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A review on the Studies on Faunal diversity, status, Threats and Conservation of Thar Desert or Great Indian Desert Ecosystem

Gaurav Sharma
Zoological Survey of India, Prani Vigyan Bhawan,
M-Block, New Alipore Kolkata-700053, India

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ABSTRACT: Deserts cover more than one fifth of the Earth's land, and they are found on every continent. Far from being barren wastelands, deserts are biologically rich habitats with a vast array of animals and plants that have adapted to the harsh conditions there. The Thar Desert or Great Indian Desert is the world's tenth largest desert and forms a significant portion of western India and covers an area of about 2,78,330 sq km, of which 1,96,150 sq km (70%) is in Rajasthan, 62,180 sq km (23%) in Gujarat and about 20,000 sq km (7%) in Punjab and Haryana states. So far about 2,043 species from single celled animal Protozoa to Mammalia recorded from the Thar Desert. Of these, 619 species are of vertebrates and the rest are invertebrates. This faunal diversity comes to about 2.12% of total Indian fauna, though the Thar occupies about 9% of the country. The Thar desert being a fragile ecosystem is further threatened because of the rapid increase in human population specially in Rajasthan state. In recent years, human population in Rajasthan is further increasing by 3% against 1.8% at the national level. Though Indira Gandhi Canal has transformed more than 11% un-inhabitated desert grassland into a fertile land, the indigenous biodiversity is under threat because the canal has changed the soil moisture, soil texture and vegetation composition. The Rajasthan State Government has declared number of areas as protected in the Thar desert region. The state government of Gujarat has established a Wild Ass Sanctury and Gir National Park to protect two endangered endemic mammal species, *i.e.,* Wild Ass and Asiatic Lion. The Government of India has started a centrally sponsored scheme under the title of Desert Development Programme based on watershed management with the objective to check spreading of desert and improve the living condition of people in desert.

Key Words: Faunal diversity, threats, conservation, Thar desert.

INTRODUCTION

Deserts are arid regions, generally receiving less than ten inches (25 centimeters) of precipitation a year, or regions where the potential evaporation rate is twice as great as the precipitation. Deserts cover more than one fifth of the Earth's land, and they are found on every continent. Far from being barren wastelands, deserts are biologically rich habitats with a vast array of animals and plants that have adapted to the harsh conditions there. Some deserts are among the planet's last remaining areas of total wilderness. Yet more than one billion people, one-sixth of the Earth's population, actually live in desert regions.

The world's deserts are divided into four categories *i.e.* 1. Subtropical deserts are the hottest, with parched terrain and rapid evaporation. The subtropical deserts are Sahara, Arabian, Kalahari, Australian Desert, Gibson, Great Sandy, Great Victoria, Simpson and Sturt Stony, Mojave, Sonoran, Chihuahuan and Thar. The Sahara has a surface area of 9 million square kilometers (3.5 million square miles), and it stands as the largest non-polar desert in the world; 2. Cool coastal deserts are located within the same latitudes as subtropical deserts, the average temperature is much cooler because of frigid offshore ocean currents. The Cool Coastal deserts are Namib and Atacama; 3. Cold winter deserts are marked by stark temperature differences from season to season, ranging from 100°F (38°C) in the summer to 10°F (–12°C) in the winter. The Cold winter deserts are Great Basin, Colorado Plateau, Patagonian, Kara-Kum, Kyzyl-Kum, Iranian, Taklamakan and Gobi and 4. Polar regions are also considered to be deserts because nearly all moisture in these areas is locked up in the form of ice. The Polar regions deserts are Arctic and Antarctica. Antarctica has a surface area of about 14 million square kilometers (5.5 million square miles), making it the largest desert in the world. The Sahara is the world's largest hot desert and third largest desert, after Antarctica and Arctic. The largest hot desert in the world, northern Africa's Sahara, reaches temperatures of up to 122 degrees Fahrenheit (50 degrees Celsius) during the day. But some deserts are always cold, like the Gobi desert in Asia and the desert on the continent of Antarctica. Others are mountainous. Only about 10 percent of deserts are covered by sand dunes.

