Chapter 4

DISCUSSION

4.1 TAXONOMY AND PHYLOGENY

The 29 species of snakes found in Telangana belong to the eight families (Typhlopidae, Pythonidae, Boidae, Colubridae, Natricidae, Homalopsidae, Elapidae and Viperidae). While the families Pythonidae and Homalopsidae are represented by a single species each belonging to genera *Python* and *Enhydris*, respectively, other families are represented by two or more snakes species. The families Typhlopidae (with one species each belonging to the genera *Grypotyphlops* and *Ramphotyphlops*) and Boidae (with one species each belonging to the genera *Eryx* and *Gongylodphis*) are represented by two species each. Families with three species are Elapidae (with two species belonging to the genus *Bungarus* and one species belonging to the genus *Naja*) and Viperidae (with one species each belonging to the genus *Daboia*, *Echis* and *Trimeresurus*). Four species belonging to four genera – namely, *Amphiesma*, *Atretium*, *Macrophistodon* and *Xenochrophis* belong to family Natricidae. It is to be noted that the species belonging to family Natricidae were earlier included under family Colubridae. The most speciose family of snakes in Telangana is family Colubridae with as many as 13 species belonging to the following genera *Coelognathus* (one species), *Ptyas* (one species), *Argyrogena* (one species), *Coluber* (one species), *Oligodon* (two species), *Dendrelaphis* (one species), *Lycodon* (three species), *Boiga* (two species), and *Ahaetulla* (one species).

The overall taxonomy and phylogeny of these 29 species of snakes of Telangana follow accepted taxonomy and phylogeny.

Snakes belong to the reptilian group known as squamates that include besides snakes, lizards and amphisbaenians (Worm lizards). Squamates include more than 9556 species (Uetz & Hošek, 2014) of which 3,458 species belong to the Serpentes group. New species of snakes are being described annually, and since 2008 their species diversity has increased from 3149 taxa to 3458 taxa, with an average annual increment of 62 taxa per
year with as many as 26 taxa described as new between February 2013 and February 2014 (Uetz & Hošek, 2014).

Squamates are found on every continent except Antarctica, in Indian and Pacific oceans, and span many diverse ecologies and body form from limbless burrowers to arboreal gliders (Greene, 1997; Pianka & Vitt, 2003; Vitt & Caldwell, 2009). Squamates have inspired many scientific investigations ranging from evolution, ecology and behaviour (Vitt & Caldwell, 2009) to medicine (Kasturiratne et al., 2008; Madhavi et al., 2008) and applied physics (Geim et al., 2003).

With the advent of the molecular tools the squamate taxonomy and phylogenetics has changed radically in the past few years and a lot of phylogenetic inconsistencies is being resolved from basal to apical level.

The new analyses indicate that the dibamids (Family Dibamidae, Dibamid legless lizards) and gekkotans (Infraorder Gekkota, geckos and pygopodid legless lizards) being placed at the root of the squamate tree, a sister group relationship between amphisbaenians (worm lizards) and lacertids (lizards), and a clade (Toxicofera) uniting Iguania with snakes and Anguimorpha with Scleroglossa (Townsend et al., 2004; Vidal & Hedges, 2004, 2005; Fry et al., 2006; Wiens et al., 2010, 2012; Mulcahy et al., 2012; Pyron et al., 2013a). In the past (Slowinski & Lawson, 2002; Lawson et al., 2004; Wiens et al., 2008) studied the higher-level snake groups. The Toxicofera including Anguimorpha (including families Varanidae – monitor lizards, Anguidae – alligator lizards, glass lizards, etc., Helodermatidae – gila monster and Mexican beaded lizard, Shinisauridae – Chinese crocodile lizard, and Xenosauridae – knob-scaled lizards), Iguania (iguanas, agamid lizards, chameleons, etc.), and Serpentes (snakes) are monophyletic.

Numerous studies by (Heise et al., 1995; Slowinski & Lawson, 2002; Noonan & Chippindale, 2006; Burbrik & Pyron, 2008; Wiens et al., 2008, 2012; Vidal et al., 2010; Pyron et al., 2011, 2013a,b; Pyron & Burbrik, 2012) have shown the dynamic relationships of serpents’ phylogenetics and to some extent have put light on evolutionary relationships among this group. Recent studies indicate that the blind snakes (Scolecocephidia) are not monophyletic (Burbrik & Pyron, 2008; Wiens et al., 2008, 2010, 2013, 2014).
2012; Pyron & Burbrink, 2012; Pyron et al., 2013a,b) and Anomalepididans (Dawn blind snakes) are very weakly related to Serpentes (Burbrink & Pyron, 2008; Pyron et al., 2013a,b). Within the Scolecophidian families Gerrhopilidae, Leptotyphlopidae, Typhlopidae and Xenotyphlopidae form a clade as sister group to all other snakes. Among these families, recent studies indicate monophyletic origin of many genera (Vidal et al., 2010; Pyron et al., 2013b). An enigmatic family Xenophidiidae is weakly related to all alethinophidians which show strong relationship between Anilidae (Pipe snakes) and Tropidophiidae (Dwarf boas) (together comprising Aniloidae). The family Bolyeriidea (pythons, boas and relatives) (Slowinski & Lawson, 2002; Lawson et al., 2004; Noonan & Chippindale, 2006; Burbrink & Pyron, 2008; Wiens et al., 2008, 2012; Pyron et al., 2013a).

Among the alethinophidians a mixture of strong and weak relationships are supported. As it is not the scope of this work to analyse the relationship among snake groups, I present discussion pertaining to Indian families of snakes only. The family Uropeltidae (Shield-tail snakes) form strong relationships with Anomochilidae (Dwarf pipe snakes) and Cylindrophiidae (Asian pipe snakes) and this clade shows close affinity to families Xenopeltidae (Sunbeam snakes), Loxocemidae (Mexican burrowing pythons) and Pythonidae (Pythons). Interestingly the family Boidae (Boas) and Calabaridae (Calabar) show relationship and are as a group weakly related to the former.

The genus Python is the sister group to all other genera in family Pythonidae (Pyron et al., 2013a). The Boidae family perhaps shows better understanding of relationship among members totally both classical and molecular taxonomy (Burbrink, 2005; Noonan & Chippindale, 2006; Wiens et al., 2008, 2012; Lynch & Wagner, 2010; Noonan & Sites, 2010), excepting the work of (Kluge, 1991). The Indian boid snakes belong to subfamily Erycinae.

Among the advanced snakes (referred to as Coenophidia) recent studies have reflected that owing to large number of species the current understanding is in dynamic state (Kelly et al., 2003; Lawson et al., 2005; Burbrink & Pyron, 2008; Wiens et al., 2008, 2012; Zaher et al., 2009; Pyron & Burbrink, 2012; Pyron et al., 2011). However, Pyron et al. (2013a) the most recent work tried to explain these relationships. According to this study the family Acrochordidae (File snakes) has a strong relationship and forms a
sister group with family Xenodermatidae (Odd-scaled snakes), and this clade then forms a sister group to the remaining Colubroidea (as also advanced by works of Boulenger, 1894; Kraus & Brown, 1998; Kelly et al., 2003). The family Viperidae (Vipers and pit vipers), however, forms the sister group to all colubroids. Indian vipers are placed in subfamily Viperinae.

