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

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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 ecological 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. Antilope cervicapra (Blackbuck), Sus scrofa (Wild boar) and Macaca radiate (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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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

45,000 floral species across different biogeographic regions (Meena et al. 2018). Each biogeographic region plays a significant role in sustainably conserving our natural heritage. Among different biogeographic regions, semi-arid regions are characterized by specific features such as high temperatures, less rainfall and frequent droughts with thorny savannah and annual and perennial grass vegetation (United Nations 2011). These drylands, which also include semi-arid ecosystems, unstable, but extremely resilient (Mortimore 1989) and due to these special characteristics, biodiversity in these semi-arid regions has its importance. In India semi-arid zone is a transition zone between the Western Ghats and deserts, and occupies more than 40% of the country's geographical area (Kalsi 2007) and the area of semi-arid region has increased by 8.45 million hectares between 1971-90 and 1991-2004 across six states of India (Rao et al. 2013).

In this region, the pressure on natural resources is high as compared to other bios- geographic regions due to a high human and livestock density, as compared to the national average. In spite of this, people in semi-arid regions go for diversified agricultural practices due to different soil types and length of growing seasons (Kalsi 2007).

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).

Most of the biodiversity studies have focused on rich vegetation areas and forest areas and biodiversity hot spots. However, drylands remain less studied, particularly biodiversity-related issues (Myers et al. 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 Kaechele 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.

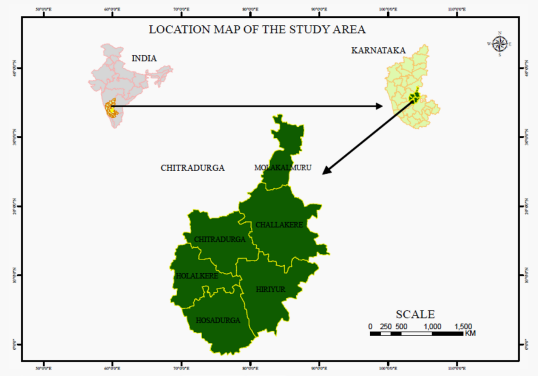

Fig. 1. Per cent species under different categories of IUCN, IWPA schedules and Appendices of CITES in semi-arid Chitradurga district.

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 km2. This district comprises six regions, namely, Chitradurga, Challakere, Hiriyur, Hosadurga, Holalkere, and Molakalamuru and falls between latitude 13º 34' to 15º 02' N and longitude 76º 01' to 77º 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 410C. 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 Uniob for Conservation of Nanture 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
Family : Bovidae							
1		*Antilope cervicapra* (Linnaeus, 1758)	Blackbuck	NT	Sch- I	-	Herbivorous
Family : Canidae							
2		*Camis aureus* (Linnaeus, 1758)	Jackal	NE	-	-	Omnivorous
3		*Vulpes bengalensis* (Shaw, 1800)	Bengal Fox	LC	Sch- II	App - III	Omnivorous
4		*Canis lupus pallipes* (Sykes, 1831)	Indian wolf	NE	Sch - I		Omnivorous
Family : Cereopithecidae							
5		*Macaca radiata* (E. Geoffroy, 1812)	Bonnet macaque	LC	Sch - II	App - II	Omnivorous
Family : Felidae							
6		*Felis chaus* (Schreber, 1777)	Jungle cat	LC	Sch - II	App -II	Carnivorus
7		*Panthera pardus* (Linnaeus, 1758)	Leopard	VU	Sch - I	App -I	Carnivorus
Family : Herpestidae							
8		*Herpestes edwardsii* (E. Geoffroy saint, Hilaire, 1818)	Indian Gray mongoose	LC	Sch - II	App - III	Omnivorous
Family : Hyaenidae							
9		*Hyaena hyaena* (Linnaeus, 1758)	Hyaena	NT	Sch - III	App - III	Carnivorous
Family : Hystricidae							
10		*Hystrix indica* (Kerr, 1792)	Indian Procupine	LC	Sch-IV	-	Omnivorous
Family : Leporidae							
11		*Lepus nigricollis* (F. Cuvier, 1823)	Black naped hare	LC	Sch- IV	-	Herbivorous
Family : Muridae							
12		*Musmusculus* (Linneus, 1758)	House mouse	LC	Sch - V	-	Omnivorous
13		*Mus booduga* (Gray, 1837)	Little Indian field mouse	LC	Sch - V	-	Omnivorous
14		*Bandicota bengalensis* (Gray, 1835)	Bandicoot	LC	Sch - V		Omnivorous
Family : Pteropodidae							
15		*Cynopterus brachyotis* (Müller, 1838)	Small fruit bat	LC	Sch - V	-	Frugivorous & Nectrivorous
16		*Pteropus giganteus* (Brtünnich, 1782	Indian flying fox	LC	Sch-V	App-II	Frugivorous & Nectrivorous
Family : Sciuridae							
17		*Funambulus palmarum* (Linnaeus, 1766)	Three striped palm squirrel	LC	-	-	Granivorous & Herbivorous
Family : Suidae							
18		*Sus scrofa* (Linnaeus, 1758)	Wildboar	LC	Sch-III	-	Omnivorous
Family : Ursidae	19						
		Melursus ursinus (Shaw, 1791)	Slothbear	VU	Sch - I		Omnivorous

