

## Mammalian Fauna of Semi-Arid Chitradurga District, Karnataka, India

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### ABSTRACT

Mammalian fauna has been dealt with at length by biodiversity studies as part of studying animal groups. Among all animal groups, mammalian fauna plays a vital role in both the terrestrial and aquatic ecosystems by being and playing prey and predator roles across ecosystems. In this context, a study on mammalian fauna was conducted in the semi-arid region of Chitradurga district, India. Semi-arid ecosystems are unstable but are more resilient to the various biotic and abiotic pressures. In this concern, understanding the status and specific habitats of any species is necessary and in particular, flagship groups such as mammals. The present study was carried out from August 2014 to July 2016. This study aimed to document the mammalian fauna, their habitats and their conflicts with humans and also to explore possible threats in a semi-arid region. Standard eco-

logical methods i.e. Visual Encounter Survey and sign survey were adopted for recording mammalian fauna. During our study period, a total of 19 mammalian species belonging to 13 families were documented. Among 13 families of mammals recorded, Canidae and Muridae are the most dominant families. This region has been subjected to an enormous biotic and abiotic pressure on natural resources due to various factors such as habitat loss, overgrazing and drought. During the study period, we observed a few species, i.e. *Antelope cervicapra* (Blackbuck), *Sus scrofa* (Wild boar) and *Macaca radiata* (Bonnet macaque) frequently raiding the crops and leading to human-animal conflicts in the semi-arid region. As Chitradurga district is located in the heart of Deccan plateau under a semi-arid region of the country, this could be one of the promising regions among other semi-arid areas for undertaking detailed mammalian studies for the conservation aspects.

**Keywords** Mammalian fauna, Semi-arid region, Biodiversity, Human-animal conflict.

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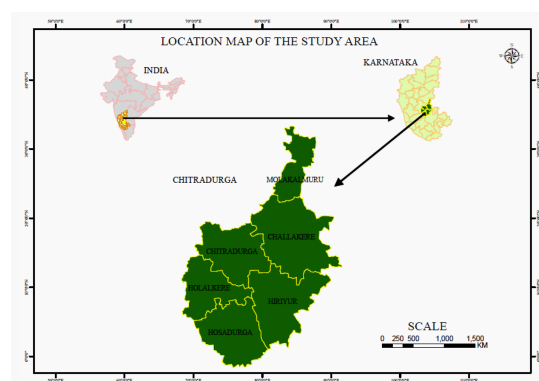
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### INTRODUCTION

India is home to a highly diversified flora and fauna with rich natural ecosystems and geographical complexity (Alfred et al. 2001). It is one of the mega-biodiversity countries, with 2.4% of the world's land area holding approximately 91,000 faunal and

The compositions of biodiversity in dry-land ecosystems are exclusively different from other tropical and temperate zones (Cruz-Elizalde et al. 2016). Species diversity and richness are more in rich vegetation zones (Tropical and temperate) due to diversified habitat types and food availability, climatic conditions (Wiens et al. 2006, Cortés et al 2008). However, drylands, which include arid, semi-arid regions and deserts are less in species richness but are home to some of the most threatened and endemic species (Flores-Villela and Gerez 1994, Bastin et al. 2017). However, various forces such as climate change, pollution and land-use practices are putting increasing pressure and risk on natural resources, biodiversity and human societies (Díaz et al. 2006, Ceballos et al. 2015).

2000, Schimel 2010 Durant et al. 2012, Nautiyal et al. 2015, Bastin et al. 2017). Biodiversity plays an essential role in sustaining any region by providing an ecological, economic and socio-cultural resource to the region with a positive impact on the ecosystem and human life (Semwal et al. 2004, Nautiyal and Kacchele 2007, Nautiyal 2011). In this context, studying the biodiversity in any biogeographic region is necessary to understand the health of ecosystems. Among Animal biodiversity studies, mammals which play both prey and predator roles in ecosystems, are considered as charismatic and flagship species in the conservation of ecosystems and their habitats (Azlan 2006). They are highly potential species inhabiting different landscape and also are directly and indirectly exposed to various threats, particularly their habitat alteration due to human encroachment and interference in many parts of the globe (Payne et al. 1985, Kang et al. 2016). A few mammalian species can be seen and are restricted to only drylands due to ecological conditions of the particular geographic regions. Besides, they are capable of developing more adaptive mechanisms with ecosystems towards various pressures such as climate change, drought, habitat loss (Abere and Oguzor 2011). In this context, there is a need for an in-depth study on mammalian fauna across different habitats and ecosystems of various biogeographic regions of the country, particularly semi-arid regions. Hence, this study was undertaken to document the status of mammals and to identify threats in the semi-arid region of Chitradurga district of Karnataka state, India.



**Fig. 1.** Per cent species under different categories of IUCN, IWPA schedules and Appendices of CITES in semi-arid Chitradurga district.