The Thar Desert or Great Indian Desert is the world's tenth largest desert and forms a significant portion of western India and covers an area of about 2,78,330 sq km, of which 1,96,150 sq km (70%) is in Rajasthan, 62,180 sq km (23%) in Gujarat and about 20,000 sq km (7%) in Punjab and Haryana states. The desert continues into Pakistan as the Cholistan Desert. The entire desert in the Indian subcontinent (India and Pakistan) covers an area of nearly half of the Arabian desert and 1/7th of the Sahara desert. This is the most thickly populated desert in the world by having an average density of 83 persons per sq km as against 6-9 persons in other deserts. The livestock population is also very high and is still increasing, *i.e.*, 46-226 per sq km in different districts. Due to the hostile environment, the Thar desert is considered a fragile ecosystem in which the minor factors may create imbalance in the ecosystem. Despite all these factors, the Thar exhibits a wide variety of habitats and biodiversity. From biodiversity point of view, the Thar may not be rich but is interesting mainly because of the following two reasons. First, the Thar is the extension of Sahara desert through Persian and Arabian deserts and is located at the meeting point of Palaearctic and Oriental biogeographical regions. Hence, the Thar has the admixture of Palaearctic, Oriental and Saharan elements in the biodiversity. Secondly, both plant and animal species constitute an invaluable stock of rare and resistant germplasm. Though the biodiversity in the Thar is important, presently it is under great pressure in order to meet the demand of food and fodder for increased human and livestock populations respectively. During the post independence period, several developmental projects have been initiated in the region. In this respect, the worth mentioning is the increased availability of irrigation water, specially the Indira Gandhi Nahar Pariyojna (IGNP) which has transformed the desert grasslands into crop land. In these circumstances, the native biodiversity (xeric element) has become under threat. The populations of some animals, which were abundantly found only a few decades back, are dwindling very fast. In this respect, some attempts have been made to assess the threats to the vertebrate fauna but the same is not true for the invertebrate fauna. Tremendous changes in the avifaunal structure of the Thar Desert are taking place due to the Indira Gandhi Nahar Pariyojna (IGNP), species never seen earlier are now regularly found near the canal and needs documentation.

The district Rann of Kutchch or Kutchch-Bhuj in Gujarat state forms of separate agroclimatic zone within the Thar desert of India. Like other parts of Indian Thar, Rann of Kutchch is also characterized by a low rainfall and sparse vegetation. However, this region has a special and different topography from the rest of the desert because of its location near the sea and low-lying areas by which the marine water enters into its vast expanse. As a result, Rann of Kutchch is an admixture of saline, marshy and coastal desert where water and soils are extremely saline. This has made the area special from biodiversity point of view and due to its geological history.

Desert animals have adapted ways to help them keep cool and use less water. Many desert animals are nocturnal, coming out only when the brutal sun has descended to hunt. Most desert birds are nomadic, crisscrossing the skies in search of food. Because of their very special adaptations, desert animals are extremely vulnerable to introduced predators and changes to their habitat. Desert plants may have to go without fresh water for years at a time. Some plants have adapted to the arid climate by growing long roots that tap water from deep underground. Some of the world's semi-arid regions are turning into desert at an alarming rate. This process, known as "desertification," is not caused by drought, but usually arises from the demands of human populations that settle on the semi-arid lands to grow crops and graze animals. The pounding of the soil by the hooves of livestock may degrade the soil and encourage erosion by wind and water. Global warming also threatens to change the ecology of desert. Higher temperatures may produce an increasing number of wildfires that alter desert landscapes by eliminating slow-growing trees and shrubs and replacing them with fast-growing grasses.

GEOGRAPHIC DISTRIBUTION

According to Gupta and Prakash (1975), the origin of the Indian Desert lies with geotectonic and climatic changes during the upheaval of Himalaya and several glaciations epochs. It is delimited by the irrigated Indus plains in the west, the Aravalli hill ranges in the east, Rann of Kuchchh in the south and the plains of Punjab and Haryana in north and north east, lying between 22°30' N and 32°05' N latitudes and 68°05' E to 75°45' E longitudes. This has an elevation of about 350-450m above sea level at the Aravalli range in the east, about 100m in south and west and about 20m in Rann of Kutchch. Some workers believe that the Thar was not arid until 2000-3000 years ago and a few rivers passed through this regions, while others believe that it is much older and aridity must have started establishing late during the Pleistocene. These conflicting theories have become debatable from zoogeographical point of views. The Great Indian Desert comprises in parts of four states of India *viz.*, 3 districts of Punjab *i.e.* Firozpur, Faridkot and Bathinda; 4 districts of Haryana

i.e. Sirsa, Hissar, Bhiwani and Mahendragarh; 14 districts of Rajasthan *i.e.* Sri Ganganagar, Hanumangarh, Churu, Jhunjhunu, Sikar, Nagaur, Ajmer, Bikaner, Jaisalmer, Jodhpur, Pali, Barmer, Sirohi and Jalore; 10 districts of Gujarat *i.e.* Ahmedabad, Banaskantha, Junagadh, Jamnagar, Kutchch, Mahesana, Patan, Porbandar, Rajkot and Surendranagar.

