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Survival of Mammalian diversity in and around Human Landscape, in the Thar Desert, Rajasthan.

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ABSTRACT

The present study was carried out in and around Jodhpur city in human landscape area, Thar desert of Rajasthan. This study emphasizes on list out mammalian diversity in different sub habitat type in human landscape, which supports and play important role in ecosystem, maintaining food chain and sustaining desert biodiversity. We also listed the emerging threats, which causing drastic change in mammalian population and this also give an understanding how wild mammals survive in human landscape in the changing climate situation in the study area. Thar desert is characterized with low rainfall, high temperature, and many climatic events like dusty wind storms and rainy winters etc. Due to growing urbanization, many roads have been constructed to connect cities, towns and villages, which led to habitat destruction of wild areas. Due to variety of habitats and micro ecosystem, this desert area harbors many distinct consumer species including amphibian, reptilian, avian and mammalian species. The unique mammalian species of Thar desert includes- *Canis lupus* (Indian grey wolf), *Hyaena hyaena* (Hyaena), *Canis aureus* (Golden jackal), *Felis sylvestris* (Desert cat), *Gazelle bennetti* (Chinkara), *Boselaphus tragocamelus* (Blue bull), *Antelope cervicapra* (Black buck), *Sus scrofa* (Wild boar), *Hystrix indica* (Porcupine), *Lepus tibetanus* (Desert hare), *Semnopithecus entellus* (Hanuman langur) *etc.* Conservation of mammalian predator species is imperative to regulate the ecosystem and food chain.

KEYWORDS-Mammals, human landscape, Prey-predator, Crop raiding, Conservation.

INTRODUCTION

Density and abundance of mammalian species play an important role in the ecosystem and to sustain the species population in the area. Availability of prey mammalian species like small mammals and other herbivore animals, which being listed further in the context, is the most important factor for determining carnivore distribution across habitat types and their overall abundance (Carbme &Gittleman, 2002). This study lists out mammalian diversity in different sub habitat type in and around human landscape, which supports and play important role in ecosystem specially food chain and sustaining desert biodiversity. Development, growing urbanization, change in agricultural and land use, animal husbandry etc. has affected their population in the study area and human wildlife relation. In semiarid areas with high human density, the forests are highly fragmented with minimal water resources resulting in increased dependency on restricted available resources (Malagnoux*et al*. 2007; Gibbs, 2000). Thar desert Thar desert is characterized with low rainfall, high temperature (can exceed 50 ^{o}C during summer and below 5 ^{o}C in winters), and many climatic events like dusty wind storms and rainy winters etc. Due to growing urbanization, many roads have been constructed to connect cities, towns and villages, which led to habitat destruction of wild areas. Due to variety of habitats and micro ecosystem, this desert area harbors many distinct consumer species including amphibian, reptilian, avian and mammalian species. In this paper, we are presenting the findings on mammalian species diversity, their major threats, their interaction with other species including human and their conservational management in different human landscape of the Thar desert . The unique mammalian species of Thar desert includes- *Canis lupus* (Indian grey wolf), *Hyaena hyaena* (Hyaena), *Canis aureus* (Golden jackal), *Felis sylvestris* (Desert cat), *Gazelle bennetti*(Chinkara), *Sus scrofa* (Wild boar), *Boselaphus tragocamelus* (Blue bull), *Antelope cervicapra* (Black buck), *Semnopithecus entellus* (Hanuman langur) *Hystrix indica* (Porcupine), *Lepus tibetanus* (Desert hare), *etc.* The mammalian species observed in study area are surviving well in human landscape in the deserts (Prakash, 1994;1995), some of the species like Hanuman langurs are buffered against catastrophic die-off during ENSO-related drought in human landscape (Wait *et al*.,2007b). Rodents are numerically the most abundant species of desert lands around the world, and in Thar desert too (Prakash, 1975). Several species are facing problems in the wild for survive because of developmental activities, climate change, habitat loss, grazing pressure, illegal mining, etc. (Ojha *et al*. 2017).