## MATERIALS AND METHODS

### Study area

The present study was undertaken in Chitradurga district, which is located in the core of Deccan plateau and central part of Karnataka state in India, with a semi-arid climate, covering an area of 8436 km<sup>2</sup>. This district comprises six regions, namely, Chitradurga, Challakere, Hiriyur, Hosadurga, Holalkere, and Molakalamuru and falls between latitude 13° 34' to

15° 02' N and longitude 76° 01' to 77° 01' E with an elevation of 732 meters from above the MSL (Government of India 2014) (Fig. 1). This district experiences a low to moderate rainfall (with an average rainfall of 744 mm), hot summer and pleasant monsoon. The district is characterized by a seasonally dry and tropical savannah climate. Summer starts in early March and extends up to the first week of June. April is the hottest month, with an average temperature of 41°C. Monsoon season starts from June and will extend up to November. Pleasant weather conditions can be

**Table 1.** Checklist of mammals from semi-arid Chitradurga district and their conservation and foraging status. -IUCN- International Union for Conservation of Nature and Natural Resources (VU : Vulnerable; NT; Near Threatened; LC: Least Concern; NE: Not Evaluated) IUCN, 2020); IWPA -Indian Wildlife Protection Act, 1972 (Sch: Schedule); CITES -Convention on International Trade in Endangered Species of Wild Fauna and Floea (App: Appendix).

| Sl. No.                         | Family | Scientific name                                               | Common name                 | IUCN | IWPA      | CITES     | Foraging type             |
|---------------------------------|--------|---------------------------------------------------------------|-----------------------------|------|-----------|-----------|---------------------------|
| <b>Family : Bovidae</b>         |        |                                                               |                             |      |           |           |                           |
| 1                               |        | <i>Antelope cervicapra</i> (Linnaeus, 1758)                   | Blackbuck                   | NT   | Sch- I    | -         | Herbivorous               |
| <b>Family : Canidae</b>         |        |                                                               |                             |      |           |           |                           |
| 2                               |        | <i>Canis aureus</i> (Linnaeus, 1758)                          | Jackal                      | NE   | -         | -         | Omnivorous                |
| 3                               |        | <i>Vulpes bengalensis</i> (Shaw, 1800)                        | Bengal Fox                  | LC   | Sch- II   | App - III | Omnivorous                |
| 4                               |        | <i>Canis lupus pallipes</i> (Sykes, 1831)                     | Indian wolf                 | NE   | Sch - I   |           | Omnivorous                |
| <b>Family : Cereopithecidae</b> |        |                                                               |                             |      |           |           |                           |
| 5                               |        | <i>Macaca radiata</i> (E. Geoffroy, 1812)                     | Bonnet macaque              | LC   | Sch - II  | App - II  | Omnivorous                |
| <b>Family : Felidae</b>         |        |                                                               |                             |      |           |           |                           |
| 6                               |        | <i>Felis chaus</i> (Schreber, 1777)                           | Jungle cat                  | LC   | Sch - II  | App -II   | Carnivorous               |
| 7                               |        | <i>Panthera pardus</i> (Linnaeus, 1758)                       | Leopard                     | VU   | Sch - I   | App -I    | Carnivorous               |
| <b>Family : Herpestidae</b>     |        |                                                               |                             |      |           |           |                           |
| 8                               |        | <i>Herpestes edwardsii</i> (E. Geoffroy saint, Hilaire, 1818) | Indian Gray mongoose        | LC   | Sch - II  | App - III | Omnivorous                |
| <b>Family : Hyaenidae</b>       |        |                                                               |                             |      |           |           |                           |
| 9                               |        | <i>Hyaena hyaena</i> (Linnaeus, 1758)                         | Hyaena                      | NT   | Sch - III | App - III | Carnivorous               |
| <b>Family : Hystricidae</b>     |        |                                                               |                             |      |           |           |                           |
| 10                              |        | <i>Hystrix indica</i> (Kerr, 1792)                            | Indian Procupine            | LC   | Sch-IV    | -         | Omnivorous                |
| <b>Family : Leporidae</b>       |        |                                                               |                             |      |           |           |                           |
| 11                              |        | <i>Lepus nigricollis</i> (F. Cuvier, 1823)                    | Black naped hare            | LC   | Sch- IV   | -         | Herbivorous               |
| <b>Family : Muridae</b>         |        |                                                               |                             |      |           |           |                           |
| 12                              |        | <i>Mus musculus</i> (Linnaeus, 1758)                          | House mouse                 | LC   | Sch - V   | -         | Omnivorous                |
| 13                              |        | <i>Mus booduga</i> (Gray, 1837)                               | Little Indian field mouse   | LC   | Sch - V   | -         | Omnivorous                |
| 14                              |        | <i>Bandicota bengalensis</i> (Gray, 1835)                     | Bandicoot                   | LC   | Sch - V   |           | Omnivorous                |
| <b>Family : Pteropodidae</b>    |        |                                                               |                             |      |           |           |                           |
| 15                              |        | <i>Cynopterus brachyotis</i> (Müller, 1838)                   | Small fruit bat             | LC   | Sch - V   | -         | Frugivorous & Nectivorous |
| 16                              |        | <i>Pteropus giganteus</i> (Brünnich, 1782)                    | Indian flying fox           | LC   | Sch-V     | App-II    | Frugivorous & Nectivorous |
| <b>Family : Sciuridae</b>       |        |                                                               |                             |      |           |           |                           |
| 17                              |        | <i>Funambulus palmarum</i> (Linnaeus, 1766)                   | Three striped palm squirrel | LC   | -         | -         | Granivorous & Herbivorous |
| <b>Family : Suidae</b>          |        |                                                               |                             |      |           |           |                           |
| 18                              |        | <i>Sus scrofa</i> (Linnaeus, 1758)                            | Wildboar                    | LC   | Sch-III   | -         | Omnivorous                |
| <b>Family : Ursidae</b>         |        |                                                               |                             |      |           |           |                           |
| 19                              |        | <i>Melursus ursinus</i> (Shaw, 1791)                          | Slothbear                   | VU   | Sch - I   |           | Omnivorous                |