The Indian Desert may be subdivided into the following four subdivisions although it is difficult to fix the exact boundaries of each subdivision *i.e.*, 1. Thar- sea of sand, sand hills, silt covered valleys; 2. Pat- lower sand hills with north south orientation, flat sandy soil lying on impervious clay called salt lakes 'Dhands', plateau like drains and hollows filled with fresh or saline lakes called 'Kochars'. Floodwaters of eastern Nara and the Raini are available for irrigation; 3. Ghaggar- relics of a gigantic river system in which flood water of Sutlej river still enters; 4. Steppe desert- uplands of Rajasthan, more or less rocky plateau along the north and western fringes, turned into pene-plains of arid wasteland.

The Indian Desert has been divided into four types of landscapes, *viz.*, hills, plains with hills, marshes and plains with sand dunes. The region of sand dunes is most spectacular and the typical part of Thar desert, which covers more than 1,00,000 sq km in India and extends into Pakistan. The sand dunes of Rajasthan occupy about 58% area of the desert. These are in varying degree of frequency and may be subdivided into two chains: the western part of Barmer, Jaisalmer and Bikaner districts up to the height of about 20-100m and many kilometers long and the eastern part of Bikaner and Churu districts. The latter is discontinuous and scattered and extended in Haryana and Gujarat states. The dunes are highly sandy and contain 0.12-0.18mm size grains, 1.8-4.5% clay and 0.4-1.3% silt. In the major part of Pali and parts of Nagaur, Jodhpur and Jalore districts of Rajasthan along with the Mahesana and Banaskantha districts of Gujarat, the soil is brown and grey loam. Parts of Jamnagar and Kutchch districts are covered with medium black soils. Hills, rocky pediments, the Rann, salt basin and coastal sandy plains constitute the rest which are mostly devoid of vegetation.

A few saline depressions are also present in the Thar, *viz.*, Taal Chhapar, Didwana, Pachpadra, Lunkaransar and Kuchaman. Luni is the main river in western Rajasthan, which has about half a dozen tributaries. It originates near Puskar (Ajmer) and runs about 320km upto Rann of Kutchch. In Jhunjhunu districts of Rajasthan, there is a small river Kantli, which runs to 135km upto Churu district only. The water flows in the rivers only during the monsoon period from June to September. The Indira Gandhi Canal carrying water from Ravi-Beas through Punjab and Haryana enters Rajasthan. The total length of the feeder and main canal is 649km from Harike barrage in Punjab to Jaisalmer. After completion of the project 11% area of western Rajasthan will be irrigated. Though Indira Gandhi Nahar Pariyojna (IGNP) is considered to be hope for future agriculture in Rajasthan, the project has become a subject of debate.

The Rann of Kutchch represents a vast saline flat occupying an area of 23,310 sq km is located in extreme north-west of Gujarat and stretches between 22°41'11″ and 24°41'47″ N latitudes and 68°9'46″ to 71°54'47″ E longitudes. In north, it is bordered with Sind (Pakistan), in south with northern Surendernagar, Banaskantha and Mehsana districts, while in the west and south-west it is surrounded by the Arabian Sea. In west, the Arabian Sea enters the landmass to form the Gulf of Kutchch which has always been very useful from commercial and navigation point of view.