MATERIAL AND METHODS

The Study was conducted in and around Jodhpur city (within 30-40 km area) in different areas like fellow lands, agricultural lands, rocky areas, sacred grooves (Oran and Gaucher land), and different community based rural areas. Jodhpur lies in semi-arid region of Thar desert between 26°,00' and 27°, 37' N latitude and 72°,55' and 73°,52' E longitude with fluctuated climate, winter being cold and some time with rain and summer are hotter. The altitudinal elevation of Jodhpur from sea level is of 250-300 meters above sea level. For the extensive survey and data collection, four sample areas were selected. The sites selected in terms of occurrence as high number of mammalian species, low and high human interference zone and various micro ecosystem. The sampling sites were named as site (A), site(B), site (C), and site (D) (*see figure 1*). This study was conducted from March 2016 to March 2020. Data were collected and recorded regarding population sighted, individual counts and samples like scats, palates, pug marks, hair etc. were collected to identify species. Further,the local people interviewed, a total 260 people of 18 - 75 year age group including male and female were interviewed and necessary information was gathered. For direct behavioral observation of mammalian species scan and Ad libitum methods were used (Altman, 1974), Photography with DSLR, camera trap etc. and scats, footmarks, body parts sample like hairs etc. for indirect evidences were followed. Indirect samples were collected on transects, tracks, and roads and off roads whenever encountered within the intensive study area.

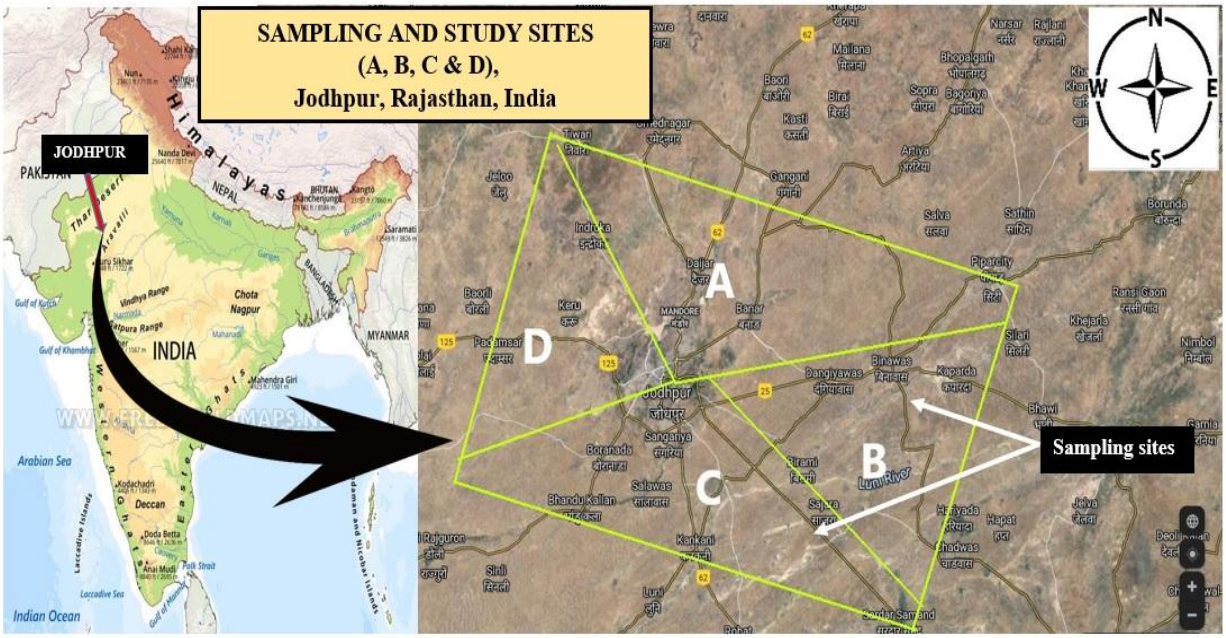

Figure 1: Map showing sampling and study sites A, B, C, and D, marked within rectangle line (green color line).

Map source 1. India map – surveyofindia.gov.in; 2. Satellite map view- Google map

OBSERVATION AND RESULTS

During study it was found that habitat under study has been adversely affected due to growing human population, change in landscapes, increasing dog population in highways and roads lies in the study area,as a result mortality of many wild species increased in recent past by road accidents, dogs predation, stuck in the farm fencing, diseases or poisoning etc. List of mammalian species recorded with their feeding habit and wildlife protection act, 1972 statusis given in *table-1*.

Table 1: List of mammalian fauna with conservation status as per the Indian Wildlife Protection Act, 1972.

