of snakes, in which majority of respondents (82.15%) believed that rodents are the prime food of the snakes. Taking into consideration the snakes of all sizes and distribution, the respondents mostly marked the correct options, yet 195 (30%) respondents marked humans as one of the prey of the snakes. People's perception towards big snakes like pythons leads to such misconceptions. Such negative perception of humans being a prey for snakes is another contributing factor for negative actions taken by humans on snakes. Indiscriminate killing of snakes without proper awareness of their importance might lead to their decline in the world, and this might affect the balance of the ecosystem negatively (Babalola et al. 2020).



**Figure 5.** Respondents' knowledge regarding diet range of snakes (n=650)

Only 20 (3.08%) respondents observed that snakes intentionally chase and bite humans, 68 (10.46%) respondents claimed that maybe the snakes intentionally chase and bite us and 562 (86.46%) respondents claimed that they never intentionally chase and bite us. Last group of people also said that snakes do not prey on humans ordinarily and most of them do not attack humans unless they feel threatened, provoked or injured.

Majority of respondents (345) reported that snakes cause loss of pet animals such as cats, dogs, birds, fishes, etc. 338 (52%) respondents reported that snakes cause loss of livestock and 188 (28.92%) reported snakes do not cause any harm other than loss of human life (Figure 6). The results in Figure 6, support the findings of Nonga and Haruna 2015 where all the respondents regarded snakes as dangerous creatures since they cause loss of lives of humans and livestock through venomous bites or constriction. The loss of pet animals and livestock by snakes, especially if the domesticated animal is a source of income for the owner, the situation of a conflict between human and snakes is understood. There have been incidences of predation on livestock animals such as goats, sheep, calves, etc. by pythons in rural areas or the domestic animals dying due to envenomation, which makes the picture of tension created between animal owner and snakes clearer for us.