The Rann of Kutchch is divided into the following administrative subunits (Talukas) *i.e.*, Bhuj, Mandis, Mundra, Abadasa, Lakhpat, Nakhatrana, Rapar Bhachau and Anjar. The Rann of Kutchch may be divided into three zones *viz.*, Kutchch (Central part), Great Rann (Rann of Kutchch) and Little Rann. The mainland of Kutchch is fringed by Great Rann in the north and Little Rann in south-east. The Banni formed by sediments deposited by north flowing rivers is a strip along the northern of the main Rann. According to the geological records, this region was under the ocean during Pleistocene as it is evident from the highly fossiliferous soil conditions, *i.e.*, sandy strands, rock sandy strands and soft marsh black mud. The important rivers draining into Rann of Kutchch are the Luni, the Rakhari, the Bhukhi, the Banas, the Nachhu and the Demi. The Luni has a well defined delta consists of a flooded plain from Chitalwana to Rathora, a distance of about 6.5km, and a delta plain from Rathora to the Rann of Kutchch about 44.8 km in length. All these rivers have their origin in the Aravalli Hills.

The extreme of cold and heat is a special feature of desert climate. There is a wide range of temperature not only between summer and winter but also between day and night. The temperature ranges from freezing point in winter to about 50□C in summer at some places. Since the Thar Desert is beyond the full force of both the south-west monsoon rising from Arabian sea and north-east monsoon from the Bay of Bengal, the rainfall is erratic and scanty in this region. The winter rains are rare and drought occurs quite frequently.

The monsoon remains active from July to September and the average rainfall is 450mm in Eastern Rajasthan, 100mm in Western Rajasthan, 300-500mm in Gujarat and 200-450mm in Punjab and Haryana desert. The maximum rainfall is received during the months of July and August, but rainfall may be irregular or scanty or there may be no rains. The relative humidity remains comparatively low.

During summer, the winds are generally violent (with 130km velocity per hour), hot and scorching (loo) with dust (vortices of dust). As a result, the shifting of sand dunes is very common in the desert. During winter, the velocity of wind remains considerably low, 4-10km per hour. With the exception of few plant species, the quick shifting of sand dunes does not allow the plants to settle. Since the light intensity is too high and the relative humidity drops down almost to zero, the evaporation in the desert is excessive during summer season. This desert too has the conventional feature of miles and miles of sand under the burning eye of the Sun, however the beauty of the desert perhaps lies in the colorful people who inhabit the land along with all the different kinds of animals encountered there. There are small hillocks and gravel plains that are found all over but the biodiversity of this desert is very rich.

FAUNAL DIVERSITY

Contrary to the general belief, the Indian Desert fairly abounds in animal life, though most of the animals except birds and a few diurnal mammals (such as antelopes, gazelles, etc.) are not easily visible to the casual observer. They may dwell into proper niches, such as burrows, long tunnels, under stones, on plant leaves and roots, in ponds, puddles and larger reservoirs and lakes, etc. Almost all the major phyla of both the vertebrates and the invertebrates are found here, ranging from the tiny, microscopic Protozoa to Mammals. Most of them are nocturnal because they go inside their burrows during day time. Flashy footpads or special systems to conserve the water are special adaptations. Both Flora and Fauna species in the Thar region constitute an invaluable stock of rare and resistant germ plasm which are too valuable from biological point of view. Though the vertebrates are now more or less adequately known taxonomically, the same is not true for invertebrates and perhaps 2-3 times or more of the existing fauna still remains to be explored.

Roonwal (1983) made an initial attempt to put together all the information about the known fauna of the Indian desert and reported nearly 1,100 species from the arid districts of Rajasthan. A multiauthored compendium *'Faunal Diversity in the Thar Desert: Gaps in Research'* edited by Ghosh, Baqri and Prakash (1996) reports about 2,043 species from single celled animal Protozoa to Mammalia. Of these, 619 species are of vertebrates and the rest are invertebrates. This faunal diversity comes to about 2.12% of total Indian fauna, though the Thar occupies about 9% of the country.