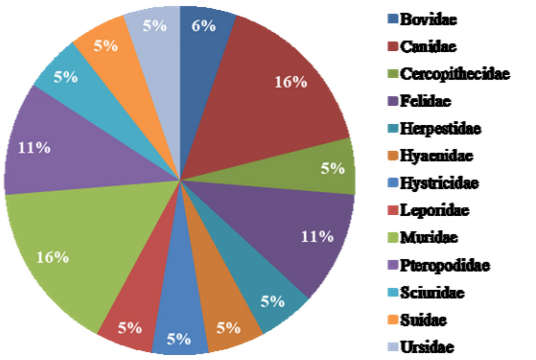

Fig. 2. Percent of species belonging to various families of mammals from Chitradurga district.

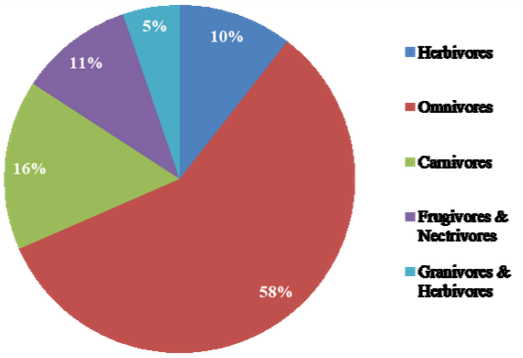

Fig. 3. Forging type of mammalion fauna in the Chitradurga district,

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 0 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, 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, Antilope 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. Monthly occurrence (2014-

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
Antilope cervicapra	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Canis aureus	2014-15	-	-	-	-	-	-	-	-	+	+	+	+
	2015-16	-	+	-	-	-	-	-	+	-	+	+	-
Valpes bengalensis	2014-15	-	-	+	-	+	+	-	+	+	+	+	+
	2015-16	-	-	-	-	+	-	+	+	-	+	-	+
Canis lupus pallipes	2014-15	-	-	-	-	+	-	-	-	+	-	+	+
	2015-16	-	-	-	-	-	-	-	+	-	+	-	-
Macaca radiata	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Felis chaus	2014-15	-	+	-	-	-	-	+	-	+	+	+	-
	2015-16	-	-	-	-	-	-	-	-	-	+	+	+
Panthera pardus	2014-15	-	-	-	-	-	-	+	-	-	-	+	-
	2015-16	-	-	+	-	-	-	-	-	+	-	-	-
Herpestes edwardsii	2014-15	+	-	-	-	-	-	-	-	-	-	+	+
	2015-16	-	-	-	-	-	-	-	-	-	-	-	+
Hyaena hyaena	2014-15	+	+	-	-	-	-	-	-	-	-	+	+
	2015-16	+	*	-	-	-	-	-	+	+	+	+	+
Hystrix indica	2014-15	*	*	+	*	-	-	*	*	+	-	+	-
	2015-16	-	-	-	+	+	*	+	-	+	+	*	+
Lepus nigricollis	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Mus musculus	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Mus booduga	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Bandicota bengalensis	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Chnopterus brachyotis	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Pteropus giganteus	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Fubambulus palmarum	2014-15	+	+	+	+	+	+	+	+	+	+	+	+
	2015-16	+	+	+	+	+	+	+	+	+	+	+	+
Sus scrofa	2014-15	+	+	+	+	-	-	*	*	+	+	-	-
	2015-16	+	+	+	+	+	-	-	+	*	+	+	+
Melursus ursinus	2014-15	-	-	+	-	*	-	-	*	*	+	+	+
	2015-16	+	+	-	-	-	-	-	*	+	*	*	-

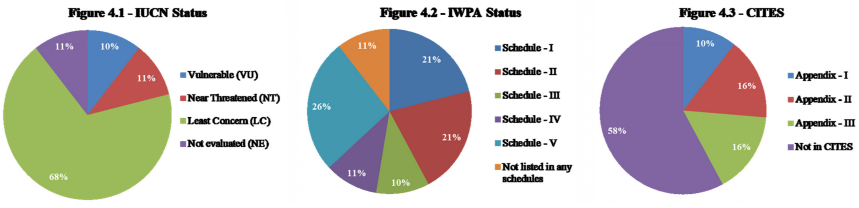

Fig. 4. Percent Species under different categories of TUCN, IWPA schedules and Appendices of CITES in semi arid Chtradurga district.

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 bengalensi, 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 Antilope cervicapra (Blackbuck), Sus scrofa (Wild boar), Macaca radiate (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 diversified 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 condi tions 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.