**Figure 6.** Respondents' knowledge on what harm do snakes cause other than loss of human life (n=650)

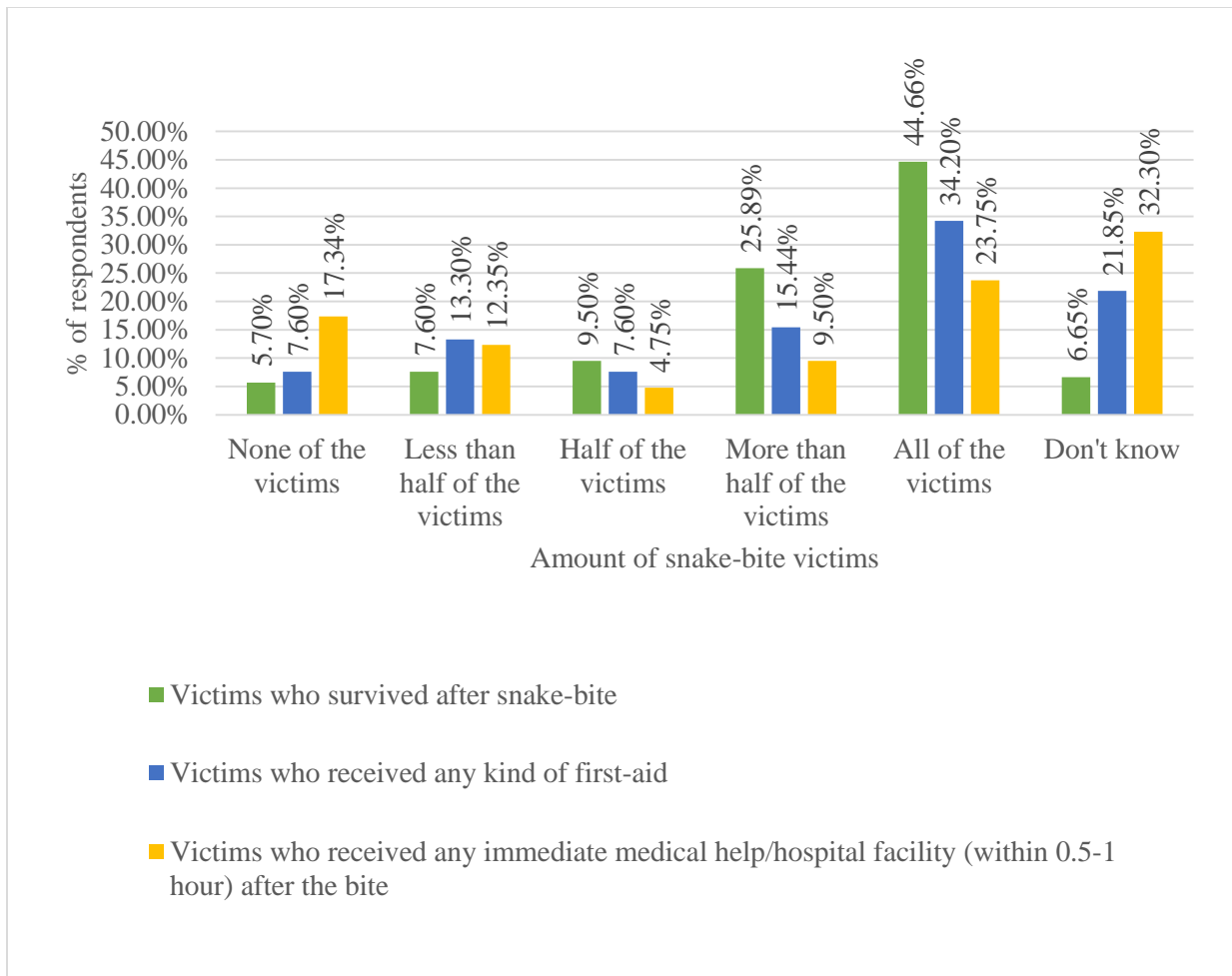
### 3.2. SNAKE-BITE SCENARIO

**Table 2.** Number of snake bite victims whom people know about and identification of the species in case of snake bite (n=650)

VARIABLE	CATEGORY	NO.(%) OF RESPONDENTS
How many people do you know who have been bitten by snake	0	229 (35.23%)
	1	112 (17.23%)
	2	96 (14.77%)
	3	60 (9.23%)
	4	40 (6.15%)
	5	40 (6.15%)
	6	21 (3.23%)
	7	8 (1.23%)
	8	0 (0.00%)
	9	0 (0.00%)
	10	8 (1.23%)
	More than 10 people	36 (5.54%)

Snakebite is fundamentally a socio-ecological process (Goldstein et al., 2021). The probability of snake-bites may vary from place to place, given the circumstances of society and ecology of the place. Snake-bite incidence is not simply a function of relatively higher snake abundance or diversity or higher rural poverty but rather the product of a range of factors such as livelihood,

natural habitat, climate etc. acting at the local scale (Malhotra et al. 2021). Cases of snake-bite are frequent in a human-dominated landscape, especially in the summer and monsoon seasons (Ranjan et al. 2021). Since, acquiring snake bite data is difficult, therefore the data are likely incomplete (Ahmed et al., 2008). Hence, based on the inputs from the respondents, we developed an estimate of the snake-bite cases. Among the respondents, most of them (229; 35.23%) did not know about any person who has been bitten by a snake. The number of respondents kept on decreasing as we increased the number of snake-bite victims whom they knew about from 0-9. 112 (17.23%) respondents claimed to know one snake-bite victim. 8 (1.23%) respondents claimed to know about 10 snake-bite victims and 36 (5.54%) respondents claimed to know about more than 10 victims (Table 2). As the results show in Table 1, total 421 (64.77%) respondents knew or had heard about at least one or more snake-bite victims. Only 37 respondents said that all victims whom they know suffered mortality. Most of the respondents (290; 44.66%) claimed that all of the victims whom they know about survived after the bite. 49 (7.60%) respondents reported that none of the victims received any kind of first-aid and majority of the respondents (222; 34.20%) reported that all of the victims received any kind of first-aid immediately after the bite. 142 (21.85%) respondents did not know whether any first-aid was provided to the victims or not. 113 (17.34%) respondents reported that none of the victim received any kind of medical help/hospital facility within half an hour to one hour after the bite took place and 154 (23.75%) respondents reported that all of the victims received medical help/hospital facility within time. However, majority of the respondents (210; 32.30%) were not aware whether the victims whom they know about received any medical help/hospital facility (Figure 7). Experts agree that snake bite victims should be transported promptly to a medical facility where they should be evaluated by qualified medical practitioners and antivenom should be readily available (Kumar et al. 2015). The mortalities in case of snake-bites largely due to the lack of medical facilities and inadequately trained medical staff (Whitaker & Whitaker 2012). Snake venoms, being complex in composition, are almost infinitely variable. This variation is one of the key obstacles to the design of universal, or at least broad-spectrum, treatments for snakebite envenoming (Gutiérrez et al., 2017; Casewell et al., 2020), which has led to increasing research interest in the causes and mechanisms of venom evolution. This adds to the various reasons of medical facilities, still not being able to completely treat even the simpler cases of snake-bites at times. This results in lack of confidence of public in hospitals and draws their attention to the superstitious methods and rituals for snake-bite treatment.



**Figure 7.** Snake-bite scenario as observed among the snake-bite victims whom the respondents know (n=421)

There have been mortalities reported despite of implementing first-aid methods. This can be due to improper first-aid and treatment and reliance on traditional snake-bite treatment. (Whitaker & Whitaker, 2012). Table 3 lists down the first-aid methods adopted/known by the respondents to manage cases of snake-bite. It is evident from the results that there is a deep lack of awareness regarding snake-bite management and first-aid methods. Time of transport is a crucial determinant in snake bite mortality but rural population being poorly informed, take inappropriate first aid measures and vital time is lost in shifting the patient to the hospital (Kumar et al. 2015).