Consequently, various workers have been contributed in different field of faunal ecology of the Great Indian Desert (Roonwal, 1970; Blanford, 1901; Pocock, 1939; Prakash, 1963; Roonwal, 1983; Rathore, 1984; Rahmani, 1989, Prakash *et al*., 1992; Rathore and Bhattacharya 2004; Tyagi and Baqri, 2005 and Sivaperuman *et al*., 2005 and 2008). Studies on Beetles have been reported by Arrow (1931), Balthasar (1963), Gorden and Oppenheimer (1975), Biswas (1978a, b), Biswas and Chatterjee (1985) and Sewak (1985, 1986, 1991, 2004a, b, 2005, 2006a, b, c, d, and 2008). Tak (1995, 2000a, b, 2004) and Tak and Rathore (1996, 2004a, b) have investigated the ants of Gujarat and Rajasthan. Termites have been studied in considerable amount by Roonwal (1970-1980), Roonwal and Bose (1978), Roonwal and Rathore (1972-1975) Roonwal and Sen-Sarma (1960), Roonwal and Verma (1973-1977), Roonwal *et al*. (1973), Rathore (1984), Rathore and Bhattacharyya, (2004), Rathore and Mandal (2005). Studies on the avifauna of the Great Indian Desert were carried out by different researchers and these studies mainly listing the species from different parts of the Thar desert (Adams, 1873 and 1874; Barnes, 1886; Ticehurst, 1922a, 1922b, 1923a, 1923b, 1923c, 1923d, 1924a and 1924b; Whistler, 1938; Rana, 1973; Ali, 1975; Prakash, 1983; Sharma, 1983; Rana and Idris, 1986; Bohra and Goyal, 1992; Rahmani, 1994, and 1997; Rahmani and Soni, 1997 and Sivaperuman *et al*., 2005 and 2008). Detailed studies on population ecology of vultures have been made by various worker in the Great Indian Desert (Chhangani and Mohnot, 2001; Chhangani, *et al*., 2002; Chhangani, 2004; Chhangani and Mohnot, 2004; Chhangani, 2005). Prakash (1999), Prakash and Rahmani (1999) and Prakash, *et al*. (2003), Prakash (1999), Cunningham *et al*., (2001 and 2003) and Oaks *et al*. (2004) and Chhangani (2008).

Among the mammals rodents is one of the well studied group in the Great Indian Desert, Prakash published more than 300 research papers in the field of rodent ecology and also a large number of scientific studies have been carried out by various workers on systematic and ecological studies of desert rodent (Agarwal (1962), Biswas and Tiwari (1966), Prakash (1963 and 1964) and Prakash and Jain (1967), Rana and Prakash (1980, 1982 and 1984), Chkravarthy *et al*. (2005), Idris (2008).

Primate is another well studied group in the Thar Desert (Sugiyama, 1965; Mohnot, 1971; Hrdy, 1974; Mohnot, 1971; Agoramoorthy and Mohnot, 1988; Agoramoorthy, 1982, 1986, 1987, 1992, 1994a, 1994b; Agoramoorthy and Mohnot, 1988; Agoramoorthy *et al*. 1988 and Agoramoorthy, 2008).

The Rann of Kutchch exhibits a spectacular biodiversity because of its evolutionary history, geographical location and ecological uniqueness of the salt desert. The review of the literature reveals that Rann of Kutchch has not been explored significantly for the invertebrate fauna while significant work has been done on the vertebrate groups except the fishes. In fact, the coast and Gulf of Kutchch are not only rich in biodiversity but also significantly explored for faunal resources. Several groups of marine invertebrates, *viz.*, Coelenterates (52 spp. of corals), Echiurans (11 spp.), Mollusca (72 spp.), Bryozoans (42 spp.) etc., have been reported from this area. Its vertebrate fauna includes a large number of marine fishes, reptiles and mammals (dolphins and whales). In the hot desert of Rann of Kutchch, only a few species of the major phyla like Protozoa, Cnidara, Platyhelminthes, Nematoda have been reported till date. The phylum Arthropoda is represented by 23 species of Isoptera, 6 species of Diptera, 10 species of Coleoptera, 20 species of Lepidoptera, 6 species of Odonata, 9 species of Metastigmata (Acari). About 317 species of vertebrates are known from the Great Kutchch region *i.e.*, 20 species of fishes, 6 species of amphibians, 35 species of reptiles, 220 species of birds and 36 species of mammals. The coastal belt falling within the Gulf of Kutchch is also distinguished by the presence of living corals. The corals are often inhabited by pearl oysters. The sea also harbours a wide variety of marine life, *viz.*, seahorse or hippocampus, sea turtles, dolphins, whales etc. The coastal region is favourite spot for the breeding of the following sea turtles: hawksbill sea turtle (*Eretmochelys imbricata*), olive ridley sea turtle (*Lepidochelys olivacea*) and Green sea turle (*Chelonia mydas*). This region has also vast resources of lobsters and prawns. The Great Rann of Kutchch is an established nesting and breeding ground of Greater Flamingo and Lesser Flamingo in India. These migratory birds are attracted to this region because of the availability of their food (algae), which is abundantly found in this saline-desert-marshy ecosystem. Due to high concentration of Greater Flamingos in Khadir and Pachham belts, this breeding place is called Flamingo city. The subspecies of Wild Ass (*Equus hemionus khur/Equus onager)* is found only in Rann of Kutchch and thus this is endemic to this region. Hedgehogs are also seen in abundance in this region. The following species in this region are threatened species *viz.*, Spiny-tailed lizards, Green Sea Turtle, Olive Ridley Turtle, Wild Ass, Desert Cat, Caracal, Wolf, Chinkara, Indian Pangolin, Dugong and Great Indian bustard. Corals, molluscs and lobsters are found distributed in the Rann of Kutchch, besides several species of threatened dolphins and whales. In fact, Rann of Kutchch sustains isolated populations of a good number of flora and fauna species which are extremely important from evolutionary point of view.