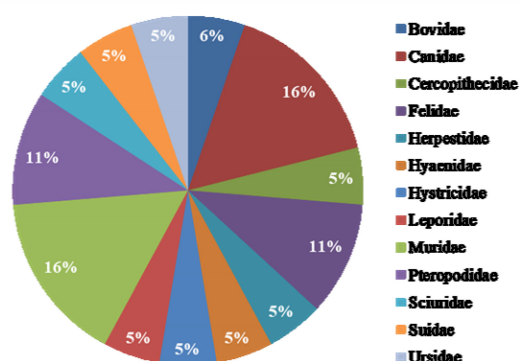


Fig. 2. Percent of species belonging to various families of mammals from Chitradurga district.

found at the beginning of Southwest monsoon in early June and extending up to September before Northeast monsoon setting from October to November. Winter sets in towards the end of November and extends up to the end of February. December is the coldest month with an average minimum temperature of 16.6 °C. Maximum and minimum temperature of Chitradurga district is 37°C and 15°C respectively (Babu 2013). The main physical features of this area include mostly xerophytes, vegetation cover composed mainly of shrubs, herbs, grasses and a few tree species. The forested area of this district is classified under two sub-groups, namely, southern tropical thorn forests and southern tropical dry deciduous forests (Champion and Seth 1968). The main landscape features of this district include built-up land, agricultural land, thorny and dry deciduous forest tracts, grasslands and a few wetlands (Thippaiah 2010).

### Methodology

A mammalian survey was carried out from August 2014 to July 2016 across different possible mammalian habitats. The survey included both night and day observations once every fortnight. Direct counting and sign surveys (pugmarks, pellets/scats, fur/hairs, sounds) were used for recording mammalian species in the study area as followed by Sutherland (2006), Gajera and Dharaiya (2011). Mammalian species were also recorded during travel from one place to another place in the study region as followed by Rodgers (1991), Chellam et al. (1994). While surveying the mammalian species feeding behavior,

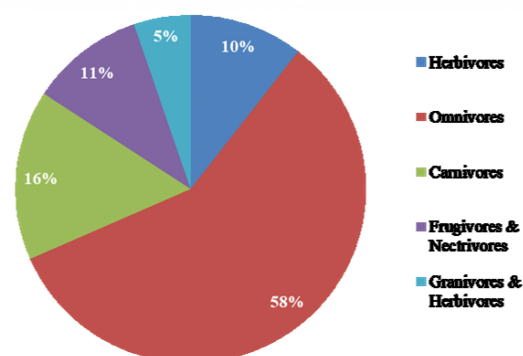


Fig. 3. Forging type of mammalian fauna in the Chitradurga district.

habitat and location of the mammalian species were also recorded. Besides, conservation aspects of the various international and national status of the recorded mammals was assigned by using IUCN, CITES and IWPA reports. Further, the possible threats to mammalian species and human-animal conflicts were also recorded.

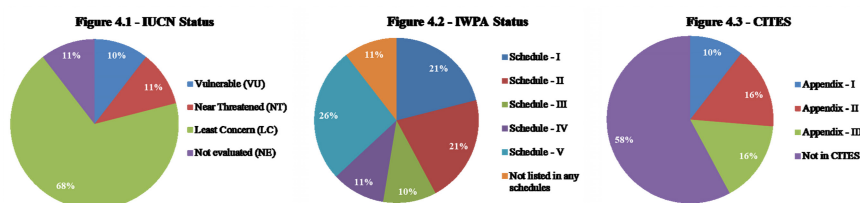
### RESULT AND DISCUSSION

A total of 19 species belonging to 13 families of mammals were recorded in the semi-arid region of Chitradurga district, India (Table 1). Among 13 families of mammals, Canidae and Muridae (16% each) was the most dominant family (Fig. 2). Of the recorded mammalian species, more species (11%) were omnivorous (Table 1 and Fig. 3).

Among the recorded mammalian species, according to IUCN (International Union for Conservation of Nature) categories, two species namely *Panthera pardus* and *Melursus ursinus* are vulnerable (V) (Table 1 and Fig. 4). *P. pardus*, *M. ursinus*, *Antelope cervicapara* and *Canis lupus pallipes* are listed in the schedule - I of IWPA (Indian Wildlife (Protection) Act -1972) and in Appendix - I of the CITES (The Convention on International Trade in Endangered Species of Wild Fauna and Flora) (Table 1). Among recorded species, 11% of species are vulnerable species, 21% of species are Schedule 1 and 10% species are Appendix – I of CITES (Fig. 4). Vulnerable, Schedule 1 and Appendix –I mammalian species was not observed continuously during the study period.

**Table 2.** Monthly occurrence of mammals during 2014-16 in semi-arid Chitradurga district.  
+ Percent; - Absent; \*other evidence (Pugmarks, hairs and excreta).