Since the prevalence of snakebite is the highest in the poorest areas of any given community where snake-human conflict occurs, snake-bites have significant socio-economic repercussions on vulnerable sectors (Mohapatra et al., 2011; Mise et al., 2016; Guti' errez et al., 2017). The poorer

communities cannot afford the medical expenses many a times and hence neglect the idea of carrying the patient to the hospital. In this scenario, where each member of family is earning and is contributing to sustain the family, loss of any such individual can result in a terrible loss for the family in a long term. Compensation scheme run by forest department is one of the important initiatives to support such families for shorter period of time (Roshnath et al. 2018). So, Government of India has passed a bill “Payment of Compensation to Victims of Natural Calamities and Snake Bite Act, 2014” to compensate the victims belonging to three different categories where minimum payment of 200,000 INR would be given in case of death, 50,000 INR in case of bodily harm and insurance scheme for people residing near areas where venomous snakes and snake-bite incidences are more frequent (Rai et al. 2021). Furthermore, in the year 2018, the Uttar Pradesh State Government announced a compensation of 400,000 INR to family members of the victim after including death due to snakebite in the list of state calamities. During our survey, only 173 (26.62%) of the respondents were aware about the monetary compensation that is given by the government in case of a death caused due to snake-bite which shows lack of awareness among society. Earlier, most of the compensations remained unclaimed because of the complicated process of obtaining and submitting the viscera report, but such formalities have been discontinued. Still there is enormous effort, money and time are involved in the management of snake bite cases. From costs associated with a snake bite begin with travel to the hospital and end in to post treatment expenses (Roshnath et al. 2018). Only, 377 (58%) respondents demanded for a monetary compensation to pay for the medical expenses in snake-bite treatment, 188 (28.92%) respondents were not sure whether such a compensation must be provided by the government or not and 85 (13.08%) respondents did not demand any such compensation from government. However, only 58% of the cases known to this study appear to have received compensation which justifies the results of our study where 58% respondents demanded for compensation to pay for medical expenses. Government has also released a provision for insurance for snake-bite, it is still unknown in major portion of the public as our results show that out of the sampled population, only 36 (5.54%) respondents claimed to have an insurance for the snake-bite and 614 (94.46%) respondents did not have any insurance for the snake-bite.

*Table 3. First-aid methods that are being adopted by people in case of snake-bite*

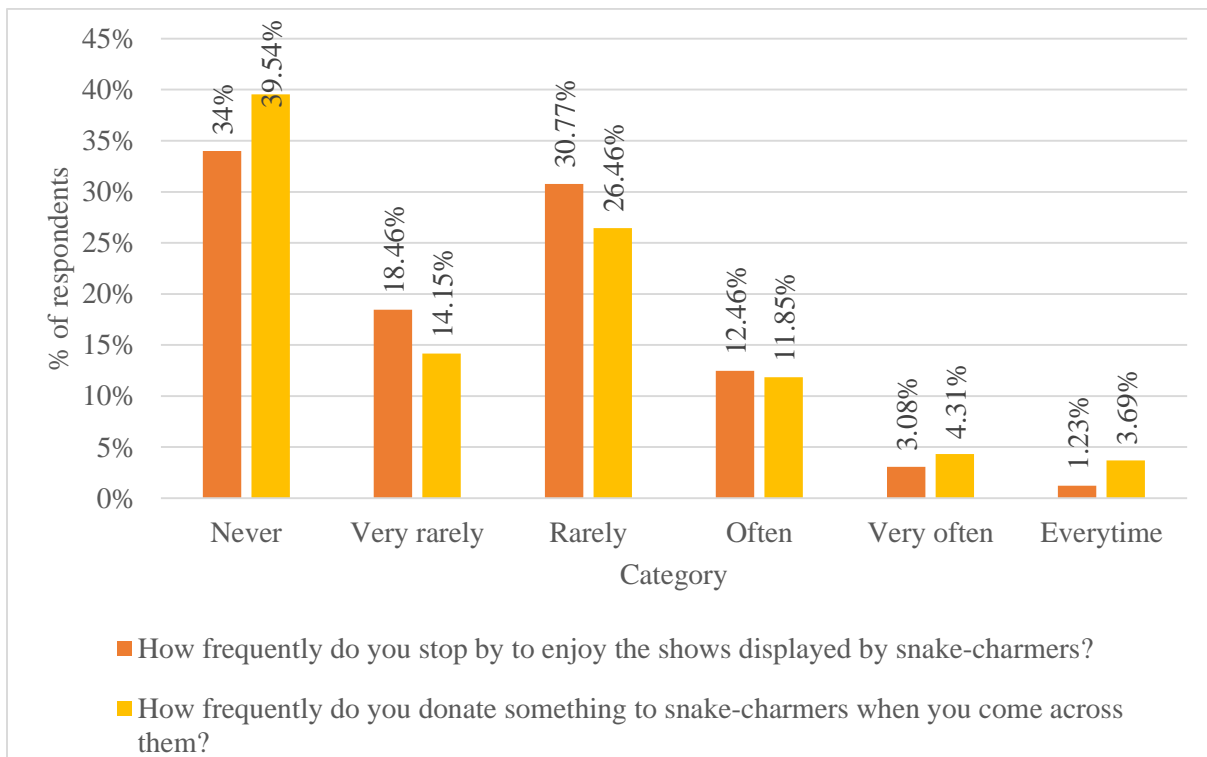
<b>Actions included in the protocols for snake-bite management</b>	
1.	Washing the bitten part with soap and running water
2.	Keeping the person calm and at rest
3.	Making the person lie down with wound below the heart.
4.	Removing any jewelry from the bitten part
5.	Rushing the victim immediately to hospital
<b>Actions prohibited in case of snake-bite management</b>	
1.	Making a cut on the bite spot
2.	Tightly tying the bitten part above the bite spot
3.	Taking actions as per superstitions or their belief
4.	Tightly tying the bitten part
5.	Holding the bite spot tightly with hands
6.	Making the victim drink clarified butter
7.	Making the victim eat Neem ( <i>Azadirachta indica</i> ) leaves
8.	Removing blood from bitten part
9.	Covering the wound with loose, sterile bandage
10.	Rubbing random herbs on the bite spot
11.	Immediately killing the snake
12.	Usage of regular first aid kit
13.	Giving CPR
14.	Applying Antiseptic
15.	Using Torniquet