Characteristic Fauna

Some species of Reptiles, Birds and Mammals are characteristic fauna of Thar Desert as shown in Table 1.

Table 1. Shows characteristic fauna of Desert Ecosystem.

Reptiles	**Birds**	**Mammals**
Desert Monitor *(Varanus griseus* (Daudin, 1803)	Great Indian Bustard *(Ardeotis nigriceps* (Vigors, 1831)	Asiatic Lion *(Panthera leo persica* Meyer, 1826)
Spiny tailed lizard (*Uromastyx hardwickii* Gray, 1827)	Houbara Bustard (*Chlamydotis undulata* (Jacquin, 1784)	Indian Wild Ass *(Equus onager* Boddaert, 1785*)*
Central Asian Cobra *Naja naja oxiana* (Eichwald, 1831)	Demoiselle Crane *(Grus virgo* (Linnaeus, 1758)	Caracal *(Caracal caracal* (Schreber, 1776)
	Imperial/Black-bellied Sandgrouse *Pterocles orientalis*	Desert Cat (*Felis silvestris* Schreber, 1775)
	White-browed Bushchat *(Saxicola macrorhynchus* Stoliczka, 1872)	Desert Fox (*Vulpes vulpes pusilla*)
	Cream-coloured Courser *(Cursorius cursor* Latham, 1787)	Chinkara *(Gazella bennettii* (Sykes, 1831)
		Scaly Anteater *(Manis crassicaudata* Gray, 1827)
		Wolf *(Canis lupus pallipes* Sykes, 1831)

Threatened Fauna

Surprisingly, serious attempts have not been made to assess the threats to the invertebrate fauna in the changing scenario, though they become the first victim of any habitat destruction. However, significant work has been done on the vertebrate species in the Thar region. The following species of Reptiles, Aves and Mammals are threatened as shown in Table 2, 3 & 4.

Table 2. Threatened Reptiles of the Thar Desert.

Order	Family	Genus	Species	Common Name
Squamata	Elapidae	*Naja*	*naja naja*	Common cobra
Squamata	Elapidae	*Naja*	*naja oxiana*	Central Asian cobra
Squamata	Colubridae	*Ptyas*	*mucosus*	Rat snake
Squamata	Agamidae	*Uromastix*	*hardwicki*	Spiny tailed lizard
Squamata	Varanidae	*Varanus*	*griseus*	Desert Monitor
Squamata	Varanidae	*Varanus*	*bengalensis*	Indian monitor

Table 3. Threatened Aves of the Thar Desert.

Order	Family	Genus	Species	Common Name
Galliformes	Phasianidae	*Pavo*	*cristatus*	Indian Peafowl
Gruiformes	Phasianidae	*Galloperdix*	*lunulata*	Painted Spurfowl
Gruiformes	Gruidae	*Grus*	*virgo*	Demoiselle Crane
Gruiformes	Gruidae	*Grus*	*grus*	Common Crane
Gruiformes	Otididae	*Ardeotis*	*nigriceps*	Great Indian Bustard
Gruiformes	Otididae	*Chlamydotis*	*undulata*	Houbara Bustard
Charadriiformes	Glareolidae	*Cursorius*	*cursor*	Cream-coloured Courser
Passeriformes	Muscicapidae	*Saxicola*	*macrorhyncha*	Stoliczka's Bushchat

Table 4. Threatened Mammals of the Thar Desert.