The clade Colubroidea includes families Colubridae (Colubrids), Elapidae (Cobras, coral snakes and sea snakes), Homalopsidae (Rear-fanged water snakes) and Lamprophiidae (House & water snakes). Within this clade monophyly of Homalopsidae is strongly supported and recent studies indicate that the genus *Enhydris* is strongly monophyletic and can be split into multiple genera (Pyron et al., 2013a). The family Homalopsidae is weakly related to sister group of Elapidae and Lamprophiidae (Pyron et al., 2011, 2013a) but other studies show a strong relationship of this group with Elapidae, Lamprophiidae and Colubridae (Wiens et al., 2008, 2012). The family Lamprophiidae is strongly monophyletic. The Indian forms are placed in subfamilies Psammophiinae (Sand snakes) and Pseudoxyrhophiinae (Leaf-nosed snakes) (Vidal et al., 2008; Kelly et al., 2009, 2011; Pyron et al., 2011).

Family Elapidae is monophyletic (Pyron et al., 2013a) and, interestingly, one species, *Calliophis melanurus*, forms sister group to all other elapids (Pyron et al., 2013a,b). Monophyly of Colubridae and most of its subfamilies is strongly supported (Pyron et al., 2011, 2013a,b), however the relationships between the subfamilies are weakly supported (Vidal et al., 2007; Pyron et al., 2011, 2013; Chen et al., 2012; Grazziotin et al., 2012). The subfamilies Calamariinae and Pseudoxenodontinae are strongly supported as sister taxa, and weakly placed as a sister group to rest of Colubridae. Among the Colubrinae, a strong relationship between the genera *Ahaetulla*, *Chrysopelea* and *Dendrelaphis* is evident and these and these three form weakly placed as sister group to the rest of the Colubrinae (Pyron et al., 2011, 2013a,b). The family Natricidae harbours numerous non-monophyletic genera including the Asian taxa – *Amphiesma*, *Atretium*, *Macrophistodon* and *Xenochrophis* (Alfaro & Arnold, 2001; Pyron et al., 2011, 2013b; Guo et al., 2012).
The most comprehensive study so far made on snake phylogeny in recent years is that of Pyron et al. (2013a) and it reveals that amongst Coenophidian phylogenetic relationships – the super group Colubroidea is paraphyletic.

4.2 DIVERSITY & DISTRIBUTION

The present study revealed presence of 29 snake species belonging to eight families (Typhlopidae, Pythonidae, Boidae, Colubridae, Natricidae, Homalapsidae, Elapidae and Viperidae). Two families – Pythonidae and Homalapsidae – are such that were represented by a single species each belonging to genera Python and Enhydris, respectively. Two families – Typhlopidae and Boidae – are such that represented by two species each, one species each belonging to the genera Gyrpotyphlops and Ramphotyphlops under the former and, Eryx and Gongylophis under the later, respectively. Two families – Elapidae and Viperidae – are such that were represented by three species each; with species belonging to the genera Bungarus (two species) and Naja (one species) under the former and, Daboia (one species), Echis (one species) and Trimerusurus (one species) under the later. One family – Natricidae – is represented by four species belonging to genera Amphiesma (one species), Atretium (one species), Macropisthodon (one species) and Xenochrophis (one species). The family Colubridae is most speciose and is represented by 13 species belonging to nine genera. One species each belong to the following genera Coelognathus, Ptyas, Argyrogena, Coluber, Dendrelaphis and Ahaetulla. Two species each belong to the following genera Oligodon and Boiga. Three species belong to the genus Lycodon, which needless to say was most speciose among the colubrids.

All snake fauna of Telangana are more or less evenly distributed throughout the State, with an exception of rare to very rare species. Maximum numbers of species of snakes were found in districts that have either good forested tracts or forested tracts interspersed with rocky boulders. As many as 25 species of the 29 species recorded from Telangana were observed to be present in Nalgonda District as it is one of the largest districts and also has all types of habitats more or less evenly distributed. Next in line was Mahbubnagar District (21 species), followed by Adilabad District (20 species), both these districts have equal areas of forested tracts and agricultural expanse.
Among the rare snake species the Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae) (known from a few specimens from Nalgonda and Hyderabad districts) is known from three historic and three recent specimens. The Yellow-collar wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae) (known from less than eight specimens from the urban conglomerate of Hyderabad in Hyderabad district has been recently discovered species in Telangana which still awaits scientific reporting. The Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae) (known from two localities, one each from Adilabad and Mahbubnagar districts) is a forest species and is known only from two reports from Telangana. One of the globally widespread species that marginally occurs in Telangana is the Banded krait *Bungarus fasciatus* (Schneider, 1801) (Elapidae) is known from one historic and three recent specimen sightings only.

### 4.3 Preferred Climatic Parameters

As an important component of the present study, I looked into the species distribution and through maximum entropy pattern of understanding the species distribution modeling was conducted to understand the possible ranges and also suitable climatic parameters that affect the distribution of snake species in Telangana.

#### 4.3.1 Preferred climatic parameters – Family-wise

The distribution of snake fauna of Telangana belonging to eight families, namely – Typhlopidae, Pythonidae, Boidae, Colubridae, Natricidae, Homalopsidae, Elapidae and Viperidae is discussed in the light of climatic requirements as predicted by the MaxEnt analysis.

#### 4.3.1a Family Typhlopidae

The MaxEnt analysis revealed that the blind snakes preferred annual mean temperature range is in between 26.0°C and 28.5°C. The more frequency of snakes can be seen in between 26.5°C and 27.0°C annual mean temperature and least number of
observations can be observed in between 27.5°C and 28.0°C annual mean temperature. The blind snakes preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of snakes can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations can be observed in between 799.0mm and 921.0mm annual precipitation. Two dimensional niche of the family Typhlopidae based on Annual Mean Temperature and Annual Precipitation represents a total of 28 (87.5%) of 32 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1b Family Pythonidae

The MaxEnt analysis revealed that the Indian rock python preferred annual mean temperature range is in between 26.3°C to 28.5°C. The more frequency of python can be seen in between 26.3°C and 26.7°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.2°C annual mean temperature. The python preferred annual precipitation range is in between 633.0mm and 1106.0mm. The more frequency of snakes can be seen in between 633.0mm and 727.6mm annual precipitation and least number of observations can be observed in between 727.6mm and 822.2mm and 916.8mm annual precipitation. Two dimensional niche of the family Pythonidae based on Annual Mean Temperature and Annual Precipitation represents a total of 8 (66.7%) of 12 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1c Family Boidae

The MaxEnt analysis revealed that the boid snakes preferred annual mean temperature range is in between 26.0°C to 28.5°C. The more frequency of boid snakes can be seen in between 26.0°C and 27.0°C and 27.5°C and 28.5°C annual mean temperature and least number of observations can be observed in between 27.0°C and 27.5°C annual mean temperature. The boid snakes preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of snakes can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations
can be observed in between 822.2mm and 1287mm annual precipitation. Two dimensional niche of the family Boidae based on Annual Mean Temperature and Annual Precipitation represents a total of 19 (86.4%) of 22 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1d Family Colubridae