### 3.3. INFLUENCE OF SNAKE-CHARMERS AND MYTHS

Snake-charmers have been prevalent in India for ages and they have built up a reputation among public through street shows and floating convincing stories (Khan 2016). Despite of the growth in medical science in last many years and emergence of effective treatment methods for snake-bite treatment, most of the victim report to the traditional healers or snake-charmers (Kumar et al. 2015). Traditional methods for snake-bite treatment include incisions, attempts to suck out the venom, application of herbs and ‘snake-stones’ which are not only ineffective methods but in most cases prove to be harmful and deleterious (Kumar et al. 2015). One snake-charmer catches an average of seven snakes per year (Dutt 2004). It has been stated and brought forward in various awareness programs conducted by animal welfare NGOs that snake-charmers have been found to



account for deaths of several snakes all around the year by pulling out their fangs along with the venom glands, causing fatal injuries to the snakes, sewing up their mouths, keeping them hungry and thirsty for days, extremely rough handling which again gives serious spinal and muscular injuries to the snakes. Being reptiles, snakes do not drink milk deliberately but snake-charmers force the snakes to drink milk which proves fatally harmful for snakes (Das 2020). Generally, the snake charmers keep moving from villages to villages and cities to cities, carrying live snakes and offering them to people to worship by going door to door and in return of this they get money, grains, clothes and milk to sustain their living (Khan 2016). In our study we found out that only 289 (44.46%) respondents knew and were confirm that snake-charmers cause harm to snakes, 232 (35.69%) respondents were not sure whether the snake-charmers cause any harm to snakes and according to the rest 129 (19.85%) respondents, the snake-charmers did not cause any harm to the snakes. From these results, it is clear that people are unaware of such practices followed by the snake-charmers although our results show that near to 85% of respondents were not interested in snake charmers and their shows (Figure 8).



**Figure 8.** Respondents' behavior towards snake-charmers (n=650)

Due to this lack of interest among people, the tolerance and support to the snake-charmers is slowly vanishing. The respondents reported the percentage downfall in the population of snake-charmers they have witnessed from 2010-2020 (Table 4). As all the snake species are included in Schedule 1-4 of the WPA 1972 of the Constitution of India, it is illegal to acquire or keep in his possession, custody or control, or transfer to any person by way of gift, sale or otherwise, any wild animal because under Section 39 of the WPA ' wild animals are government property (Dutt 2004). strict enforcement of laws has made it difficult for them to practice their traditional occupation using snakes (Dutt 2004).

*Table 4. Percentage downfall as witnessed by respondents from 2010-2020*

<b>n</b>	<b>x=(n1+n2)/2</b>	<b>f</b>	<b>fx</b>
0%	0	36	0
1-10%	5.5	40	220
11-20%	15.5	60	930
21-30%	25.5	48	1224
31-40%	35.5	60	2130
41-50%	45.5	92	4186
51-60%	55.5	81	4495.5
61-70%	65.5	80	5240
71-80%	75.5	81	6115.5
81-90%	85.5	48	4104
91-100%	95.5	24	2292
		<b>∑f=650</b>	<b>∑fx=30937</b>

On applying the formula:  $Mean = \frac{\sum f x}{\sum f}$  we get 47.60. Hence, the mean percentage downfall in the population of snake-charmers witnessed by the respondents from 2010 till 2020 by the respondents is 47.60%. This suggests that according to the respondents, the population of snake-charmers has been reduced almost to half of what it was a decade ago.

Some Hindus and Buddhists have deep-rooted cultural, traditional and religious beliefs involving snakes and they even worship snakes in some cases (Shah and Tiwari 2004; Perry et al. 2020).