SN	Species Common Name	Zoological Name	Habit type	Status as Per WPA 1972
I	**Order: Artiodactyl**			
	Chinkara	*Gazella bennetti*	Herbivore	Schedule I
	Black buck	*Antilope cervicapra*	Herbivore	Schedule I
	Blue bull	*Boselaphus tragocamelus*	Herbivore	Schedule III
	Wild boar	*Sus scrofa*	Omnivore	Schedule III
2	**Order: Lagomorphs**			
	Desert Hare	*Lepus tibetanus*	Herbivore	Schedule IV
3	**Order: Rodentia**			
	Five stripped palm squirrels	*Funambuluspennantii*	Herbivore	Schedule IV
	Indian crested porcupine	*Hystrix indica*	Herbivore	Schedule IV
	Indian gerbils	*Tatera indica*	Herbivore	ScheduleIV
	Desrtjird	*Meriones hurrianae*	Herbivore	ScheduleIV
4	**Order: Insectivora**			
	Hedgehog	*Hemiechinus collaris*	Insectivore	ScheduleIV
	Grey musk shrews	*Suncusmurinus*	Insectivore	
5	**Order: Carnivora**			
	Indian grey wolf	*Canis lupus*	Carnivore	Schedule I
	Hyeana	*Hyaena hyaena*	Carnivore	ScheduleIII
	Golden jackal	*Canis aureus*	Carnivore	Schedule II
	Desert fox	*Vulpes vulpespussila*	Omnivore	Schedule I
	Indian fox	*Vulpes bengalensis*	Omnivore	Schedule II

	Desert cat	*Felis sylvestris*	Carnivore	Schedule I
	Jungle cat	*Felis chaus*	Carnivore	Schedule II
	Indian common civet	*Viverricula indica*	Carnivore	Schedule II
	Indian small mongoose	*Herpestes javanicus*	Carnivore	Schedule II
	Ruddy mongoose	*Herpestes smithii*	Carnivore	Schedule II
	Common mongoose	*Herpestes edwardsii*	Carnivore	Schedule II
6	**Order: <u>Primates</u>**			
	Hanuman langur	*Semnopithecus entellus*	Herbivore	Schedule II
7	**Order: <u>Chiroptera</u>**			
	Indian flying fox	*Pteropusgigantus*	Herbivore	ScheduleIV

(Note: WPA- Wildlife Protection Act.)

The diverse mammalian fauna is found to be due to presence of many traditional conservational methods such as religious based, artificial feeding, sacred grooves and large population of mammal's dependency on human subsidies. In recent studies, protection at community level on religious aspect plays important role in western Rajasthan. People do not kill and harm animals because animals is connected with Gods name and power in Hindu mythology. A good example of this system is protection in Oran lands. Oran lands are left over geographical areas on the name of local God or Goddess, where hunting, poaching, capturing of wild animals is strictly prohibited in these areas and no agricultural practices and cutting of trees are allowed here (Ojha *et al*. 2017). Other reason of this high diversity is due to Human subsidies. The type of human subsidies are artificial food provisioning, and water bodies localy called Kheli made by local people for their livestock directly benefit to wild animals in severe drought condition during summer season in the study area. In Kumbhalgarh wildlife sanctuary, the Hanuman langur population suffered a disastrous decline. Similarly, the langur population in an adjacent protected area, the Tadgahr-Raoli wildlife sanctuary, suffered a 20% reduction from 1999 to 2001 (Waite *et al*. 2007a) while in Jodhpur, langur population remained unaffected, suggesting that langurs were defended against the drought. Thus, artificial provisioning to langurs in Jodhpur area break out the drought (Wait *et al*. 2007b). Ojha and Rajpurohit (2018) also reported that people provide artificial feeding to

birds (pigeon, crow, house sparrow etc.) in form of bread, biscuit and cereals due to religious and cultural aspects. The leftover foodstuffs in night consumed by Indian crsted porcupine in Jodhpur city and other part of western Rajasthan. We have reported dependency of Indian palm civet on artificial food provisioning and leftover foods in Parsurammahadev temple region, Aravalli region of Rajasthan. This availability of artificial food has changed species behavior but it has become a major cause of survival and well reproductive success in such areas. Thus, wildlife is benefited with the presence of human around them and human subsidies plays vital role in survival of these species in TD.