Scientific name & common name	Distribution			Habitat[s]
	Worldwide*	India*	Chitradurga	
Antilope cervicapra (Blackbuck)	Pakistan, and introduced in Argentina and Asia, and East Africa	Panjab south to Tamil Nadu and east to Bihar, and Gujarat	Challakere, Chitradurga, Hiriyur	Cultivated lands, Open plains with short grasses
Canis aureus (Jackal)	and South-eastern Europe	Throughout the country	Throughout the district	Countryside, forest fringes and woody land
Vulpes bengalensis (Bengal Fox)	Bangladesh, Nepal and Pakistan	Throughout the country except for North-eastern India and higher Himalayas and	Throughout the district	Countryside, Forest fringes and woody land
Canis lupus pallipes (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, Molkalmuru, And few eastern parts of Chitradurga, Hosadurga and Holalkere	Grassland, Scrubland and dry open countryside
Macaca radiate (Bonnet macaque)	Endemic to India	Southern India, Goa, Gujarat and Maharashtra	Throughout the district	Human habitats, forest fringes, agriculture lands
Felis chaus (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
Panthera pardus (Leopard)	Spread over some parts of Africa and tropical Asia, from Siberia, South and West Asia to across most of sub-Saharan Africa	Thoughout country except for extreme high altitudes, hot and cold deserts	Chitradurga, Few parts of Hiriyur and Holalkere taluks which 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
Herpestes edwardsii (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
Hyaena hyaena (Hyaena)	North and East Africa, the Caucasus, the Middle East, Middle and Central Asia and the Indian Subcontinent	South to the Nilgiri hils, west to Gujarat, north to the lowland of Jammu & Kashmir and Kumaon, east to West Bengal	Challakere, Molakalmuru, Hiriyur, Chitradurga and few perts of Holalkere and Hosadurga	Countryside grasslands, forest fringes with rocky areas
Hystrix indica (Indian Porcupine)	South and Central Asia	Throughout country	Throughout the	Agriculture lands, Grasslands, Scrublands, fringes of forests with rocky hills
Lepus nigricollis (Black-naped here)	Bangladesh, Bhutan, Indonesia, Mauritius, Réunion, Pakistan, Nepal, Seychelles and Sri Lanka	Throughout country	Throughout the district	Agriculture fields, Short grassland
Mus musculus (House mouse)	Spread throughout the world.	Thoughout country	Thoughout the district	Human habitats and Agriculture fields.

Table 3. Continued.

Scientific name & common name	Distribution Worldwide*	India*	Chitradurga district	Habitat[s]
Mus booduga (Little Indian field mouse)	Bangladrsh, Myanmar, Nepal, Pakistan and Sri Lanka	Throughout country	Throughout the district	Agriculture lands and grasslands
Bandicoot bengalensis (Bandicoot)	Malaysia, Myanmar, Nepal, Pakistan. Sri Lanka and Thailand	Throughout the country	Throughot the district	In and around human habitats and agriculture lands
Cynopterus brachyotis (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
Pteropus giganteus (Indian flying fox)	Bangladesh,Bhutan China, Maldives, Myanma Nepal, Pakistan and Sri Lanka	Throughout the country	Thoughout the distric	Agriculture lands, forest areas with high and thick trees (Like Tamarind, Ficus trees)
Funambulus palmarum (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.
Sur scrofa (Wild boar)	All continents except Antarctica, and many occanic 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
Melursus ursinus (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, Hiriyur, 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 Antilope 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. radiate 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, ENVl5-Zoological Survey of India, KoIkata.

Alfred J.R.B., Das A.K. and Sanyal A.K. (2006a) Animals of India: Mammals. ENVIS- Zoolgical 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 Antilope 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 Potosí, 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 T, De Ornellas P et al (2012) Forgotten biodiversity in desert eco systems. 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 Palaeartic 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 Evo lution 9(4):2142-2148.

Flores-Villela O, Gerez P (1994) Biodiversidad y conservación en México: vertebrados, vegetación y uso de suelo. Comisión Nacional para el Conocimiento y uso de la Biodiversidad, 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 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 Antilope 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. Galliformes 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 Antilope 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 mam mals of Sorsan grassland, Rajasthan: A faunal survey. Inter national 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 interven tions 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) Biodi versity Monitoring and its Distribution in and Around Ura nium 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 re gimes. Biodiversity and Conservation 16:3737–3754.
Payne J, Francis CM, Phillips KA (1985) field guide to the mam mals of Borneo. The Sabah Society, Kota Kinabalu.
Pocock RI (1939) The Fauna of British India, Including Ceylon and Burma. Mammlia-Volume I. Taylor and Francis Ltd., London. 463 pp.
Pocock RI (1941) The Fauna of British India, Including Ceylon and Burma. Mammlia-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. 324pp.
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? Evi dence 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 Research 8(12):22646-22652.
Sutherland WJ (2006) Ecological Census Techniques - A Hand Book, Second Edition. Cambridge University Press, Cam bridge, 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 col lection 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 re sponse. 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. 2:1-2141.