This can be better understood from the beliefs of people in festivals like Nag Panchami, a snake festival for Hindus when people generally avoid killing the snakes and worship the sculptures and images of snakes (Atreya and Kanchan 2018). However, the same attitude of not killing the snakes is not perpetuated throughout the year (Devkota et al. 2021). Our survey identified a list of myths prevalent among the people and classified them on the basis of the level of prevalence (Table 5). These myths prove to be disastrous not only for the humans but for the snakes as well. Although local folklore and reported harms and mortalities, may accentuate the negative perception of snakes, some snake species might positively be protected from harm by some traditional beliefs (Babalola et al. 2020). Snake bite cases are frequent and because of meager medical help, public usually relies on local ‘hakims’ and ‘vaidyas’ who claim to have herbal, Mantra and Dams cure for snake bite (Khan 2016). Since most of the snakebites occur in the poorer sector of the public, which cannot afford medical facilities, the superstitious means and the local vaidyas and hakims becomes more considerable as it costs people much less as compared to the hospitals. Snake-bites are often treated with local medications and rituals based on myths (such as, venom can be sucked out of bite mark, ingestion of certain plants expel venom, etc.), hence further threatening the life of the victim (Ranjan et al. 2021). The lack of public in medical facilities and scientific methods leads to their strong confidence in rituals and spiritual preachers who, being good at fooling public, further spread convincing myths regarding the treatment of snake-bite and dealing with snakes. The prevalence of myths strengthens its roots in the minds of people due to the biology of snakes involving swift graceful mysterious gliding motion, sudden appearance/disappearance and reappearance from nowhere; bright lid-less eyes, fixed gaze, colorful beauty, strength to squeeze to death, fatal consequences of bite, regularly shedding skin for a shinier and healthier one, suggesting snake's longevity and immortality which attaches a value of wonder, respect and fear to the snakes and glorifies the concepts about snakes for people (Khan 2016).

*Table 5. Identified Myths and their prevalence (n=650)*

<b>IDENTIFIED MYTHS</b>	<b>% of respondents</b>
<b>Less Prevalent Myths</b>	
If a human witnesses a cobra pair (Naag and Naagin) mating, he turns blind	0.62%
If a snake catches a mole, the snake will die if it eats the mole and will turn blind if it releases the mole.	
Neem leaves and chilies taste sweet to the snakes	

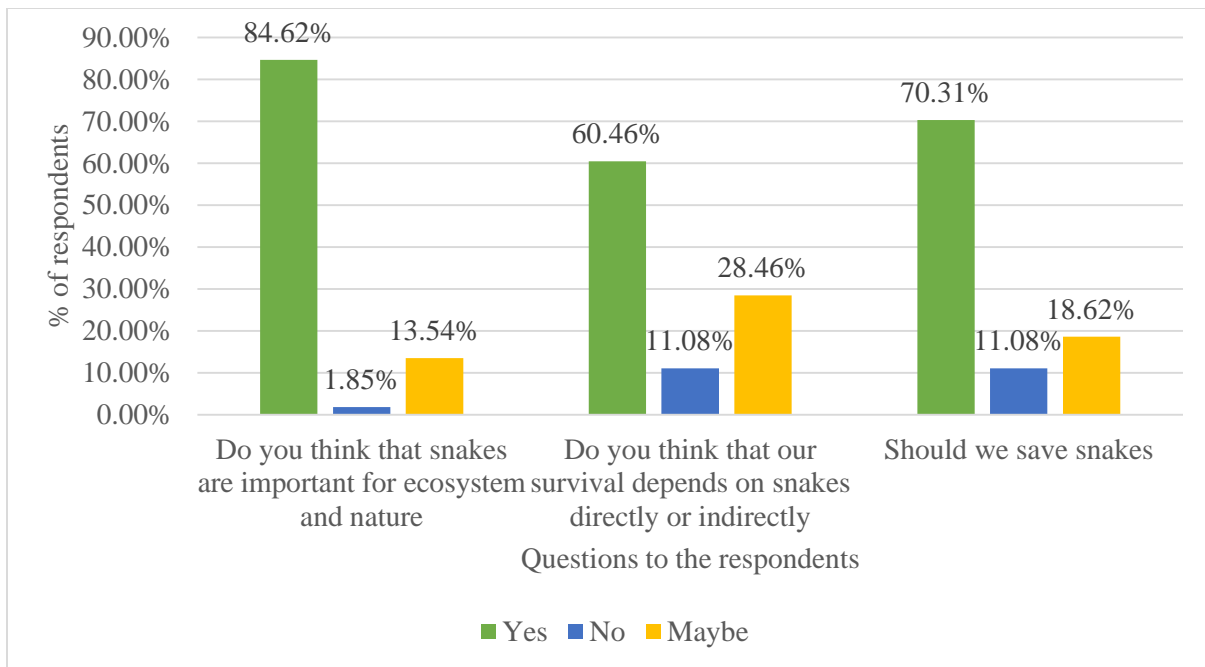
In case of snake bite, encircling holy place (temple, mosque, church, etc.) helps avoiding its intended ill effect.	1.23%
Snakes can hypnotize humans	
Applying red hot iron at bite place cures the victim.	1.85%
Chanting of mantras does anti-venom action & safe guard victim from all effects of snake venom	
If snake is killed, new snakes are born from its blood	
Snake-bites can be treated by 'MANKA'	
Snakes blessed by god have hair on their body	
Snakes bring evil spirits along with them	
Snakes possess black-magic	
Whistling or murmuring the word 'snake' at evening or night attracts snake to your home	
Snake does not bite person, having leprosy disease & in case of bite, venom does not affect such person.	2.46%
Worshiping snakes or keeping fast in the name of snakes, protect humans from any ill effect of snake bite or its venom.	
Snakes become venomous only on land and not when they are in water	3.08%
Snakes can hear and fulfill your wishes	
Very old snakes have a boon to transform into human whenever they wish to	
Dead snake can also bite	3.69%
Snakes can curse you	
Applying 'Nagmani' (Snake stone/gem) or rubbing extract of some herbs at bite place has anti venom action.	4.31%
If a pregnant lady watches into the eyes of the snake, the snake loses its eyesight	
<b>Moderately Prevalent Myths</b>	
Baba, taantrik have god gift to reduce the damaging effects of snake venom, which they have achieved by years of study, worship & hardship.	5.54%
Snakes can live over 1000 years	6.15%
Snakes can store photograph of their killer or someone who tried to kill them or their partner, in their eyes	7.38%
Snakes have poison in their skin also	
Snakes protect treasures or ancestral properties	
Keeping a peacock feather at home keeps snakes away	8%
If a snake bites, the victim must be re-introduced to the bite of the same snake so that it may suck its blood out	8.62%
There are 'Ikshadhaari Saanp' which can transform into a lady or some other creature as per their wish	
Very old snakes can fly	9.23%
Snakes always travel in pairs and take revenge if their partner is killed	9.85%
Snakes have venom in their tongue and tail and inject venom in humans through their tongue or tails	11.08%
Person bitten by snake feels that, Neem leaves or chilies taste sweet.	11.69%
Very old snakes grow beard on their chins	