The MaxEnt analysis revealed that the colubrid snakes preferred annual mean temperature range is in between 25.0°C to 28.6°C. The more frequency of colubrid snakes can be seen in between 27.9°C and 28.6°C annual mean temperature and least number of observations can be observed in between 25.0°C and 25.7°C annual mean temperature. The colubrid snakes preferred annual precipitation range is in between 633.0mm and 1312.0mm. The more frequency of snakes can be seen in between 633.0mm and 768.0mm annual precipitation and least number of observations can be observed in between 1176.2mm and 1312.0mm annual precipitation. Two dimensional niche of the family Colubridae based on Annual Mean Temperature and Annual Precipitation represents a total of 67 (90.5%) of 74 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1e Family Natricidae

The MaxEnt analysis revealed that the natricid snakes preferred annual mean temperature range is in between 25.5°C to 28.5°C. The more frequency of natricid snakes can be seen in between 27.9°C and 28.5°C annual mean temperature and least number of observations can be observed in between 25.5°C and 26.1°C annual mean temperature. The natricid snakes preferred annual precipitation range is in between 677.0mm and 1295.0mm. The more frequency of snakes can be seen in between 677.0mm and 800.0mm annual precipitation and least number of observations can be observed in between 1047.8mm and 1171.4mm annual precipitation. Two dimensional niche of the family Natricidae based on Annual Mean Temperature and Annual Precipitation represents a total of 37 (84.1%) of 44 distinct and non-overlapping observations having a
climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1f Family Homalopsidae

There was only single site record of the species belonging to this family and the MaxEnt analysis revealed that the homalopsid snakes in Telangana preferred annual mean temperature range of 28.5°C and annual precipitation range of 678.0mm. No two dimensional niche analysis could be conducted due to limited site locality records.

4.3.1g Family Elapidae

The MaxEnt analysis revealed that the elapid snakes preferred annual mean temperature range is in between 26.2°C to 28.5°C. The more frequency of elapid snakes can be seen in between 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.1°C annual mean temperature. The elapid snakes preferred annual precipitation range is in between 664.0mm and 1287.0mm. The more frequency of snakes can be seen in between 664.0mm and 788.6mm annual precipitation and least number of observations can be observed in between 1162.4mm and 1287.0mm annual precipitation. Two dimensional niche of the family Elapidae based on Annual Mean Temperature and Annual Precipitation represents a total of 45 (84.9%) of 53 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.1h Family Viperidae

The MaxEnt analysis revealed that the viperid snakes preferred annual mean temperature range is in between 25.2°C to 28.5°C. The more frequency of viperid snakes can be seen in between 27.2°C and 27.9°C annual mean temperature and least number of observations can be observed in between 25.2°C and 25.9°C annual mean temperature. The viperid snakes preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of snakes can be seen in between 677.0mm to 799.0mm annual precipitation and least number of observations can be observed in between
1165.0mm and 1287.0mm annual precipitation. Two dimensional niche of the family Viperidae based on Annual Mean Temperature and Annual Precipitation represents a total of 16 (80.0%) of 20 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables.

4.3.2 Preferred climatic parameters – Species-wise

The distribution of 29 species of snakes belonging to eight families, namely – Typhlopidae, Pythonidae, Boidae, Colubridae, Natricidae, Homalopsidae, Elapidae and Viperidae is discussed in the light of climatic requirements as predicted by the MaxEnt analysis.

4.3.2a Beaked worm snake *Grypotyphlops acutus* (Duméril & Bibron, 1844)

The MaxEnt analysis revealed that the Beaked worm snake preferred annual mean temperature range is in between 26.0°C and 28.5°C. The more frequency of Beaked worm snake can be seen in between 26.0°C and 26.5°C annual mean temperature and least number of observations can be observed in between 28.0°C and 28.5°C annual mean temperature. The Beaked worm snake preferred annual precipitation range is in between 678.0mm and 1123.0mm. The more frequency of snakes can be seen in between 678.0mm and 767.0mm and, 1034mm and 1123mm annual precipitation and least number of observations can be observed in between 856.0mm and 945.0mm annual precipitation. Two dimensional niche of the Beaked worm snake based on Annual Mean Temperature and Annual Precipitation represents a total of 6 (66.7%) of 9 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Minimum Temperature of Coldest Month (BIO6) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2b Brahminy worm snake *Ramphotyphlops braminus* (Daudin, 1803)

The MaxEnt analysis revealed that the Brahminy worm snake preferred annual mean temperature range is in between 26.2°C and 28.4°C. The more frequency of Brahminy worm snake can be seen in between 26.2°C and 26.4°C annual mean temperature and least number of observations can be observed in between 28.1°C and 28.4°C annual mean temperature. The Brahminy worm snake preferred annual precipitation range is in between 675.0mm and 1121.0mm. The more frequency of snakes can be seen in between 675.0mm and 780.0mm annual precipitation and least number of observations can be observed in between 858.0mm and 998.0mm annual precipitation. Two dimensional niche of the Brahminy worm snake based on Annual Mean Temperature and Annual Precipitation represents a total of 24 (66.7%) of 28 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Wettest Month (BIO13) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2c Indian rock python *Python molurus* (Linnaeus, 1758)

The MaxEnt analysis revealed that the Indian rock python preferred annual mean temperature range is in between 26.3°C and 28.5°C. The more frequency of Indian rock python can be seen in between 26.3°C and 26.7°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.2°C annual mean temperature. The Indian rock python preferred annual precipitation range is in between 633.0mm and 1106.1mm. The more frequency of Indian rock python can be seen in between 633.0mm and 727.6mm annual precipitation and least number of observations can be observed in between 727.6mm and 916.8mm annual precipitation. Two dimensional niche of the Indian rock python based on Annual Mean Temperature and Annual Precipitation represents a total of 8 (66.7%) of 12 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Driest Month (BIO14) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2d Red sand boa *Eryx johnii* (Russell, 1801)

The MaxEnt analysis revealed that the Red sand boa preferred annual mean temperature range is in between 26.2°C and 28.5°C. The more frequency of Red sand boa can be seen in between 26.2°C and 27.1°C annual mean temperature and least number of observations can be observed in between 27.1°C and 27.6°C annual mean temperature. The Red sand boa preferred annual precipitation range is in between 677.0mm and 1099.0mm. The more frequency of Red sand boa can be seen in between 677.0mm and 761.4mm annual precipitation and least number of observations can be observed in between 845.8mm and 1099.0mm annual precipitation. Two dimensional niche of the Red sand boa based on Annual Mean Temperature and Annual Precipitation represents a total of 9 (75.0%) of 12 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Annual Precipitation (BIO12) is the most contributing environmental variable relatively to the MaxEnt model.