Order	Family	Genus	Species	Common Name
Carnivora	Felidae	*Panthera*	*pardus*	Leopard
Carnivora	Felidae	*Felis*	*chaus*	Jungle cat
Carnivora	Felidae	*Felis*	*sylvestris*	Desert cat
Carnivora	Felidae	*Caracal*	*caracal*	Caracal
Carnivora	Hyaenidae	*Hyaena*	*hyaena*	Striped Hyaena
Carnivora	Canidae	*Canis*	*lupus*	Wolf
Carnivora	Canidae	*Vulpes*	*vulpes pusilla*	Desert Fox
Carnivora	Canidae	*Vulpes*	*bengalensis*	Indian Fox
Carnivora	Mustelidae	*Mellivora*	*capensis*	Ratel/ Honey badger
Perissodactyla	Equidae	*Equus*	*onager*	Wild Ass/Khur
Artiodactyla	Bovidae	*Gazella*	*bennettii*	Chinkara
Artiodactyla	Bovidae	*Antilope*	*cervicapra*	Blackbuck
Pholidota	Manidae	*Manis*	*crassicaudata*	Indian Pangolin

Studies bv ZSI

Almost all the major phyla of vertebrates and invertebrates ranging from the tiny microscopic protozoa to mammals are found here. Though a few scientists from the headquarters of Zoological Survey of India, Kolkata had conducted faunistic surveys, the studies in the planned and systematic way were initiated only after the Desert Regional Centre, ZSI was established in the year 1960 at Jodhpur.

Though the vertebrates are now more or less adequately known taxonomically, the same is not true for invertebrates and perhaps 2-3 times or more of the existing fauna still remains to be explored. In this connection Desert Regional Centre has organised a workshop to identify gaps in the faunal exploration of the ecosystem and its proceedings entitled *"Faunal Diversity in the Thar Desert: Gaps in Research"* edited by Ghosh *et al.*, 1996 is the state of art on the subject. Since then the number of surveys have been undertaken by scientists from different group of animals and the current status of faunal diversity is listed in Table 5. The major studies conducted in Thar desert by ZSI scientists are as given below.

Table 5. Approximate Number of Species in the Thar Desert.

Phylum	**Class**	**Order**	**No of Species**
Protozoa			52
Porifera			7
Platyhelminthes			87
Rotifera			8
Nematoda			170
Acanthocephala			4
Mollusca			24
Annelida			26
Arthropoda	Crustacea		57
Arthropoda	Acarina		157
Arthropoda	Chilopoda		8
Arthropoda	Diplopoda		1
Arthropoda	Insecta	Ephemeroptera	2
Arthropoda	Insecta	Odonata	31
Arthropoda	Insecta	Orthoptera	40
Arthropoda	Insecta	Dermaptera	7
Arthropoda	Insecta	Dictyoptera	20
Arthropoda	Insecta	Isoptera	46
Arthropoda	Insecta	Mallophaga	40
Arthropoda	Insecta	Hemiptera	75
Arthropoda	Insecta	Thysanoptera	21
Arthropoda	Insecta	Neuroptera	13
Arthropoda	Insecta	Lepidoptera	300
Arthropoda	Insecta	Diptera	80
Arthropoda	Insecta	Siphonaptera	5
Arthropoda	Insecta	Hymenoptera	65
Arthropoda	Insecta	Coleoptera	60
Arthropoda		Anoplura	7
Bryozoa (Ectoprocta)			11
Chordata	Pisces		142
Chordata	Amphibia		8
Chordata	Reptilia		51
Chordata	Aves		350
Chordata	Mammalia		68
Total			**2043**

The studies on *"Status survey of Chinkara and Desert Cat in Rajasthan"* conducted by Kankane published in 2000.

The Fauna of Gujarat (Part-1) published in 2000 and groups covered are Freshwater Fishes, Marine and Estuarine Fishes, Amphibia, Reptilia, Aves and Mammalia.

The collaborative studies conducted on *"Habitat suitability analysis of Chinkara, Gazella bennetti in Rajasthan- A remote sensing and GIS approach"* by ZSI and IIRS published in 2001.

The Fauna of Gujarat (Part-2) published in 2004 and groups covered are Oribated Mites, Metastigmata (Ticks), Odonata, Isoptera, Coccoidea, Coleoptera, Diptera, Formicidae, Echinodermata, Crustacea, Prawns, Annelida, Echiura, Marine Mollusca, Nematoda, Cnidaria and Protozoa.