Dhaaman/Dhaamin (Indian rat snake) tail contains poison and thus it causes deadly infection if someone is hit by the tail of dhaamin.	12.31%
Well known enemy of snake - mongoose is immune to snake venom or in some cases mongoose eats some leaves & roots of specific tree to safeguard itself from lethal effect of snake venom.	12.92%
Naag' (Cobra) has a 'naag-mani' which can bring prosperity	13.54%
<b>Highly Prevalent Myths</b>	
Snakes take revenge	16%
Snakes dance on the tune of 'Been' (flute) of snake-charmers	17.23%
Snakes like fragrance, so they usually hang or dwell on plants and trees like 'Raatarani', 'Chandan', 'Kevada', etc.	
Ajgar' (Pythons) can suck any creature from long range as well by inhaling air	19.08%
Snakes like to drink milk	
Do-muha saanp' (Red-sand Boa) actually has two heads on either end of the body, and can moves from each end for six months	21.54%
Do-muha saanp' (Red-sand Boa) has medicinal uses	22.15%
Ajgar' (Pythons) can eat humans	31.54%

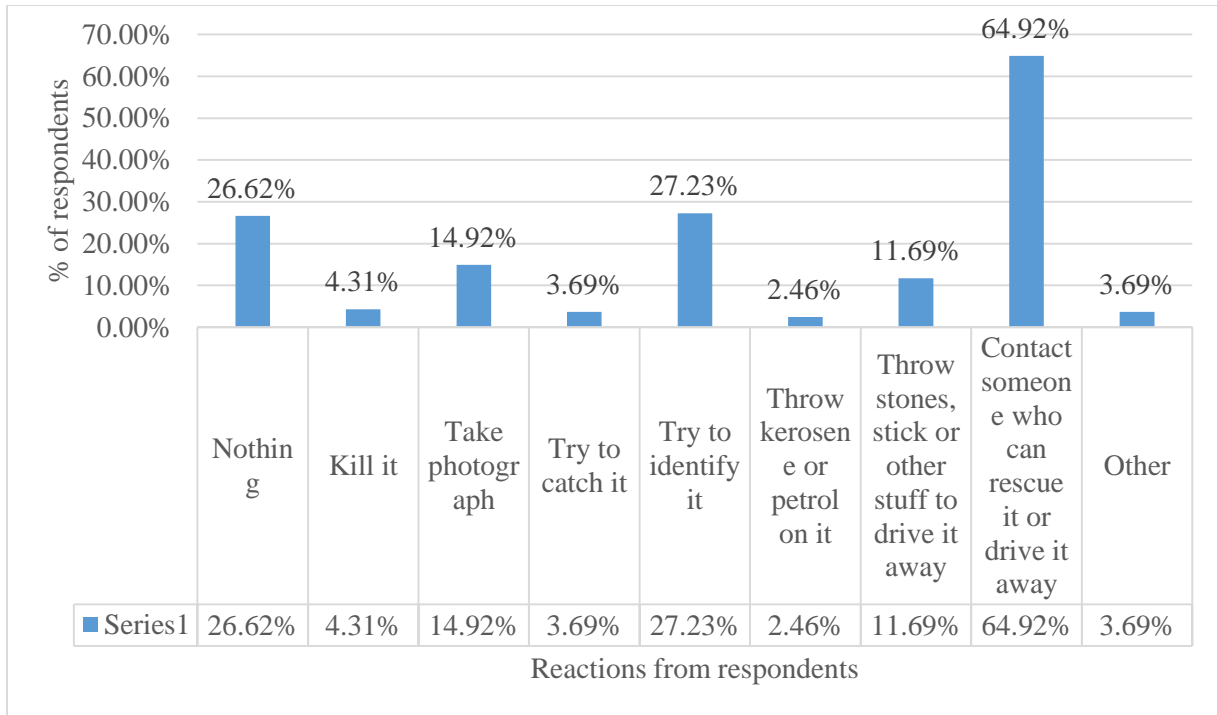
### 3.4. CONSERVATION ATTITUDE AMONG PUBLIC:

Snake population decline can be attributed to anthropogenic habitat fragmentation or destruction (Gibbons et al. 2000) and intentional killing of snakes (Godley and Moler 2013; Whitaker and Shine 2000). Killing of snakes can be due to various reasons such as killing out of fear, for food or for use in traditional medicine (Conant and Collins 1998; Soewu 2008; Pandey et al. 2016; IUCN 2018). The fear for snakes is a natural human behavior which mostly comes as a result of the numerous incidents of snake-bites and the mortalities caused that people have heard about, instead of them ever encountering or getting bitten by a snake (Nonga and Haruna 2015). Our study found out that only 105 (16.15%) respondents stated that snakes are a threat to human life, 337 (51.85%) stated that they are not a threat and 208 (32%) were not sure regarding this. According to these results, the majority of public believing that snakes are not a threat can be attributed as a significant contribution of education and awareness programs. The unappealing skin coloration of snakes and the innate, protective, evolutionary adaptation of the human brain, which influences the basic human emotions, are some factors which restrict the humans from liking snakes and tolerating them around. (Prokop and Fancovicova 2013; Prokop and Randler 2018; Prokop et al. 2018). However, in our survey, majority of respondents (397; 61.08%) respondents stated that they like snakes whereas 253 (38.92%) respondents stated that they do not like snakes. Despite the fear, 550 (84.62%) respondents said that snakes are important for ecosystem and

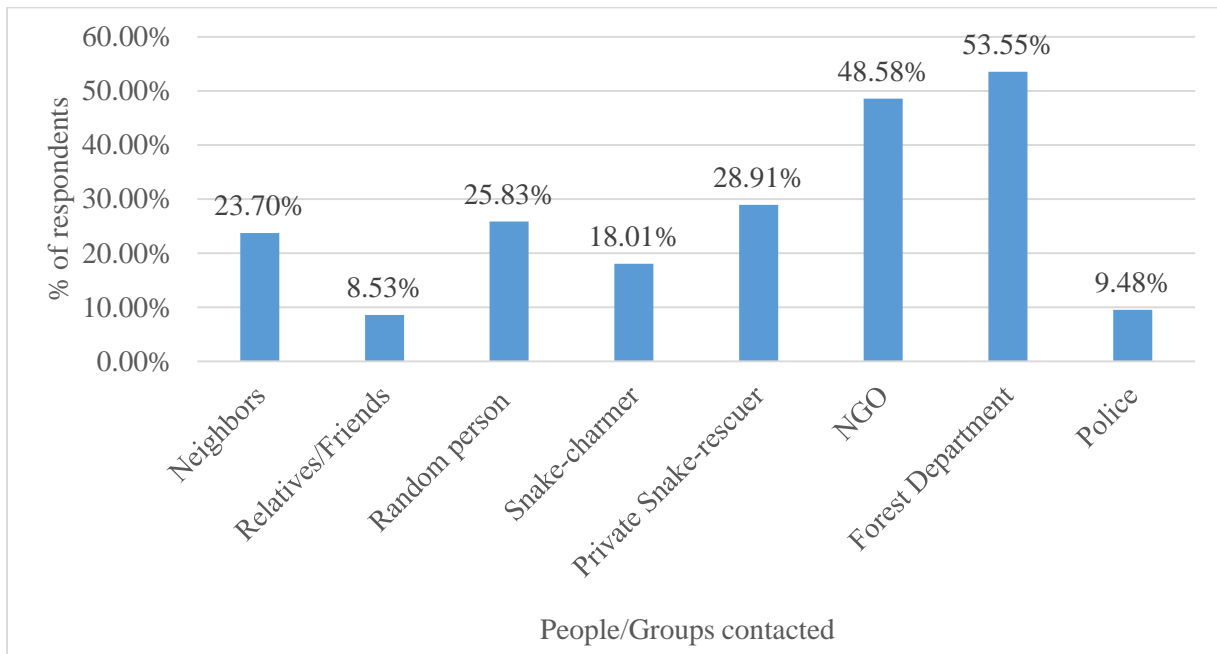
nature, which supports the studies of Pandey et al. 2016 and Marshall et al. 2018. Unfortunately, despite of people understanding the importance of snakes, a total of 185 snake species are listed in the IUCN red list of threatened species (IUCN 2013). 393 (60.46%) respondents stated that they think that our survival directly or indirectly depends on snakes and 457 (70.31%) respondents supported the idea that we should save snakes (Figure 9). If indiscriminate killing of snakes goes unchecked it will increase the risk of population decline and local extirpation of rare and endangered snake species, which may have cascading community and even ecosystem level effects (Pandey et al. 2016) with negatively affecting the balance of ecosystem (Babalola et al. 2020).