4.3.2e Common sand boa *Gongylophis conicus* (Schneider, 1801)

The MaxEnt analysis revealed that the Common sand boa preferred annual mean temperature range is in between 26.0°C and 28.5°C. The more frequency of Common sand boa can be seen in between 26.0°C and 26.5°C annual mean temperature and least number of observations can be observed in between 27.0°C and 27.5°C annual mean temperature. The Common sand boa preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of Common sand boa can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations can be observed in between 1043.0mm and 1287.0mm annual precipitation. Two dimensional niche of the Common sand boa based on Annual Mean Temperature and Annual Precipitation represents a total of 14 (77.8%) of 18 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Wettest Month (BIO13) is the most contributing environmental variable relatively to the MaxEnt model.
4.3.2f Common trinket snake *Coelognathus helena* (Daudin, 1803)

The MaxEnt analysis revealed that the Common trinket snake preferred annual mean temperature range is in between 26.0°C and 28.5°C. The more frequency of Common trinket snake can be seen in between 26.0°C and 26.5°C annual mean temperature and least number of observations can be observed in between 26.5°C and 27.5°C annual mean temperature. The Common trinket snake preferred annual precipitation range is in between 633.0mm and 1158.0mm. The more frequency of Common trinket snake can be seen in between 633.0mm and 738.0mm annual precipitation and least number of observations can be observed in between 738.0mm and 843.0mm annual precipitation. Two dimensional niche of the Common trinket snake based on Annual Mean Temperature and Annual Precipitation represents a total of 9 (69.2%) of 13 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Minimum Temperature of Coldest Month (BIO6) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2g Indian rat snake *Ptyas mucosa* (Linnaeus, 1758)

The MaxEnt analysis revealed that the Indian rat snake preferred annual mean temperature range is in between 26.2°C and 28.5°C. The more frequency of Indian rat snake can be seen in between 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 27.1°C and 27.6°C annual mean temperature. The Indian rat snake preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of Indian rat snake can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations can be observed in between 1165.0mm and 1287.0mm annual precipitation. Two dimensional niche of the Indian rat snake based on Annual Mean Temperature and Annual Precipitation represents a total of 28 (90.3%) of 31 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Minimum Temperature of Coldest Month (BIO6) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2h Banded racer *Argyrogena fasciolata* (Shaw, 1802)

The MaxEnt analysis revealed that the Banded racer preferred annual mean temperature range is in between 25.5°C and 28.5°C. The more frequency of Banded racer can be seen in between 26.7°C and 27.3°C annual mean temperature and least number of observations can be observed in between 25.5°C and 26.1°C annual mean temperature. The Banded racer preferred annual precipitation range is in between 671.0mm and 1113.0mm. The more frequency of Banded racer can be seen in between 671.0mm and 759.4mm annual precipitation and least number of observations can be observed in between 759.4mm and 1113.0mm annual precipitation. Two dimensional niche of the Banded racer based on Annual Mean Temperature and Annual Precipitation represents a total of 6 (60.0%) of 10 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Warmest Quarter (BIO18) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2i Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976

The MaxEnt analysis revealed that the Nagarjunasagar racer preferred annual mean temperature range is in between 26.2°C and 28.5°C. The corresponding annual mean temperature value ranges for two sites from where the Nagarjunasagar racer is known are between 26.2°C and 26.6°C, and between 28.1°C and 28.5°C. The corresponding mean annual precipitation value ranges for two sites from where the Nagarjunasagar racer is known are between 678.0mm and 705.8mm, and between 789.2mm and 817.0mm. Two dimensional niche of the Nagarjunasagar racer based on Annual Mean Temperature and Annual Precipitation represents a total of 2 (100.0%) of 2 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2j Common kukri snake *Oligodon arnensis* (Shaw, 1802)

The MaxEnt analysis revealed that the Common kukri snake preferred annual mean temperature range is in between 26.2°C and 28.5°C. The more frequency of Common kukri snake can be seen in between 26.2°C and 26.7°C, and 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.1°C and 27.6°C and 28.1°C annual mean temperature. The Common kukri snake preferred annual precipitation range is in between 678.0mm and 1047.0mm. The more frequency of Common kukri snake can be seen in between 678.0mm and 751.8mm, 825.6mm and 899.4mm, and 973.2mm and 1047.0mm annual precipitation and least number of observations can be observed in between 751.8mm and 825.6mm annual precipitation. Two dimensional niche of the Common kukri snake based on Annual Mean Temperature and Annual Precipitation represents a total of 4 (57.1%) of 6 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2k Russell’s kukri snake *Oligodon taeniolatus* (Jerdon, 1853)

The MaxEnt analysis revealed that the Russell’s kukri snake preferred annual mean temperature range is in between 26.2°C and 28.5°C. The corresponding annual mean temperature value ranges for two sites from where the Russell’s kukri snake is known are between 26.0°C and 26.5°C, and between 28.0°C and 28.5°C. The corresponding mean annual precipitation value ranges for two sites from where the Russell’s kukri snake is known are between 678.0mm and 683.4mm, and between 699.6mm and 705.0mm. Two dimensional niche of the Russell’s kukri snake based on Annual Mean Temperature and Annual Precipitation represents a total of 2 (100.0%) of 2 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Annual Precipitation (BIO12) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2i Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803)

The MaxEnt analysis revealed that the Common bronzeback tree snake preferred annual mean temperature range is in between 26.4°C and 28.6°C. The more frequency of Common bronzeback tree snake can be seen in between 27.7°C and 28.2°C annual mean temperature and least number of observations can be observed in between 27.3°C and 27.7°C annual mean temperature. The Common bronzeback tree snake preferred annual precipitation range is in between 677.0mm and 1312.0mm. The more frequency of Common bronzeback tree snake can be seen in between 677.0mm and 804.0mm annual precipitation and least number of observations can be observed in between 931.0mm and 1058.0mm annual precipitation. Two dimensional niche of the Common bronzeback tree snake based on Annual Mean Temperature and Annual Precipitation represents a total of 7 (63.6%) of 11 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2m Common wolf snake *Lycodon aulicus* (Linnaeus, 1754)

The MaxEnt analysis revealed that the Common wolf snake preferred annual mean temperature range is in between 25.5°C and 28.5°C. The more frequency of Common wolf snake can be seen in between 27.9°C and 28.5°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.3°C annual mean temperature. The Common wolf snake preferred annual precipitation range is in between 678.0mm and 1099.0mm. The more frequency of Common wolf snake can be seen in between 678.0mm and 762.2mm annual precipitation and least number of observations can be observed in between 762.2mm and 930.6mm annual precipitation. Two dimensional niche of the Common wolf snake based on Annual Mean Temperature and Annual Precipitation represents a total of 2 (40.0%) of 5 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Coldest Quarter (BIO19) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2n Barred wolf snake *Lycodon striatus* (Shaw, 1802)

The MaxEnt analysis revealed that the Barred wolf snake preferred annual mean temperature range is in between 26.4°C and 28.5°C. The more frequency of Barred wolf snake can be seen in between 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 26.8°C and 27.3°C annual mean temperature. The Barred wolf snake preferred annual precipitation range is in between 671.0mm and 1099.0mm. The more frequency of Barred wolf snake can be seen in between 671.0mm and 756.6mm annual precipitation and least number of observations can be observed in between 756.6mm and 1013.4mm annual precipitation. Two dimensional niche of the Barred wolf snake based on Annual Mean Temperature and Annual Precipitation represents a total of 2 (40.0%) of 5 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Coldest Quarter (BIO19) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2o Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007

The MaxEnt analysis for the distribution of the Yellow-collared wolf snake could not be done as it is known only from few locations in Hyderabad. The annual mean temperature range from the location it was recorded was in between 20.8°C and 32.5°C, with mean annual precipitation range being 766.0mm.