The observed floral diversity of the study area includes-Babool (*Acacia nilotica*), Rohira (*Ticomella undulata*), Kumath (*Acacia senegal*), Jaal (*Salvadora persica*), Khejri (*Prosopis cineraria*), Ker (*Capparis decidua*), Pipal (*Ficus religiosa*), Bargad (*Ficus bengalensis*), Neem (*Azadirachta indica*), Ber (*Ziziphus nummularia*), Aak (*Calotropus procera),*Thor (*Euphorbia caducifolia*),Guggal(*Commiphora wightii*), Bawlia (*Vachellia jacquemontii*), Kheemp (*Leptadenia pyrotechnica*), Bui (*Aerva persica),* Phog (*Calligonum polygonoides*), Arna *(Clerodendurm phlomidis),* Grass *(Cymbopogon jwarancusa) etc.*This floral diversity along with agriculture and horticulture crops might be one of the reasons that thrives mammalian species abundance and these animals play important role in sustaining floral diversity by helping in pollination and seed dispersal. Land use pattern of Jodhpur district have total area as per village record is 2256405 hectare, out of which 7032 ha. (0.31%) areas under forest, 122713 ha. (5.43%) permanent pasture and grazing lands and 1410944 ha. (62.53%) area being cultivated. Major crops grown in and around Jodhpur includes Rabi and Khareef crops. Rabi includes Wheat, Barley (cereals), Grams, Pulses, and Rape and Mustard, Taramira and Linseed (Oilseeds) while Khareef includes Paddy, Jowar, Bajra, Maize, Millets (cereals), Moong, Moth, Urad, Chaula and other (pulses), Seesam, Groundnut, Soybean, castor (oilseeds), and Cotton, Sugarcane etc (www.agriculture.rajasthan.gov.in). Grazer species optimally utilize floral food resources while some mammalian species found to be raiders in croplands (*see figure 2*) e.g. Blue Bull and Wild Boars.

The study was conducted in different sub-habitat types of human landscape and species inhabiting such sub-habitats were recorded (see *table-2*). It is clear from the table 2 that the rocky scrub and sandy rocky mixed sub-habitat type shows maximum diversity. These sub-habitat types represent important predator species like Wolf, Jackal, Hyaena, Desert fox, Desert cat etc. while sandy scrub and agricultural areas have major herbivore species and rodent population.

Table 2: Species observed in different sub- habitat types of human landscape.

SN	Type of Sub-Habitat	Observed Mammalian species in study area
1	Rocky scrub	Wolf, jackal, hyaena, desert fox, desert cat, jungle cat, chinkara, black buck, blue bull, wild boars, Hanuman langur porcupine, mongoose, civets, bats and rodents.
2	Sandy scrub	Desert fox, Indian fox, desert cat, chinkara, blue bull, wild boars, mongoose, hedgehog and rodents.
3	Sandy and rocky mixed scrub area	Wolf, jackal, hyaena, desert fox, desert cat,chinkara, black buck, blue bull, wild boars,Hanuman langur,porcupine, mongoose, bats, and rodents.
4	Agricultural area	Desert fox, chinkara, black buck, blue bull, wild boars, Hanuman langur, porcupine, desert hare, hedgehog androdents.

Livestock population of Jodhpur according to Rajasthan livestock census (2012) is 3590264. Different livestock population recorded as per Rajasthan livestock census (2012) have mentioned in *table-3*.

Table 3: Livestock population recorded as per Rajasthan livestock census (2012).

SN	Common Name	Scientific Name	Population
1	Cow	*Bos tarusindicus.*	848343
2	Buffalo	*Bubalus bubalis*	305238
3	Sheep	*Ovis aries*.	731229
4	Goat	*Capra aegagrushircus*.	1681913
5	Camel	*Camelus bactrianus*	16749
6	Donkey	*Equus hemionus*	4176
7	Horses	*Equus ferus*	1616

Table 4. Crop raiding mammalian specie recorded on the basis of Interviews of local communities (N=260).

SN	Sampling site (Village's croplands)	Crop raider species	Crop loss
1	A: Tinwri, Karwad, Manaklao, Bhawad	Blue bull, wild boar, chinkara,porcupine and rodents	5%
2	B: Devaliya, Dangiwas, Ramrawaskalan	Blue bull, wild boar, chinkara, porcupine and rodents	6 %
3	C: GudaBishnoi, Khejarla, Kankani, Luni	Blue bull, wild boar, chinkara, porcupine, jackal and rodents	10%
4	D: Keru, Arna, Barli, Moklawas	Blue bull, wild boar, chinkara, Hanuman langur, porcupine, and rodents	8%

Table 5: Observed predator and predation cases in the study area.

SN	Wild and Domestic (Livestock) species	Observed Predator	Observed species with numbers	Total observed predation cases
A.	**Wild Species**			
1.	Chinkara (*Gazella bennetti)*	Wolf, Feral dogs, Jackal	Wolf (5) Dogs (12) Jackal (1) Fox (0)	18
2.	Black buck (*Antilope cervicapra)*	Wolf, Feral dogs	Wolf (8) Dogs (13) Jackal (0) Fox (0)	21
3.	Blue bull (*Boselaphus tragocamelus)*	Wolf, Feral dogs, Jackal	Wolf (4) Dogs (7) Jackal (0) Fox (0)	11
4.	Wild boar (*Sus scrofa)*	Wolf	Wolf (1) Dogs(0)	01