**Figure 9.** General perception of respondents about snakes and their conservation (n=650)



**Figure 10.** Respondents' reaction on encountering a snake (n=650)



**Figure 11.** People/Groups contacted by respondents on encountering a snake (n=422)

In Figure 10 we can see that most of the respondents (422; 64.92%) contact someone who can catch or rescue the snake or at least drive it away and only 28 (4.31%) respondents kill the snake.

Older studies indicate that most people were inclined to kill snakes on sight rather than leave them alone (Shankar et al. 2013; Pandey et al. 2016; Marshall et al. 2018; Devkota et al., in press) which is not the case now. Nearly a quarter of respondents reported that they either do nothing or try to identify the snake species. 76 (11.69%) respondents stated that they do not kill the snake, but rather throw stones, sticks or other stuff at the snake to drive it away, which can be fatal for the snake as it might injure the snake fatally. Thus, in an attempt to drive the snake away, people might unintentionally kill the snake. As per the results in Figure 11 we can see that most of the respondents either contact Forest Department or some NGO who is involved with rescuing wild animals with 53.55% and 48.58% respondents subsequently. However, 117 (18.01%) respondents still contact snake-charmers on spotting a snake. The public awareness and sensitization programs towards snakes, snakebites and its conservation have resulted in an increase in number of rescue calls to forest department, instead of killing the animal on sight (Ranjan et al. 2021). The public needs to be taught about the laws of WPA 1972 and the desired actions to be taken on spotting a snake which includes contacting the Forest Department at first place, which would then either take up the rescue itself or will divert it to some other channel. In our survey, 244 (37.61%) respondents reported that forest department responds on time on being contacted, 221 (34.07%) respondents reported that it responds on time only sometimes, 112 (17.26%) respondents reported that the department does not respond on time and 72 (11.06%) respondents did not remember exactly whether the forest department responded on time on being contacted. The lack of confidence of people in Forest Department is understandable because Forest Department still lacks to have well-trained staff to rescue snakes and also the delays in response.



## 4. SUGGESTIONS

- As our results show that more snake encounters tend to happen in monsoons seasonally and evening hours diurnally, hence it is advised to take more precaution in working in agricultural land, gardens, forested areas for wood collection of woods and grass during monsoon or in the evenings on a diurnal basis.
- Our results show that most of the people know that rodents are a primary prey for snakes, therefore, people must be made aware regarding regular rodent control in monsoon in homes and gardens as it can be a beneficial method in keeping snakes away from human residents.
- Lesser the mortality through snake-bites, more will be the tolerance of snakes among humans. As our results indicate that most people do not have correct knowledge regarding the first-aid for snake-bite and contacting the medical facility instantly, therefore, the gaps regarding the snakebite prevention and management must be identified and appropriate measures must be taken to augment and percolate correct knowledge regarding prevention, control and management of snakebites, which has also been suggested by the studies of Kumar et al. 2015.
- The administration of every locality in a district must keep a demographic record of the population that is covered by it and must share it with the local hospitals as well, so that an administrative and medical framework could be set up by identifying the areas that need more attention and predict the probability of the scenario of snake-bite cases.
- Since, it was evident through our results that there is a lack of confidence of public in medical science and hospitals, therefore, it must be checked and people, especially the rural populations must be made well aware to approach the medical facilities as soon as possible. In order to gain this confidence, the medical students and staff must be trained exclusively for snakebite management so as to generate a more proficient and fast way of dealing with snake-bite cases.
- Most of the rural sector lacks good hospitals with the facility of antivenom resulting in wastage of vital time in carrying the victim to the hospital with required facilities, increasing the chances of casualties. Hence, it may be suggested to make the snakebite

treatment facilities available in the rural sectors where the snakebite cases are more frequent.

- Alongside accessibility, treatment should be cost-effective or bear by government this, so that it allows the poorer sector to afford the medical facilities. This will allow more people to approach hospitals instead of following fraud people.
- Our results showed that, there is still lack of awareness in people towards the conservation, identification, knowledge about snakes, etc. In Kerela it was observed that an education programme on the conservation of non-venomous snakes achieved positive attitudinal change among the local people (Balakrishnan, 2010) and also public awareness programs have significantly helped in reducing the human and snake mortalities (Ranjan et al. 2021), this must be brought into practice by the administration on a more regular basis, reaching the farthest corners of the population.
- As our results showed that, students are also unaware regarding snakes, therefore the schools and colleges must conduct such awareness programs on a regular basis in order to educate the upcoming generations to co-exist with the snakes and spread awareness regarding the first-aid for snakebite, identification of species and importance and conservation of snakes. The prevention of snake-bites and conservation of snakes may be included in the regular syllabus as well.
- As some people lack confidence in forest department, hence the Forest Department must aim to have well-trained and efficient snake-rescue teams with less response time. This would generate confidence of people in Forest Department and will cut down the prevalence of snake-charmers or killing of snakes on encounters.
- Social media can be good platform in spreading awareness among people (Jachowski et al. 2016) as people link to social media very easily and it plays a significant role in determining the mindset of people towards the world. Hence, social media must be used to circulate knowledge and awareness among a huge population easily by involving socially active pages and people with high social media reach as stakeholders in awareness campaigns. However, in the rural areas due to poor network connection and low socio-economic status of people living there, the awareness through internet might get hindered.

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