4.3.2p Forsten’s cat snake *Boiga forsteni* (Dumeril, Bibron & Dumeril, 1854)

The MaxEnt analysis for the distribution of the Forsten’s cat snake could not be done as it is known only from one locality in Mahbubnagar district. The annual mean temperature range from the location it was recorded was in between 21.5°C and 32.8°C, with mean annual precipitation range being 673.0mm.
4.3.2q Common Indian cat snake *Boiga trigonata* (Bechstein, 1802)

The MaxEnt analysis revealed that the Common Indian cat snake preferred annual mean temperature range is in between 26.4°C and 28.5°C. The more frequency of Common Indian cat snake can be seen in between 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 26.8°C and 28.1°C annual mean temperature. The Common Indian cat snake preferred annual precipitation range is in between 678.0mm and 1287.0mm. The more frequency of Common Indian cat snake can be seen in between 678.0mm and 921.6mm annual precipitation and least number of observations can be observed in between 921.6mm and 1165.2mm annual precipitation. Two dimensional niche of the Common Indian cat snake based on Annual Mean Temperature and Annual Precipitation represents a total of 5 (62.5%) of 8 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Altitude (ALT) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2r Common vine snake *Ahaetulla nasuta* (Lacepede, 1789)

The MaxEnt analysis revealed that the Common vine snake preferred annual mean temperature range is in between 25.0°C and 28.6°C. The more frequency of Common vine snake can be seen in between 26.5°C and 28.6°C annual mean temperature and least number of observations can be observed in between 25.0°C and 25.7°C annual mean temperature. The Common vine snake preferred annual precipitation range is in between 633.0mm and 1295.0mm. The more frequency of Common vine snake can be seen in between 633.0mm and 765.4mm annual precipitation and least number of observations can be observed in between 765.4mm and 1162.6mm annual precipitation. Two dimensional niche of the Common vine snake based on Annual Mean Temperature and Annual Precipitation represents a total of 36 (90.0%) of 40 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Altitude (ALT) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2s Striped keelback *Amphiesma stolatum* (Linnaeus, 1758)

The MaxEnt analysis revealed that the Striped keelback preferred annual mean temperature range is in between 26.2°C and 28.5°C. The more frequency of Striped keelback can be seen in between 27.6°C and 28.1°C annual mean temperature and least number of observations can be observed in between 27.1°C and 27.6°C annual mean temperature. The Striped keelback preferred annual precipitation range is in between 678.0mm and 1295.0mm. The more frequency of Striped keelback can be seen in between 678.0mm and 801.4mm annual precipitation and least number of observations can be observed in between 801.4mm and 924.8mm annual precipitation. Two dimensional niche of the Striped keelback based on Annual Mean Temperature and Annual Precipitation represents a total of 23 (88.5%) of 26 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Altitude (ALT) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2t Olive keelback water snake *Atretium schistosum* (Daudin, 1803)

The MaxEnt analysis for the distribution of the Olive keelback water snake could not be done as it is known only from one locality in Nalgonda district. The annual mean temperature range from the location it was recorded was in between 22.8°C and 34.3°C, with mean annual precipitation range being 678.0mm.

4.3.2u Green keelback *Macrophistodon plumbicolor* (Cantor, 1839)

The MaxEnt analysis revealed that the Green keelback preferred annual mean temperature range is in between 25.5°C and 28.5°C. The more frequency of Green keelback can be seen in between 26.1°C and 26.7°C annual mean temperature and least number of observations can be observed in between 26.7°C and 27.9°C annual mean temperature. The Green keelback preferred annual precipitation range is in between 678.0mm and 905.0mm. The more frequency of Green keelback can be seen in between 678.0mm and 768.8mm annual precipitation and least number of observations can be observed in between 768.8mm and 859.6mm annual precipitation. Two dimensional
niche of the Green keelback based on Annual Mean Temperature and Annual Precipitation represents a total of 2 (40.0%) of 5 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Annual Precipitation (BIO12) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2v Checkered keelback *Xenochrophis piscator* (Schneider, 1799)

The MaxEnt analysis revealed that the Checkered keelback preferred annual mean temperature range is in between 26.1°C and 28.7°C. The more frequency of Checkered keelback can be seen in between 26.1°C and 26.7°C annual mean temperature and least number of observations can be observed in between 28.1°C and 28.7°C annual mean temperature. The Checkered keelback preferred annual precipitation range is in between 676.0mm and 1259.0mm. The more frequency of Checkered keelback can be seen in between 676.0mm and 766.8mm annual precipitation and least number of observations can be observed in between 766.8mm and 857.6mm annual precipitation. Two dimensional niche of the Checkered keelback based on Annual Mean Temperature and Annual Precipitation represents a total of 25 (89.3%) of 28 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation of Driest Quarter (BIO17) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2w Common smooth-scaled water snake *Enhydris enhydris* (Schneider, 1799)

The MaxEnt analysis for the distribution of the Common smooth-scaled water snake could not be done as it is known only from one locality in Nalgonda district. The annual mean temperature range from the location it was recorded was in between 22.8°C and 34.3°C, with mean annual precipitation range being 678.0mm.
4.3.2x Banded krait *Bungarus fasciatus* (Schneider, 1801)

The MaxEnt analysis revealed that the Banded krait preferred annual mean temperature range is in between 27.9°C and 28.3°C. The more frequency of Banded krait can be seen in between 28.2°C and 28.3°C annual mean temperature and least number of observations can be observed in between 28.0°C and 28.0°C annual mean temperature. The Banded krait preferred annual precipitation range is in between 834.0mm and 872.0mm. The more frequency of Banded krait can be seen in between 834.0mm and 849.2mm and 856.8mm and 872.0mm annual precipitation and least number of observations can be observed in between 849.2mm and 856.8mm annual precipitation. Two dimensional niche of the Banded krait based on Annual Mean Temperature and Annual Precipitation represents a total of 1 (25.0%) of 4 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2y Common Indian krait *Bungarus caeruleus* (Schneider, 1801)

The MaxEnt analysis revealed that the Common Indian krait preferred annual mean temperature range is in between 26.2°C and 28.5°C. The more frequency of Common Indian krait can be seen in between 28.1°C and 28.5°C annual mean temperature and least number of observations can be observed in between 27.1°C and 27.6°C annual mean temperature. The Common Indian krait preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of Common Indian krait can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations can be observed in between 1165.0mm and 1287.0mm annual precipitation. Two dimensional niche of the Common Indian krait based on Annual Mean Temperature and Annual Precipitation represents a total of 35 (83.3%) of 42 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2z Spectacled cobra *Naja naja* (Linnaeus, 1758)