| Scientific name              | Year    | Month |     |     |     |     |     |     |     |     |     |     |      |
|------------------------------|---------|-------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
|                              |         | Aug   | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | July |
| <i>Antelope cervicapra</i>   | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Canis aureus</i>          | 2014-15 | -     | -   | -   | -   | -   | -   | -   | -   | +   | +   | +   | +    |
|                              | 2015-16 | -     | +   | -   | -   | -   | -   | -   | +   | -   | +   | +   | -    |
| <i>Valpes bengalensis</i>    | 2014-15 | -     | -   | +   | -   | +   | +   | -   | +   | +   | +   | +   | +    |
|                              | 2015-16 | -     | -   | -   | -   | +   | -   | +   | +   | -   | +   | -   | +    |
| <i>Canis lupus pallipes</i>  | 2014-15 | -     | -   | -   | -   | +   | -   | -   | -   | +   | -   | +   | +    |
|                              | 2015-16 | -     | -   | -   | -   | -   | -   | -   | +   | -   | +   | -   | -    |
| <i>Macaca radiata</i>        | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Felis chaus</i>           | 2014-15 | -     | +   | -   | -   | -   | -   | +   | -   | +   | +   | +   | -    |
|                              | 2015-16 | -     | -   | -   | -   | -   | -   | -   | -   | -   | +   | +   | +    |
| <i>Panthera pardus</i>       | 2014-15 | -     | -   | -   | -   | -   | -   | +   | -   | -   | -   | +   | -    |
|                              | 2015-16 | -     | -   | +   | -   | -   | -   | -   | -   | +   | -   | -   | -    |
| <i>Herpestes edwardsii</i>   | 2014-15 | +     | -   | -   | -   | -   | -   | -   | -   | -   | -   | +   | +    |
|                              | 2015-16 | -     | -   | -   | -   | -   | -   | -   | -   | -   | -   | -   | +    |
| <i>Hyaena hyaena</i>         | 2014-15 | +     | +   | -   | -   | -   | -   | -   | -   | -   | -   | +   | +    |
|                              | 2015-16 | +     | *   | -   | -   | -   | -   | -   | +   | +   | +   | +   | +    |
| <i>Hystrix indica</i>        | 2014-15 | *     | *   | +   | *   | -   | -   | *   | *   | +   | -   | +   | -    |
|                              | 2015-16 | -     | -   | -   | +   | +   | *   | +   | -   | +   | +   | *   | +    |
| <i>Lepus nigricollis</i>     | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Mus musculus</i>          | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Mus booduga</i>           | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Bandicota bengalensis</i> | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Chnopterus brachyotis</i> | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Pteropus giganteus</i>    | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Fubambulus palmarum</i>   | 2014-15 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
|                              | 2015-16 | +     | +   | +   | +   | +   | +   | +   | +   | +   | +   | +   | +    |
| <i>Sus scrofa</i>            | 2014-15 | +     | +   | +   | +   | -   | -   | *   | *   | +   | +   | -   | -    |
|                              | 2015-16 | +     | +   | +   | +   | +   | -   | -   | +   | *   | +   | +   | +    |
| <i>Melursus ursinus</i>      | 2014-15 | -     | -   | +   | -   | *   | -   | -   | *   | *   | +   | +   | +    |
|                              | 2015-16 | +     | +   | -   | -   | -   | -   | -   | *   | +   | *   | *   | -    |



**Fig. 4.** Percent Species under different categories of TUCN, IWPA schedules and Appendices of CITES in semi arid Chitradurga district.

Monthly occurrence (2014-16) of mammalian fauna from the study region is presented in Table 2.

Among the recorded mammalian species from the study areas, a few species namely *Macaca radiata*, *Mus musculus*, *Mus booduga*, *Bandicota bengalensis*, *Lepus nigricollis*, *Cynopterus brachyotis*, *Pteropus giganteus* and *Funambulus palmarum* were predominantly observed throughout the district in their respective ecological settings. Detailed habitats of individual species and their regional distribution (within the study area), distribution in India and elsewhere in the world are presented in Table 3.

During our survey period, we recorded human-animal conflicts. Among mammalian species *Antelope cervicapra* (Blackbuck), *Sus scrofa* (Wild boar), *Macaca radiata* (Bonnet macaque) and rodents were observed frequently raiding and damaging crops and their produces. Furthermore, *Felis chaus* (Jungle cat) was found raiding domestic poultry and killing them, causing a huge loss for those people living in the countryside. Similarly, as per the version of local people, elephants from adjacent districts were also visiting a few parts of the district. Besides, during the study period, we observed potential threats to mammalian fauna in this district due to drought, hunting, habitat loss/destruction, over grazing and killing of animals using electricity to protect crops.

About 5416 mammalian species belonging to 154 families and 29 orders occurs worldwide (Wilson and Reeder 2005). India is home to 427 species of mammals, both terrestrial and aquatic, belonging to 48 families and 14 orders (Sharma et al. 2013). Several researchers and naturalists have studied various ecosystems in different parts of India contributing to Indian mammalian studies (Pocock 1939, Pocock 1941, Ellerman and Morrison-Scott 1951, Ellerman 1961, Prater 1971, Alfred et al. 2002, Alfred et al. 2006a, Alfred et al. 2006b, Johnsingh and Manjrekar 2013, Johnsingh and Manjrekar 2015, Menon 2014, Sharma et al 2015, Sharma et al. 2013). However, Karnataka state, which is located in the southern part of India, is home to highly diversified ecosystems (wet-evergreen, semi-evergreen, dry evergreen, moist deciduous, dry deciduous, thorn scrub, open grasslands and mangrove) with substantially di-

versified floral and faunal species (Director 2013). Karnataka state accounts for 137 mammalian species belonging to 84 genera, 36 families and 13 orders (Pradhan and Talmale 2013). Most of the studies in Karnataka have been conducted on mammals in rich vegetation areas and conservation areas i.e. national parks and sanctuaries (Tiwari et al. 1971, Prater 1980, Karanth 1986, Corbet and Hill 1992, Pradhan and Kurup 2001). However, a few studies have been conducted on drylands, which include both arid and semi-arid regions of the country (Nautiyal et al. 2015, Harshey and Chandra 2001, Nautiyal et al. 2013, Subramanyam and Khan 2017). In our study, we have recorded 19 mammalian species belonging to 13 families in semi-arid Chitradurga district. While studies on mammals were not conducted in the semi-arid Chitradurga region, a very few studies have looked at mammalian fauna in other similar climatic zones of Karnataka and elsewhere in India. Dev and Singh (2016) documented 40 species of mammals belonging to 20 families from Shekhawati region in the arid zone of Thar Desert, India. Nautiyal et al. (2013) reported 11 species of mammals from a few parts of semi-arid regions of Gulbarga and Yadgir districts of Karnataka. Baranidharan et al. (2019) reported 21 mammalian species from Tamil Nadu state, India. Meena et al. (2018) have reported 11 mammalian species from Sorsan grassland, Baran, Rajasthan, India. Similar mammalian diversity was present in semi-arid Chitradurga district. *Antelope cervicapra*, *Hyaena hyaena*, *Panthera pardus* and *Melursus ursinus* found in the Chitradurga region were under special focus in various global and national level conservation policies (IUCN, CITES and IWPA).