			Jackal (0) Fox (0)	
5.	Desert Hare **(***Lepus tibetanus)*	Wolf, Jackal, Desert fox, Feral dogs	Wolf (7) Dogs (23) Jackal (5) Fox (9)	44
6.	Indian crested porcupine (*Hystrix indica*)	Wolf, Feral dogs,	Wolf (4) Dogs (9) Jackal (0) Fox (0)	13
7.	Gerbils (*Tatera indica)*&Jird (*Meriones spc.)*	Wolf, Jackal, Desert fox, Feral dogs	Wolf (5) Dogs (20) Jackal (21) Fox (26)	72
8.	Mongoose (*Herpestes spc.*)	Wolf, Feral dogs	Wolf (2) Dogs (3) Jackal (0) Fox (0)	05
9.	Hanuman langur (*Semnopithecus entellus*)	Feral dogs	Wolf (0) Dogs (1) Jackal (0) Fox (0)	01
B	**Domestic Species**			
1	Cow (*Bos tarusindicus.*)	Wolf	Wolf (1) Dogs (0) Jackal (0) Fox (0)	01
2	Buffalo (*Bubalus bubalis)*	*No predator*	Wolf (0) Dogs (0) Jackal (0) Fox (0)	00
3	Sheep (*Ovis aries*)	Wolf	Wolf (33) Dogs (0) Jackal (1) Fox (0)	34
4	Goat (*Capra aegagrushircus*)	Wolf	Wolf (12) Dogs (0) Jackal (0) Fox (0)	12
5	Camel (*Camelus bactrianus)*	*No predator*	Wolf (0) Dogs (0) Jackal (0) Fox (0)	00
6	Donkey (*Equus hemionus)*	*No predator*	W(0) D(0) J(0) F(0)	00
7	Horses (*Equus ferus*)	*No predator*	W(0) D(0) J(0) F(0)	00

By studying different croplands area in study (sampling) site (A), site (B), site (C) and site (D) (*see figure 1*.), The crop raiding by various species were recorded during the day and night. Details of the crop raiding by different mammalian species at various sample sites (A), (B), (C), and (D) in the study area were recorded through direct observations and Interviews with the local community (N = 260) is given in the *table-3*. Thus, there is always exist mutual and harmful interaction between human and wildlife. It is observed that blue bull and wild boar are being the major crop raiders and causes major economic loss to the farmers in these areas where there is predation as in sampling site A and B is comparatively lesser economic loss have been observed mainly due to prey predator interaction which controls this raiding activity. Thus, these interactions are essential to sustain the high mammalian diversity in these areas.

Besides the crop raid the major issue of human wildlife conflict is the livestock depredation by the carnivores. It was found that the major predator of the study area includes *Canis lupus, Canis aureus, Canis familiaris* and *Vulpes vulpespussila*. Total number of the prey and predator cases in the study area are given in the *table 5*. Data gathered from scat analysis, verbal interview and from direct observations during study. From the observed data, it is clear that livestock population and available herbivore prey species are responsible for the survival of top predator the wolf. Other major predator being the feral dogs, which is becoming threat to many prey species. Feral dogs attacks and kill many different mammalian prey species, which has led to drastic population decline of prey species like chinkara, black buck, porcupine etc. During study, we observed that the area where wolves inhabit, feral dog population and their attack case is much lower. Thus, conservation of one major predator species like wolf is important in the study area to run ecosystem smoothly.

Observation and results clearly suggest that the wolf of the study area in human landscape subsidies by the local people in term of livestock depredation specially goat and sheep. Similarly, protection of chinkara and other ungulates by the local community provide enough food to the wolf population of the study area during scarcity of livestock food and during migration.