The MaxEnt analysis revealed that the Spectacled cobra preferred annual mean temperature range is in between $26.2^\circ$C and $28.5^\circ$C. The more frequency of Spectacled cobra can be seen in between $27.6^\circ$C and $28.1^\circ$C annual mean temperature and least number of observations can be observed in between $28.1^\circ$C and $28.5^\circ$C annual mean temperature. The Spectacled cobra preferred annual precipitation range is in between 664.0mm and 1287.0mm. The more frequency of Spectacled cobra can be seen in between 664.0mm and 788.6mm annual precipitation and least number of observations can be observed in between 1162.4mm and 1287.0mm annual precipitation. Two dimensional niche of the Spectacled cobra based on Annual Mean Temperature and Annual Precipitation represents a total of 16 (80.0%) of 20 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Maximum Temperature of Warmest Month (BIO5) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2aa Russell’s viper *Daboia russelli* (Shaw & Nodder, 1797)

The MaxEnt analysis revealed that the Russell’s viper preferred annual mean temperature range is in between $26.4^\circ$C and $28.5^\circ$C. The more frequency of Russell’s viper can be seen in between $26.4^\circ$C and $26.8^\circ$C annual mean temperature and least number of observations can be observed in between $28.1^\circ$C and $28.5^\circ$C annual mean temperature. The Russell’s viper preferred annual precipitation range is in between 677.0mm and 1287.0mm. The more frequency of Russell’s viper can be seen in between 677.0mm and 799.0mm annual precipitation and least number of observations can be observed in between 1165.0mm and 1287.0mm annual precipitation. Two dimensional niche of the Russell’s viper based on Annual Mean Temperature and Annual Precipitation represents a total of 14 (77.8%) of 18 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables. For this species, the Precipitation Seasonality (BIO15) is the most contributing environmental variable relatively to the MaExnt model.
4.3.2ab Saw-scaled viper *Echis carinatus* (Schneider, 1801)

The MaxEnt analysis revealed that the Saw-scaled viper preferred annual mean temperature range is in between $26.3^\circ{C}$ and $28.5^\circ{C}$. The more frequency of Saw-scaled viper can be seen in between $26.3^\circ{C}$ and $26.7^\circ{C}$ annual mean temperature and least number of observations can be observed in between $26.7^\circ{C}$ and $28.1^\circ{C}$ annual mean temperature. The Saw-scaled viper preferred annual precipitation range is in between $678.0\text{mm}$ and $1099.0\text{mm}$. The more frequency of Saw-scaled can be seen in between $678.0\text{mm}$ and $846.4\text{mm}$ and, $1014.8\text{mm}$ and $1099.0\text{mm}$ annual precipitation and least number of observations can be observed in between $846.4\text{mm}$ and $1014.8\text{mm}$ annual precipitation. Two dimensional niche of the Saw-scaled viper based on Annual Mean Temperature and Annual Precipitation represents no sightings (0.0%) of 3 distinct and non-overlapping observations having a climatic profile with values for annual mean temperature and annual precipitation within the range limits of these two variables, indicating that the effect of these two parameters is purely coincidental or lack of sufficient observation points to conclude any effect. For this species, the Precipitation of Coldest Quarter (BIO19) is the most contributing environmental variable relatively to the MaExnt model.

4.3.2ac Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802)

The MaxEnt analysis for the distribution of the Bamboo pit viper which is known from only two locations reveal that the species prefers the annual mean temperature range between $25.8^\circ{C}$ and $36.3^\circ{C}$ and mean annual precipitation range being between $731.0\text{mm}$ and $1099.0\text{mm}$. For this species, the Mean Temperature of Coldest Quarter (BIO11) is the most contributing environmental variable relatively to the MaExnt model. Perhaps more number of sighting records will help in understanding better the preferred climatic parameters for Bamboo pit viper in Telangana.
4.4 ECOLOGY

4.4.1 Nocturnal, diurnal or crepuscular

Activity either during the day time or night time governs the snakes’ detection by people. Excepting one species, Indian rock python *Python molurus* (Linnaeus, 1758) (Pythonidae) that was crepuscular in nature, all other snake fauna were either nocturnal or diurnal in nature. The nocturnal species of Telangana include Beaked worm snake *Grypotyphlops acutus* (Duméril & Bibron, 1844) (Typhlopidae), Brahminy worm snake *Ramphotyphlops braminus* (Daudin, 1803) (Typhlopidae), Red sand boa *Eryx johnii* (Russell, 1801) (Boidae), Common sand boa *Gongyladis conicus* (Schneider, 1801) (Boidae), Common wolf snake *Lycodon aulicus* (Linnaeus, 1754) (Colubridae), Barred wolf snake *Lycodon striatus* (Shaw, 1802) (Colubridae), Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae), Forsten's cat snake *Boiga forsteni* (Duméry et al., 1854) (Colubridae), Common Indian cat snake *Boiga trigonata* (Bechstein, 1802) (Colubridae), Green keelback *Macrophiostodon plumbicolar* (Cantor, 1839) (Natricidae), Common smooth-scaled water snake *Enhydryis enhydryis* (Schneider, 1799) (Homalopsidae), Banded krait *Bungaros fasciatus* (Schneider, 1801) (Elapidae), Common Indian krait *Bungaros caeruleus* (Schneider, 1801) (Elapidae), Russell’s viper *Daboia russelii* (Shaw & Nodder, 1797) (Viperidae), Saw-scaled viper *Echis carinatus* (Schneider, 1801) (Viperidae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae). A few of these species were also occasionally sighted active during day time, but such activities were restricted to human-induced disturbances or other biotic pressures.

The diurnal species of Telangana include Common trinket snake *Coelognathus helena* (Daudin, 1803) (Colubridae), Indian rat snake *Ptyas mucosa* (Linnaeus, 1758) (Colubridae), Banded racer *Argyrogena fasciatala* (Shaw, 1802) (Colubridae), Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae), Common kukri snake *Oligodon arnensis* (Shaw, 1802) (Colubridae), Russell’s kukri snake *Oligodon taeniolatus* (Jerdon, 1853) (Colubridae), Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803) (Colubridae), Common vine snake *Ahaetulla nasuta* (Lacepede,
Two species, namely, Checkered keelback *Xenochrophis piscator* (Schneider, 1799) (Natricidae) and Spectacled cobra *Naja naja* (Linnaeus, 1758) (Elapidae) were found active both during day and night time.