Besides the diversity-related studies of any group of species, there is a need to understand the habitat preferences of particular species, their interactions and conflicts with humans as part of ecological studies for formulating the conservation strategies with regard to particular species and ecosystems. Particularly, mammalian species diversity and distribution are known to positively correlate and widely associate with the availability of biotic factors, climatic conditions and altitudinal ranges (Qian et al. 2009, Stein et al. 2014, Feng et al. 2019). Semi-arid Chitradurga has its own structural complexity and functions. Mainly

**Table 3.** Habitat type of mammalian fauna of Chitradurga district and their local and global distribution.  
(\*Sharma et al 2013. <sup>s</sup> Personal observation.

| Scientific name & common name                        | Worldwide*                                                                                                                                 | India*                                                                                                               | Chitradurga                                                                                       | Habitat <sup>s</sup>                                                                                                                           |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Antelope cervicapra</i><br>(Blackbuck)            | Pakistan, and introduced in Argentina and United States                                                                                    | Panjab south to Tamil Nadu and east to Bihar, and Gujarat and Rajasthan                                              | Challakere, Chitradurga, Hiriyur                                                                  | Cultivated lands, Open plains with short grasses                                                                                               |
| <i>Canis aureus</i><br>(Jackal)                      | Asia, and East Africa and South-eastern Europe                                                                                             | Throughout the country                                                                                               | Throughout the district                                                                           | Countryside, forest fringes and woody land                                                                                                     |
| <i>Vulpes bengalensis</i><br>(Bengal Fox)            | Bangladesh, Nepal and Pakistan                                                                                                             | Throughout the country except for North-eastern India and higher Himalayas                                           | Throughout the district                                                                           | Countryside, Forest fringes and woody land                                                                                                     |
| <i>Canis lupus pallipes</i><br>(Indian wolf)         | Middle-east and South Asia, Bangladesh, Pakistan, Afghanistan, Iran, Iraq, and westwards to Iraq and Northern Saudi Arabia, Israel, Jordan | Peninsular India                                                                                                     | Challakere, Molakalmuru, And few eastern parts of Chitradurga, Hosadurga and Holalkere            | Grassland, Scrubland and dry open countryside                                                                                                  |
| <i>Macaca radiata</i><br>(Bonnet macaque)            | Endemic to India                                                                                                                           | Southern India, Goa, Gujarat and Maharashtra                                                                         | Throughout the district                                                                           | Human habitats, forest fringes, agriculture lands                                                                                              |
| <i>Felis chaus</i><br>(Jungle cat)                   | Egypt, West and Central Asia, South and Southeast Asia                                                                                     | Throughout the country except for higher Himalayas                                                                   | Throughout the district                                                                           | Aquatic habitats (near rivers, lake beds with bushes), Long grasses and agriculture fields                                                     |
| <i>Panthera pardus</i><br>(Leopard)                  | Spread over some parts of Africa and tropical Asia, from Siberia, South and West Asia to across most of sub-Saharan Africa                 | Throughout country except for extreme high altitudes, hot and cold deserts                                           | Chitradurga, Few parts of Hiriyur and Holalkere taluks which are adjacent to Chitradurga district | Forests, forest fringes, water bodies in and around the forest area and sometimes observed near human habitats which are close to forest areas |
| <i>Herpestes edwardsii</i><br>(Indian Gray mongoose) | Afghanistan, Bahrain, Bhutan, Indonesia, Iran, Japan, Kuwait, Malaysia, Mauritius, Nepal, Pakistan, Saudi Arabia and Sri Lanka             | Throughout country                                                                                                   | Throughout the district                                                                           | Grasslands, Open country lands                                                                                                                 |
| <i>Hyaena hyaena</i><br>(Hyaena)                     | North and East Africa, the Caucasus, the Middle East, Middle and Central Asia and the Indian Subcontinent                                  | South to the Nilgiri hills, west to Gujarat, north to the lowland of Jammu & Kashmir and Kumaon, east to West Bengal | Challakere, Molakalmuru, Hiriyur, Chitradurga and few parts of Holalkere and Hosadurga            | Countryside grasslands, forest fringes with rocky areas                                                                                        |
| <i>Hystrix indica</i><br>(Indian Porcupine)          | South and Central Asia                                                                                                                     | Throughout country                                                                                                   | Throughout the                                                                                    | Agriculture lands, Grasslands, Scrublands, fringes of forests with rocky hills                                                                 |
| <i>Lepus nigricollis</i><br>(Black-naped hare)       | Bangladesh, Bhutan, Indonesia, Mauritius, Réunion, Pakistan, Nepal, Seychelles                                                             | Throughout country                                                                                                   | Throughout the district                                                                           | Agriculture fields, Short grassland                                                                                                            |

Table 3. Continued.