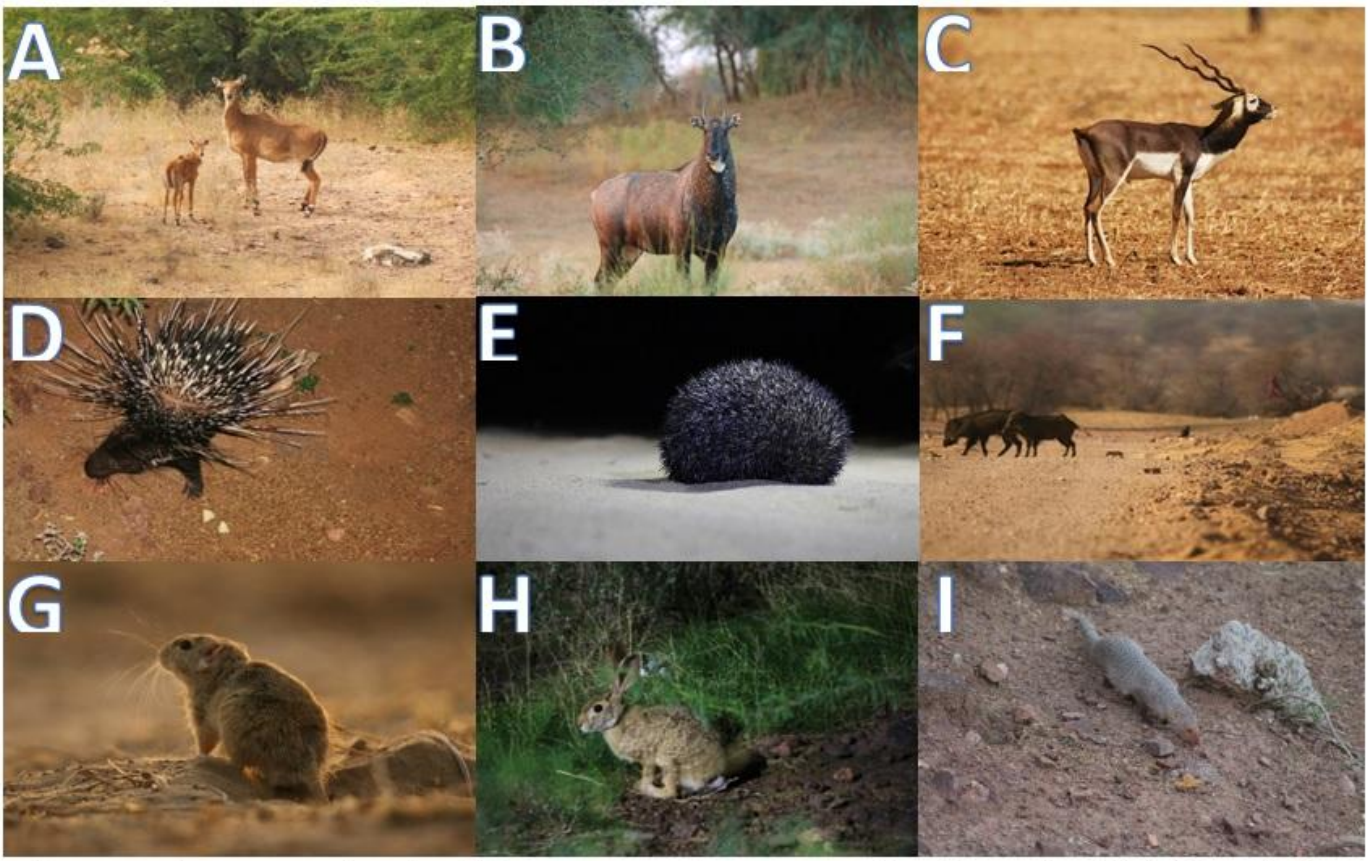

Figure 2: Pictures A-I showing different mammalian prey species observed amid field study (A-chinkara; B- Blue bull; C- Black buck; D- Indian crested porcupine; E- Hedgehog; F- Wild boar; G- Indian jird; H- Desert hare; I- Common mongoose)

We identified different kind of mortality cases of the mammalian species amid extensive field study. It is observed that mortality was caused by various threats (mentioned in *table 3)* and due to this, lowest occurring species like Wolf, Hyaena, Jackal, Desert fox and other ecological important species is being lost and threatened in this desert ecosystem. Amid study, it is found that major cause of mortality are road accidents, feral dog attacks and habitat loss due to growing industrialization, urbanization, rock mining, soil mining and many other anthropological reasons. By these anthropogenic activities, these species survival in near future is question marked '?'.

Table 6: Threats to mammalian species observed in study area.

SN	Type of Threats	Species affected in study area
1	Road accident	Wolf, Jackal, Desert Fox, Desert Cat, Porcupine, Mongoose, Chinkara, Blue Bull, Wild Boar, Black Buck, Hanuman langur, Civets, Desert Hare, Hedgehog and Rodents.
2	Stuck in fencing	Chinkara, Black Buck, and Blue Bull
3	Predation by feral dog	Desert Fox, Desert Cat, Chinkara, Black Buck, Blue Bull, Hanuman Langur, Porcupine, Desert Hare, and Mongoose
4	Electric shock	Hanuman Langur, Civets, Bats
5	Predation by Wild Carnivore Predator	Chinkara, Blue Bull, Black Buck, Desert Hare, and Rodents
6	Habitat loss	Wolf, Jackal, Hyaena, Desert Cat, Civets and Jungle Cat.
7	Hunting/Poaching/	Chinkara, Black Buck, Desert Hare, Captivity: Hyaena, Jackal and Wolf.
8	Natural calamities	Most all species affacted
9	Diseased and Poisioning	Wolf, Hyaena, Jackal, Hanuman Langur
10	Unsystematic management	Wolf, Hyaena and Jackal