### 4.4.2 Non-venomous and venomous snakes

The snake fauna of Telangana consists mainly of non-venomous species (21 species), 2 mildly venomous species and six venomous species. The non-venomous snakes of Telangana are Beaked worm snake *Grypotyphlops acutus* (Duménil & Bibron, 1844) (Typhlopidae), Brahminy worm snake *Ramphotyphlops braminus* (Daudin, 1803) (Typhlopidae), Indian rock python *Python molurus* (Linnaeus, 1758) (Pythonidae), Red sand boa *Eryx johnii* (Russell, 1801) (Boidae), Common sand boa *Gongylophis conicus* (Schneider, 1801) (Boidae), Common trunket snake *Coelognathus helena* (Daudin, 1803) (Colubridae), Indian rat snake *Ptyas mucosa* (Linnaeus, 1758) (Colubridae), Banded racer *Argyrogena fasciolata* (Shaw, 1802) (Colubridae), Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae), Common kukri snake *Oligodon arnensis* (Shaw, 1802) (Colubridae), Russell’s kukri snake *Oligodon taeniolatus* (Jerdon, 1853) (Colubridae), Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803) (Colubridae), Common wolf snake *Lycodon aulicus* (Linnaeus, 1754) (Colubridae), Barred wolf snake *Lycodon striatus* (Shaw, 1802) (Colubridae), Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae), Common vine snake *Ahaetulla nasuta* (Lacepede, 1789) (Colubridae), Striped keelback *Amphiesma stolatum* (Linnaeus, 1758) (Natricidae), Olive keelback water snake *Atretium schistosum* (Daudin, 1803) (Natricidae), Green keelback *Macrophistodon plumibicolor* (Cantor, 1839) (Natricidae), Checkered keelback *Xenochrophis piscator* (Schneider, 1799) (Natricidae), and Common smooth-scaled water snake *Enhydris enhydris* (Schneider, 1799) (Homalopsidae), are non-venomous. The mildly venomous snakes of Telangana are Forsten's cat snake *Boiga forsteni* (Duménil *et al.*, 1854) (Colubridae) and Common Indian cat snake *Boiga trigonata* (Bechstein, 1802) (Colubridae). The venomous snakes
of Telangana are Banded krait *Bungarus fasciatus* (Schneider, 1801) (Elapidae), Common Indian krait *Bungarus caeruleus* (Schneider, 1801) (Elapidae), Spectacled cobra *Naja naja* (Linnaeus, 1758) (Elapidae), Russell’s viper *Daboia russelii* (Shaw & Nodder, 1797) (Viperidae), Saw-scaled viper *Echis carinatus* (Schneider, 1801) (Viperidae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae).

### 4.4.3 Diet and trophic structure

The serpents are carnivorous in nature and will feed from insect eggs and larvae to small- to medium-sized mammals (Mehrtens, 1987). As snakes cannot bite or tear their prey, they have to swallow their prey whole. Their diet and trophic status is determined by their size, for example smaller snakes like the blind snakes feed on soft-bodied insects and their larvae, while the pythons feed on medium to large-sized vertebrates. Snakes can consume preys bigger than the diameter of the body due to flexibility of the skeletal system and disjointed jaws. The dentary bones of the mandible of the snake are joined by an elastic ligament that can be stretched to open the mouth to accommodate larger prey items. Some snakes swallow their prey live, some constrict and suffocate them to death and then swallow, while some use venom to immobilize and pre-digest the prey before swallowing them (Mehrtens, 1987; Freiberg & Walls, 1984).

Two species – Beaked worm snake *Grypotyphlops acutus* (Duméril & Bibron, 1844) (Typhlopidae), and Brahminy worm snake *Ramphotyphlops braminus* (Daudin, 1803) (Typhlopidae), feed on soft-bodied insects. One species – Indian rock python *Python molurus* (Linnaeus, 1758) (Pythonidae), feeds on medium to large-bodied vertebrates. Two species – Red sand boa *Eryx johnii* (Russell, 1801) (Boidae), Common sand boa *Gongylphis conicus* (Schneider, 1801) (Boidae), feed on insects, lizards and small vertebrates. Four species – Common trinket snake *Coelognathus helena* (Daudin, 1803) (Colubridae), Indian rat snake *Ptyas mucosa* (Linnaeus, 1758) (Colubridae), Banded racer *Argyrogena fasciolata* (Shaw, 1802) (Colubridae), and Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae), feed on small invertebrates, lizards, and small snakes. Two species – Common kukri snake *Oligodon arnensis* (Shaw, 1802) (Colubridae), and Russell’s kukri snake *Oligodon taeniolatus* (Jerdon, 1853)
(Colubridae), feed on insects, small vertebrates and eggs. Three species – Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803) (Colubridae), Forsten's cat snake *Boiga forsteni* (Duméril et al., 1854) (Colubridae) and Common Indian cat snake *Boiga trigonata* (Bechstein, 1802) (Colubridae), feed on small vertebrates and eggs. Three species – Common wolf snake *Lycodon aulicus* (Linnaeus, 1754) (Colubridae), Barred wolf snake *Lycodon striatus* (Shaw, 1802) (Colubridae), and Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae), feed on small vertebrates. One species – Common vine snake *Ahaetulla nasuta* (Lacepede, 1789) (Colubridae), feeds on small vertebrates and small snakes. Two species – Striped keelback *Amphiesma stolatum* (Linnaeus, 1758) (Natricidae) and Olive keelback water snake *Atretium schistosum* (Daudin, 1803) (Natricidae), feed on frogs, toads, lizards and small mammals. One species – Green keelback *Macrophistodon plumbicolor* (Cantor, 1839) (Natricidae), feeds on frogs and toads. One species – Checkered keelback *Xenochrophis piscator* (Schneider, 1799) (Natricidae), feeds on frogs, toads and fishes. One species – Common smooth-scaled water snake *Enhydris enhydris* (Schneider, 1799) (Homalopsidae), feeds on fishes and small vertebrates. Three species – Banded krait *Bungarus fasciatus* (Schneider, 1801) (Elapidae), Common Indian krait *Bungarus caeruleus* (Schneider, 1801) (Elapidae), and Spectacled cobra *Naja naja* (Linnaeus, 1758) (Elapidae), feed on snakes and small vertebrates. Two species – Russell’s viper *Daboia russelli* (Shaw & Nodder, 1797) (Viperidae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae), feed on small vertebrates. One species – Saw-scaled viper *Echis carinatus* (Schneider, 1801) (Viperidae), feeds on small vertebrates and insects.

**4.4.4 Reproduction**

Snakes reproduce by internal fertilization, which is accomplished by means of paired, forked hemipenes (intromittent organ), which are stored, inverted, in the male's tail. The hemipenes are often grooved, hooked, or spined in order to grip the walls of the female's cloaca (Capula, 1989). Most species are oviparous (lay eggs), majority showing no parental care (leaving/abandoning the eggs shortly after laying), while a few showing parental care, like building a nest, guarding the nest and incubation (King cobra...
Some snakes are ovoviviparous (they ‘give birth’ to live young ones). These are basically egg-bearing snakes that retain the eggs within their bodies until they are ready to hatch (Capula, 1989; Cogger, 1991). Recent studies have revealed that some snakes are fully viviparous, nourishing their young through a placenta as well as a yolk sac (Cogger, 1991).