| Scientific name & common name                            | Worldwide*                                                                                                 | Distribution India*                                                                                                                               | Chitradurga district                                                                                          | Habitat <sup>s</sup>                                                                   |
|----------------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <i>Mus musculus</i> (House mouse)                        | and Sri Lanka<br>Spread throughout the world                                                               | Throughout country                                                                                                                                | Throughout the district                                                                                       | Human habitats and Agriculture fields                                                  |
| <i>Mus booduga</i> (Little Indian field mouse)           | Bangladrsh, Myanmar, Nepal, Pakistan and Sri Lanka                                                         | Throughout country                                                                                                                                | Throughout the district                                                                                       | Agriculture lands and grasslands                                                       |
| <i>Bandicoot bengalensis</i> (Bandicoot)                 | Malaysia, Myanmar, Nepal, Pakistan. Sri Lanka and Thailand                                                 | Throughout the country                                                                                                                            | Througout the district                                                                                        | In and around human habitats and agriculture lands                                     |
| <i>Cynopterus brachyotis</i> (Small fruit bat)           | This widespread species ranges from South Asia, through parts of southern China to parts of Southeast Asia | Southern India Andaman & NicobarIs., Bihar, Goa, Gujarat, Madhya Pradesh, Maharashtra, Meghalaya, Nagaland, Odisha, Uttar Pradesh and West Bengal | Throughout the district                                                                                       | Fruit orchards, forest areas, human habitats and caves                                 |
| <i>Pteropus giganteus</i> (Indian flying fox)            | Bangladesh,Bhutan China, Maldives, Myanma Nepal, Pakistan and Sri Lanka                                    | Throughout the country                                                                                                                            | Thougout the distric                                                                                          | Agriculture lands, forest areas with high and thick trees (Like Tamarind, Ficus trees) |
| <i>Funambulus palmarum</i> (Three striped palm squirrel) | Sri Lanka                                                                                                  | Southern India,Bihar, Chhattisgarh, Gujarat, Jharkhand, Maharashtra Madhya Pradesh,                                                               | Throughout the district                                                                                       | Human habitats orchards, agriculture lands and forests.                                |
| <i>Sur scrofa</i> (Wild boar)                            | All continents except Antarctica, and many oceanic Is                                                      | Throughout the country except for the high Himalayas and desert areas of Gujarat and Rajasthan                                                    | Throughout the district                                                                                       | Agriculture fields, grasslands and forest forest areas                                 |
| <i>Melursus ursinus</i> (Sloth bear)                     | Bhutan, Nepal and Sri Lanka                                                                                | Throughout the country in suitable habitats except for Jammu & Kashmir, high Himalayas and arid parts of Gujarat                                  | Chitradurga, Hosadurga, Hiriur, Holalkere, few parts of Challakere which are adjacent to Chitradurga district | Forests foothills, grasslands                                                          |

grasslands are dominating and they play a major role in the semi-arid region and favorable habitat for *Antelope cervicapra*, *Canis lupus*, *Herpestes edwardsii*, and *Lepus nigricollis* as reported by Chandran (2015). The major livelihoods of people of semi-arid regions are agriculture and animal husbandry (Qaisrani et al. 2018). The main crops grown in this district are groundnut, red gram, sunflower, different types of pulses, jowar, bajra, ragi and other horticulture crops i.e. tomato, onion. During the study period, we observed a few mammalian species *A. cervicapra*, *S. scrofa*, *M. radiata* and rodent species frequently raiding crops and damaging them. Similar conflicts were recorded by various researchers from different parts of the country (Jhala 1997, Mankadan and Rahmani 1998, Asif and Modse 2015). These observations are a clear reflection of a long-standing human-animal

conflict. In this process, most of the farmers were found adopting various techniques such as using solar fencing, electric fencing, blade fencing, and killing, catching mammals and leaving them in the nearby forest to protect their crops which in turn, leading to the loss of mammalian biodiversity in semi-arid Chitradurga district. Habitat disturbance by various human activities i.e. encroachment, cutting and looping of trees, overgrazing by sheep and cattle was the major conflicts between humans and animals (Gajera and Dharaiya 2011). Based on our observations, we suggest that there is a need for developing proper conservation plans which support local people livelihood and ensure sustainable management of biodiversity. For achieving this goal, there is a need for creating awareness among local people through conservation awareness campaigns, long-term ecological research

and monitoring and protection of semi-arid biodiversity ecosystems through in-situ conservation.