DISCUSSION

By observing and calculating data obtained during extensive field study it is concluded that the study area is species rich in terms of mammalian species diversity, that is directly indicating to sustaining all trophic levels of the food chain in TD regions. Predator species data have also obtained and concluded that the Wolf, Jackal, Fox, Hyaena are major predator animals although their population are very less because of habitat degradation continuously occurring by anthropogenic activity. Rajpurohit *et al*. (2011) reported five predator species in outskirt area of Jodhpur city viz. Indian grey wolf (C*anis lupus*), Stripedhyaena (*Hyaena hyaena*), Golden jackal (*Canis aureus*), Desert fox (*Vulpes vulpes pusilla*) and the Common mongoose (*Herpestes edwardsii*). Ghosh (1996) reported 50 mammalian species in the arid area of western Rajasthan in his work.Wildlife living in and around human landscape

interacts with human beings, which vary in strength from low to high, and frequency from least to general on a range from positive and neutral over to negative. Negative interactions, can be called as human wildlife conflict (Graham *et al*. 2005). Fascinatingly, positive human wildlife interaction has no described term as negative interaction, which reflect the bias towards negative interactions in the writings (Peterson *et al.* 2010). The straightest influence of wildlife on humans is that of attacks which probably for defense, territorial, predatory and for protecting their young (Conover, 2001). Ojha and Rajpurohit (2018) reported first case of wolf attack on human in Jodhpur area of Thar desert. During the period of study, interaction between human and mammalian species were studied. We found that the crop raiding by herbivores and omnivores and livestock predation by carnivores in the study area are the major issues of conflicts. Species diversity plays very important role in development of ancient human societies, croplands and industrial organizations as while biodiversity is the base upon that human civilization was built (Khan, 1997). Saxena and Prakash, (1992) stated that the livestock in TD is much high that exert depletion of the biological diversity due to over grazing by them. They stated that the ungulates are the major consumers of vegetation, e.g. the blue bull (*Boselaphus tragocamelus*), blackbuck (*Antelope cervicapra*), chinkara (*Gazelle bennetti*) and wild boar (*Sus scrofa*). Other primary consumer includes desert hares (*Lepus nigricollis*), langurs (*Semnopithecus entellus*) and squirrels (*Funambuluspennanti*) with fairly large population sizes.The high numbers of herbivore observed amid study indicates the grazing pressure is increasing which might disturb the ecological food chain of this area. This herbivore species support predator species in this ecosystem and predators regulate the numbers of these grazer's species indicating prey predator relationship in the study area. Wolves have been observed in area with abundant livestock and wild herbivore prey species. Singh and Kumara (2006) reported that the occurrence of wolves lies outside the conserved area and wolves mainly depends on domestic animals for sustenance. Ojha *et al*., (2019) also observed that wolves in human landscape subsidies by the villagers in terms of devastation specially sheep and goat. They inferred that the protection of chinkara and black buck by the local communities provide enough food for the wolves during shortage of livestock. We observed that predation of wolf was mainly on livestock and wild animals. Many threats have been found to disturb these animals (*table 6*) among which feral dog attacks, road accident and habitat loss being the major threat to mammalian diversity in this study area. Thus, although study area having rich mammalian prey species but these prey species facing severe problems for survival. Among these, prey species viz. wild boar and blue bull's population have been increased tremendously that causing serious problems for

the villagers and farmers. For the regulation of these primary consumer species, carnivore predator species should be conserved and their population must be increased so that they can control prey species population to run the ecosystem smoothly. Similarly, we found that the wolf population of the human landscape and community lands are less affected in the drought conditions, compared to the protected area population as observed in other studies (Waite et al., 2007; Chhangani et al., 2018 and Ojha et al 2019). Besides threats and importance, conservation of this mammalian diversity is as important as conserving wild habitats of the western Rajasthan desert ecosystem. For the conservation, Different type of human subsidies is playing important role. Type of human subsidies by which wild animals are being protected includes- artificial feeding in form of cereals, vegetation, fruits etc, artificial water bodies localy called kheli made for livestock of local villagers also provide water to the wild animal species in extreme summer temperatures. Thus, conservation of carnivore species is imperative because by conserving them, crop raiders activity can be controlled and grazing pressure can be reduced.