Excepting the species belonging to the families Homalopsidae [Common smooth-scaled water snake Enhydris enhydris (Schneider, 1799)] and Viperidae [Russell’s viper Daboia russelii (Shaw & Nodder, 1797), Saw-scaled viper Echis carinatus (Schneider, 1801), and Bamboo pit viper Trimeresurus gramineus (Shaw, 1802)] which are viviparous in nature, all other species of snakes in Telangana are oviparous [Beaked worm snake Gypotyphlops acutus (Duménil & Bibron, 1844) (Typhlopidae), Brahminy worm snake Ramphotyphlops braminus (Daudin, 1803) (Typhlopidae), Indian rock python Python molurus (Linnaeus, 1758) (Pythonidae), Red sand boa Eryx johnii (Russell, 1801) (Boidae), Common sand boa Gongylophis conicus (Schneider, 1801) (Boidae), Common trinket snake Coelognathus helena (Daudin, 1803) (Colubridae), Indian rat snake Ptyas mucosa (Linnaeus, 1758) (Colubridae), Banded racer Argyrogena fasciolata (Shaw, 1802) (Colubridae), Nagarjunasagar racer Coluber bholanathi Sharma, 1976 (Colubridae), Common kukri snake Oligodon arnensis (Shaw, 1802) (Colubridae), Russell’s kukri snake Oligodon taeniolatus (Jerdon, 1853) (Colubridae), Common bronzeback tree snake Dendrelaphis tristis (Daudin, 1803) (Colubridae), Common wolf snake Lycodon aulicus (Linnaeus, 1754) (Colubridae), Barred wolf snake Lycodon striatus (Shaw, 1802) (Colubridae), Yellow-collared wolf snake Lycodon flavicollis Mukherjee & Bhupathy, 2007 (Colubridae), Forsten's cat snake Boiga forsteni (Duménil et al., 1854) (Colubridae), Common Indian cat snake Boiga trigonata (Bechstein, 1802) (Colubridae), Common vine snake Ahaetulla nasuta (Lacepede, 1789) (Colubridae), Striped keelback Amphiesma stolatum (Linnaeus, 1758) (Natricidae), Olive keelback water snake Atretium schistosum (Daudin, 1803) (Natricidae), Green keelback Macrophistodon plumbicolor (Cantor, 1839) (Natricidae), Checkered keelback Xenochrophis piscator (Schneider, 1799) (Natricidae), Banded krait Bungarus fasciatus (Schneider, 1801) (Elapidae), Common Indian krait Bungarus caeruleus (Schneider, 1801) (Elapidae), and Spectacled cobra Naja naja (Linnaeus, 1758)].
4.4.5 Habit and Habitat preferences

Snakes show varied habits and are found in various habitats (Capula, 1989). As Telangana is the part of dry Deccan area on peninsular India, the general habitat of the area can be classified as dry forest and scrub jungle type. Most of the region is human-influenced and very little pristine forest (primary habitats) is available. Excepting the forested tracts in the Godavari river basin and the Nallamala hills the whole region is secondary forest, scrub jungle, agriculture fields or fallow lands.

Many species in Telangana are terrestrial [Indian rock python *Python molurus* (Linnaeus, 1758) (Pythonidae), Banded racer *Argyrogena fasciolata* (Shaw, 1802) (Colubridae), Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae), Common kukri snake *Oligodon arnensis* (Shaw, 1802) (Colubridae), Russell’s kukri snake *Oligodon taeniolatus* (Jerdon, 1853) (Colubridae), Banded krait *Bungarus fasciatus* (Schneider, 1801) (Elapidae), Common Indian krait *Bungarus caeruleus* (Schneider, 1801) (Elapidae), Spectacled cobra *Naja naja* (Linnaeus, 1758), Russell’s viper *Daboia russelii* (Shaw & Nodder, 1797) (Viperidae), Saw-scaled viper *Echis carinatus* (Schneider, 1801) (Viperidae)], a few fossorial [Beaked worm snake *Grypotyphlops acutus* (Duméril & Bibron, 1844) (Typhlopidae), Brahminy worm snake *Ramphotyphlops braminus* (Daudin, 1803) (Typhlopidae), Red sand boa *Eryx johnii* (Russell, 1801) (Boidae), Common sand boa *Gongylophis conicus* (Schneider, 1801) (Boidae)], a few terrestrial and arboreal [Common trinket snake *Coelognathus helena* (Daudin, 1803) (Colubridae), and Indian rat snake *Ptyas mucosa* (Linnaeus, 1758) (Colubridae)], a few arboreal and terrestrial [Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803) (Colubridae), Common wolf snake *Lycodon aulicus* (Linnaeus, 1754) (Colubridae), Barred wolf snake *Lycodon striatus* (Shaw, 1802) (Colubridae), Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae), Forsten's cat snake *Boiga forsteni* (Duméril et al., 1854) (Colubridae), Common Indian cat snake *Boiga trigonata* (Bechstein, 1802) (Colubridae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae)], one arboreal [Common vine snake *Ahaetulla nasuta* (Lacepede, 1789) (Colubridae)], and a few semi aquatic and terrestrial [Striped keelback *Amphiesma stolatum* (Linnaeus, 1758) (Natricidae), and Checkered keelback *Xenochrophis piscator* (Schneider, 1799) (Natricidae), Olive keelback water snake
*Atretium schistosum* (Daudin, 1803) (Natricidae), Green keelback *Macrophistodon plumbicolor* (Cantor, 1839) (Natricidae), and Common smooth-scaled water snake *Enhydris enhydris* (Schneider, 1799) (Homalopsidae).

Most species of snakes in Telangana have been found inhabiting primary or modified/secondary habitats. Although many species are not human commensal, most have been found in anthropogenic habitats. The two forest-dwelling species – Banded krait *Bungarus fasciatus* (Schneider, 1801) (Elapidae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae), have often seen near anthropogenic habitats. Most species are oviparous (lay eggs), majority showing no parental care (leaving/abandoning the eggs shortly after laying), while a few showing parental care, like building a nest, guarding the nest and incubation (King cobra *Ophiophagus hannah*). Some snakes are ovoviviparous (they ‘give birth’ to live young ones). These are basically egg-bearing snakes that retain the eggs within their bodies until they are ready to hatch (Capula, 1989; Cogger, 1991). Recent studies have revealed that some snakes are fully viviparous, nourishing their young through a placenta as well as a yolk sac (Cogger, 1991).

### 4.5 Endemic Snakes

Endemism *per se* is not known for snakes in Telangana. Of the 29 species of snakes occurring in Telangana, 12 species are South Asia and India endemics. The south Asian endemic species of snakes found in Telangana include Common sand boa *Gongylophis conicus* (Schneider, 1801) (Boidae), Banded racer *Argyrogena fasciolata* (Shaw, 1802) (Colubridae), Common kukri snake *Oligodon arnensis* (Shaw, 1802) (Colubridae), Common bronzeback tree snake *Dendrelaphis tristis* (Daudin, 1803) (Colubridae), Forsten's cat snake *Boiga forsteni* (Duméril et al., 1854) (Colubridae), Common Indian cat snake *Boiga trigonata* (Bechstein, 1802) (Colubridae), Common Indian krait *Bungarus caeruleus* (Schneider, 1801) (Elapidae), and Spectacled cobra *Naja naja* (Linnaeus, 1758) (Elapidae). The Indian endemic species of snakes found in Telangana include Beaked worm snake *Grypotyphlops acutus* (Duménil & Bibron, 1844) (Typhlopidae), Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae), Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007.
(Colubridae), and Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae). Excepting the Beaked worm snake *Grypotyphlops acutus* (Duméril & Bibron, 1844) (Typhlopidae) which was found in seven localities, all the Indian endemics are restricted to two or less than two localities. The Nagarjunasagar racer *Coluber bholanathi* Sharma, 1976 (Colubridae) is known from two localities – one each in Nalgonda and Hyderabad districts. The Yellow-collared wolf snake *Lycodon flavicollis* Mukherjee & Bhupathy, 2007 (Colubridae) is known from only three sites in the urban conglomerate of Hyderabad in Hyderabad district. The Bamboo pit viper *Trimeresurus gramineus* (Shaw, 1802) (Viperidae) is known from two localities – one each from Adilabad and Mahbubnagar districts.