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## REFERENCES

- Abere S.A. and Oguzor N.S. (2011) Adaptation of animals to arid ecological conditions. *World J. Zool.* 6 (2): 209—214.
- Alfred J.R., Sinha N.K. and Chakraborty S. (2002) Checklist of mammals of India. Zoological Survey of India.
- Alfred J.R.B., Das A.K. and Sanyal A.K. (2001) Ecosystems of India, ENVIS-Zoological Survey of India, Kolkata.
- Alfred J.R.B., Das A.K. and Sanyal A.K. (2006a) Animals of India: Mammals. ENVIS- Zoological Survey of India, Kolkata.
- Alfred J.R.B., Ramakrishna and Pradhan M.S. (2006b) Validation of Threatened mammals of India. Zoological Survey of India, Kolkata.
- Asif M. and Modse S. (2015) Crop Damage by the Blackbuck Antelope cervicapra in and around Chitta Reserve Forest of Bidar, Karnataka. *Int. J. Life Sci. and Scient. Res.* (2) 4 : 500—505.
- Azlan J.M. (2006) Mammal diversity and conservation in a sec-ondary forest in Peninsular Malaysia. *Biodiver. and on-serv.* 15: 1013—1025.
- Babu G.N.M. (2013) A Note on the Floristic Diversity and Eth-no-botany of Chitradurga District. Expert Committee, Hon orable National Green Tribunal (South Zone), Center of Excellence of Union Ministry of Environment and Forests.
- Baranidharan K., Vijayabhama M. and Bhuvensh P. (2019) Faunal diversity of Sathyamangalam tiger reserve, Tamil Nadu, India. *J. Entomol and Zool. Studies* 7 (5): 826—831.
- Bastin J.F., Berrahmouni N., Grainger A., Maniatis D., Mollicone D. and Moore R. et al. (2017) The extent of forest in dryland biomes. *Science* 356 (6338) : 635—638.
- Ceballos G., Ehrlich P.R., Barnosky A.D., García A., Pringle R.M, Palmer T.M. (2015) Accelerated modern human-in duced species losses: Entering the sixth mass extinction. *Sci. Adv.* 1(5):e1400253.
- Champion S.H. and Seth S.K. (1968) A revised survey of the forest types of India. Manager of Publications, Delhi, India.
- Chandran M (2015) Grassland vegetation of India: An update. In: (Eds, G.S.Rawat and B.S Adhikari) Ecology and Manage ment of Grassland Habitats in India. ENVIS Bulletin: Wildlife and Protected Areas, Vol 17. Wildlife Institute of India.
- Chellam R, Joshua J, Williams CA, Johnsingh AJ (1994) Survey of potential sites for reintroduction of Asiatic lions. Unpub lished Report, Wildlife Institute of India, Dehra Dun, India.
- Corbet GB, Hill JE (1992) The mammals of the Indomalayan Re- gion: A systematic review. Oxford U.K. (Natural History Museum Publications and Oxford University Press).488pp
- Cortés AM, Ramírez-Pinilla MP, Suárez HA, Tovar E (2008) Edge effects on richness, abundance and diversity of frogs in Andean cloud forest fragments. *South American Journal of Herpetology* 3:213-222.
- Cruz-Elizalde R, Ramírez-Bautista A, Hernández-Ibarra X, Wilson LD (2016) Species diversity of amphibians from arid and semiarid environments of the Real de Guadalcázar State Reserve, San Luis Potosi, Mexico. *Natural areas journal* 36(3):302-310.
- Dev K, Singh P (2016) Mammalian diversity of Shekhawati region in arid zone of Thar Desert, India. *International Journal of Fauna and Biological Studies* 3(5): 16-22.
- Díaz S, Fargione J, Chapin III FS, Tilman D (2006) Biodi versity loss threatens human well-being. *PLoS Biology* 4(8):e277.
- Director (2013) Fauna of Karnataka. State Fauna Series, Zoological Survey of India.
- Durant SM, Pettorelli N, Bashir S, Woodroffe R, Wacher, De Ornellas P et al (2012) Forgotten biodiversity in desert ecosystems. *Science* 336(6087):1379-80.
- Ellerman JR (1961) The Fauna of India including Pakistan, Burma and Ceylon. Mammalia. Vol. 3 (Rodentia), Part I & II. Govt. of India, Delhi. 884pp.
- Ellerman JR, Morrison-Scot TCS (1951) Checklist of Palaearctic and Indian Mammals 1758 to 1946. Trustees of the British Museum (Natural History), London. 810 pp.
- Feng G, Yan H, Yang X (2019) Climate and food diversity as drivers of mammal diversity in Inner Mongolia. *Ecology and Evolution* 9(4):2142-2148.
- Flores-Villela O, Gerez P (1994) Biodiversidad y con servación en México: vertebrados, vegetación y uso de suelo. Comisión Nacional para el Conocimiento y uso de la Bio diversidad, Universidad Nacional Autónoma de México; México.
- Gajera N, Dharaiya N (2011) Status, occurrence, distribution of some mammals of North Gujarat, India. *Proceedings of the Zoological Society* 64(1):46.
- Government of India (2014) Census of India 2011 Karnataka. District census handbook, Chitradurga- 2011. Village and Town Town directory. Series – 30. Part XII-A. Directorate of Census operations. Karnataka.
- Harshey DK, Chandra K (2001) Mammals of Madhya Pradesh and Chhattisgarh. *Zoos' Print Journal* 16:659-668.
- Jhala YV (1997) Seasonal effects on the nutritional ecology of Blackbuck Antelope cervicapra. *Journal of Applied Ecology* 34: 1348-1358.
- Johnsingh AJT, Manjrekar N (2013) Mammals of South Asia. Volume 1. University Press (India) Pvt. Ltd.
- Johnsingh AJT, Manjrekar N (2015) Mammals of South Asia, Volume 2. University Press (India) Pvt. Ltd.
- Kalsi RS (2007) Status, distribution and management of Galli formes in arid and semi-arid zones of India. *Gallirmes of India.* 101-104.
- Kang W, Minor ES, Woo D, Lee D, Park CR (2016) Forest mam mal roadkills as related to habitat connectivity in protected areas. *Biodiversity and conservation* 25(13):2673-2686.
- Karanth KU (1986) Status of wildlife and habitat conservation in Karnataka. 1. Bombay Natural History Society. 83: 166-179.