Another aspect needs to be highlighted here is the pesticide contamination of the environment leading to the decline in the population of the fauna especially by organochlorine pesticides (OCPs). Here an example of bald eagle from USA needs to be considered. A North American species with a historic range from Alaska and Canada to northern Mexico, the bald eagle is an Endangered Species Act success story. Forty years ago, USA national symbol was in danger of extinction throughout most of its range. Habitat destruction and degradation, illegal shooting, and the contamination of its food source, largely as a consequence of DDT, decimated the eagle population. The federal government's banning of DDT and related pesticides, habitat protection afforded by the Endangered Species Act, and conservation actions taken by the American public have helped bald eagles make a remarkable recovery. Shortly after World War II, DDT was hailed as a new pesticide to control mosquitoes and other insects. However, DDT and its residues washed into nearby waterways, where aquatic plants and fish absorbed it. Bald eagles, in turn, were poisoned with DDT when they ate the contaminated fish. The chemical interfered with the ability of the birds to produce strong eggshells. As a result, their eggs had shells so thin that they often broke during incubation or otherwise failed to hatch. DDT also affected other species such as peregrine falcons and brown pelicans. Some other pesticides related to DDT are suspected to have caused increased mortality, in addition to the harmful effects on reproduction. By 1963, with only 417 nesting pairs of bald eagles known to exist, the species was in danger of extinction. As the dangers of DDT became known, in large part due to the 1962 publication of Rachel Carson's book Silent

Spring, the Environmental Protection Agency took the historic and, at the time, controversial step of banning the use of DDT and some related pesticides in the United States. That was in 1972, and it was the first step on the road to recovery for the bald eagle (U.S. Fish & Wildlife Service Migratory Bird Program, February 2021). This shows how dangerous DDT contamination is how disastrous it can be for the fauna. More scary studies have indicated that we have largely over looked the darker side of these chemicals as OCPs are reported to be carcinogenic (Mathur et al, 2002 & Ingber et al 2013) mutagenic (Ingber et al 2013 & Yaduvanshi et al 2012) teratogenic (Yaduvanshi et al 2012 & ATSDR. Atlanta, GA.1994) immunosuppressive (Repetto. R & Baliga. S.S, 1997 & Corsinia et al, 2003) create endocrine dysfunction such as hypothyroidism or high estrogenic activity (Dewailly et al 2000 & Rathore et al, 2002) disturb reproductive processes (Pant et al ,2007 & Tiemann.U. 2008) growth depressants (Colborn et al, 1993 & Mercier. M, 1981) induces several psychogenic and neurogenic abnormalities in adult stages (Mactutus & Tilson, 1986 & Van Wendel de Jood et al,2001) and are associated with abortions, premature deliveries, still births and infants with low birth weights (Saxena et al, 1981; Saxena et al, 1980; Tyagi et al 2015; Chen. Q et al 2014 & Sharma & Bhatnagar, 1996). OCPs have been in use in India nearly for a half century now. Even after having clear cut evidence suggesting that these chemicals have the ability to eliminate entire species from the planet, the annual consumption of pesticides in India is about 85,000 tons of which OCPs comprise the bulk (India Environment Portal Knowledge for change, 30/10/1998.). Therefore, today OCPs are perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment and are still widely detected in humans despite the considerable decline in environmental concentrations (Dewan et al. 2003). This kind of environmental Contamination with organochlorine pesticides (OCPs) has also been reported by Sharma and her coworkers in 1996 from Jaipur City. She reported contamination of human samples like mothers' blood, cord blood, placenta and mothers' milk with OCPs. Presence of pesticides with OCPs shows that how these xenobiotics have contaminated our Mother Nature and now faunal diversity is facing danger of existence and mammals are not staying away from this potential danger. It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and reaching out to all faunal diversity. It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and the pesticides reach the human body through various sources mainly by absorption form the gastrointestinal tract through contaminated food chain, are circulated in blood, stored milk and secreted during lactation resulting in sufficient neonatal intake. The battle against the

harmful insects would be much less costly and more efficient, and the problem of contamination of the environment by toxic materials would be vastly reduced, if insect activities are controlled by natural means. The use of pest-specific predators; parasites or pathogens; sterilization of insects with the help of radiations; trapping insects using insect attractants like pheromones; use of juvenile hormones or hormone inhibitors may therefore be suggested as alternate ways of pest control (Sharma, 1996; Sharma, M. & Bhatnagar, P, 2017).

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