- Manakadan R, Rahmani AR (1998) Crop damage by Blackbuck *Antelope cervicapra* at Rollapadu Wildlife Sanctuary, Andhra Pradesh Society. *Journal of the Bombay Natural History Society* 95: 408–417.
- Meena R, Saran RP, Chourasia V (2018) Birds, reptiles and mammals of Sorsan grassland, Rajasthan: A faunal survey *International Journal of Zoology Studies* 3(1):192–196.
- Menon V (2014) *Indian mammals- A field guide*. Hachette Book Publishing India Pvt. Ltd. 528 pp.
- Mortimore M (1989) *Adapting to Drought. Farmers, Famines and Desertification in West Africa*. Cambridge University Press, Cambridge.
- Myers N, Mittermeier RA, Mittermeier CG, da Fonseca GA, Kent J (2000) Biodiversity hotspots for conservation priorities. *Nature* 403(6772):853–858.
- Nautiyal S (2011) Can conservation and development interventions in the Indian Central Himalaya ensure environmental sustainability? A socioecological evaluation. *Sustainability Science* 6(2):151–167.
- Nautiyal S, Bhaskar K, Khan YDI (2015) Biodiversity of semiarid landscape: baseline study for understanding the impact of human development on ecosystems. Springer.
- Nautiyal S, Bhaskar K, Khan YDI, Venkateshalu (2013) Biodiversity Monitoring and its Distribution in and Around Uranium Mining Area of Gogi, Gulbarga (Yadgir), Karnataka: A Case Study. *Journal of Biodiversity* 4(2):69–77.
- Nautiyal S, Kaechele H (2007) Conserving the Himalayan forests: approaches and implications of different conservation regimes. *Biodiversity and Conservation* 16:3737–3754.
- Payne J, Francis CM, Phillips KA (1985) *field guide to the mammals of Borneo*. The Sabah Society, Kota Kinabalu.
- Pocock RI (1939) *The Fauna of British India, Including Ceylon and Burma. Mammalia-Volume I*. Taylor and Francis Ltd., London. 463 pp.
- Pocock RI (1941) *The Fauna of British India, Including Ceylon and Burma. Mammalia-Volumes II*. Taylor and Francis Ltd., London. 503 pp.
- Pradhan MS, Kurup GU (2001) Mammalia. In *Fauna of Nilgiri Biosphere Reserve, Fauna of Conservation Area Series*, Zoological Survey of India, Kolkata. 11: 311–330.
- Pradhan MS, Talmale SS (2013) Mammalia. in: (ed Director), *Fauna of Karnataka, State Fauna Series*. Zoological Survey of India. 21: 1–595.
- Prater SH (1971) *The Book of Indian Animals*. Bombay Natural History Society. Oxford University Press. 324 pp.
- Prater SH (1980) *The Book of Indian Animals* Bombay Natural History Society and Oxford University Press, Mumbai. 324 pp.
- Qaisrani A, Umar MA, Siyal GEA, Salik KM (2018) What Defines Livelihood Vulnerability in Rural Semi-Arid Areas? Evidence from Pakistan. *Earth Systems and Environment* 2(3) : 455–475.
- Qian H, Badgley C, Fox DL (2009) The latitudinal gradient of beta diversity in relation to climate and topography for mammals in North America. *Global Ecology and Biogeography* 18: 111–122. <https://doi.org/10.1111/j.1466-8238.2008.00415.x>
- Rao AK, Wani SP, Singh KK, Ahmed MI, Srinivas K, Bairagi SD, Ramadevi O (2013) Increased arid and semi-arid areas in India with associated shifts during 1971–2004. *Journal of Agrometeorology* 15(1):11.
- Rodgers WA (1991) *Techniques of wildlife census in India: A field manual*. Dehradun: Wildlife Institute of India.
- Schimel DS (2010) Drylands in the Earth System. *Science* 327(5964):418–419.
- Semwal RL, Nautiyal S, Sen KK, Rana U, Maikhuri RK, Rao KS, Saxena KG (2004) Patterns and ecological implications of agricultural land-use changes: a case study from central Himalaya, India. *Agriculture, Ecosystems and Environment* 102(1):81–92.
- Sharma G, Kamalakannan M, Venkataraman K (2013) A checklist of mammals of India with their distribution and conservation status. ZSI e-publications, Kolkata: Zoological Survey of India, 123.
- Stein A, Gerstner K, Kreft H (2014) Environmental heterogeneity as a universal driver of species richness across taxa, biomes and spatial scales. *Ecology Letters* 17:866–880. <https://doi.org/10.1111/ele.12277>
- Subramanyam VVB, Khan YDI (2017) Diversity of Mammalian Fauna And Conservation Issues Of The Anantapuramu District Of Andhra Pradesh, India. *International Journal of Recent Scientific Research* 8(12):22646–22652.
- Sutherland WJ (2006) *Ecological Census Techniques - A Hand Book*, Second Edition. Cambridge University Press, Cambridge, UK.
- Thippaiah HV (2010) *Plant diversity studies of Jogimatti Scrub Forest, District Chitradurga*. PhdThesis, Karnataka University, Dharwad, India.
- Tiwari KK, Ghose RK, Chakraborty S (1971) Notes on a collection of small mammals from Western Ghats, with Remarks on the status of *Rattus rufescens* (Gray) and *Bandicota indica malabarica* (Shaw). *Journal of Bombay Natural History Society*. 68(2): 378–384.
- United Nations (2011) *Global drylands: a UN system-wide response*. Prepared by the Environment Management Group.
- Wiens JJ, Graham CH, Moen DS, Smith SA, Reeder TW (2006) Evolutionary and ecological causes of the latitudinal diversity gradient in hylid frogs: Tree frog trees unearth the roots of high tropical diversity. *The American Naturalist* 168(5):579–596.
- Wilson DE, Reeder DM. (2005) *Mammal Species of the World: A Taxonomic and Geographic Reference- 3rd edition* Johns Hopkins University Press, Baltimore, MD. 2 : 1–141.