Baqri *et al.* under Ministry of Environment and Forests sponsored project entitled "*Studies on Faunal diversity in the Thar desert of Rajasthan"* has conducted study in thirteen districts of Thar desert of Rajasthan during 2000-04 and recorded about 901 species of fauna belonging to Nematoda (109 spp.), Insecta (279 spp.), Acarina (41 spp.), Pisces (80 spp.), Amphibia (8 spp.), Reptilia (44 spp.), Aves 272 spp.) and Mammalia (68 spp.).

The *"Fauna of Desert National Park, Rajasthan"* published in 2004 and recorded Plants and Soil Nematoda, Mollusca, Arachnida, Odonata, Orthoptera, Dermaptera, Mantodea, Isoptera, Diptera, Lepidoptera, Hymenoptera, Thysanura, Acarina, Aves, Reptilia and Mammals.

The studies on *"Fauna of Sambhar Lake, Rajasthan"* published in 2005 and recorded 64 species of Zooplankton, 37 species of Crustacea, 71 species of Insects, 71 species of Aves and 6 species of Mammals recorded.

The studies on *"Geospatial Atlas for the wetland birds of Thar Desert, Rajasthan"* conducted by Kumar *et al.* published in 2006 and recorded 144 species of wetland birds.

The studies by ZSI scientists on Thar desert published in book *"Faunal ecology and conservation of the Great Indian Desert"* edited by Sivaperuman *et al.,* 2009 and recorded 85 species of Dung Beetles by Sewak and 35 species of Ants by Tak of Thar Desert of Rajasthan and Gujarat; 28 species of Spiders in the Desert National Park by Sivaperuman and Rathore; 272 species of Aves from Thar desert, Rajasthan by Sivaperuman *et al.* and revival prospects of 21 species of larger mammals in Thar desert of Rajasthan by Kankane.

The *"Faunal Resources of Tal Chhaper Wildlife Sanctuary, Rajasthan"* published in 2009 and recorded Plant and Soil Nematodes, Isoptera, Scarabaeidae, Formicidae, Herpetofauna, Aves and Mammals.

The Environmental Impact Assessment studies conducted in *"Lignite Mining blocks of Kapurdi and Jalipa village of District Barmer"* in the year 2008 and in *"Hadla Lignite Mining Project, Bikaner, Rajasthan"* in the year 2009-10.

On the occasion of Golden Jubilee Celebration of ZSI, DRC, Jodhpur in 2010 *"National Seminar on Impact of Climate Change on Biodiversity and challenges in Thar Desert"* organized, in which researchers contributed their work on biodiversity of Thar Desert and published Abstracts and proceedings.

Threats to the ecosystem

The Thar desert being a fragile ecosystem is further threatened because of the rapid increase in human population specially in Rajasthan state. In recent years, human population in Rajasthan is further increasing by 3% against 1.8% at the national level. The rapid increase in the population of livestock has also resulted in tremendous pressure on the grasslands. In most of the Thar districts of Rajasthan, the livestock population is more than double of the human population. Hence, the typical herbivorous desert animals which can survive in the harsh climate may also perish, mainly due to continuous shrinkage of the grazing area.

Though Indira Gandhi Canal has transformed more than 11% un-inhabitated desert grassland into a fertile land, the indigenous biodiversity is under threat because the canal has changed the soil moisture, soil texture and vegetation composition. The Canal has caused the rise in the water table and about 1/3rd command area remains flooded. The flooded conditions have increased the salinity, which has further affected the native biodiversity. This altered desert ecosystem has been responsible for the increase in the cutaneous lieshmaniasis and malaria, invasion of the new agricultural pests, weeds and other plant diseases.

Mining of stones, minerals and other natural resources with or without monitoring has also resulted in the loss of biodiversity.

Though there are few communities in Rajasthan who love animals and plants and save them even by sacrificing their life, poaching and cutting of trees are still considerable threats to wildlife in the region.

In Rann of Kutchch, the 'salt desert' is considered as a unique and a fragile ecosystem, the slightest human interference may result in the fast depletion of the rare desert fauna and flora. A number of recently established industries are discharging effluents, which have adversely affected even the littoral fauna.

The depletion of the mangroves has resulted in the decline of fish catch. In recent years, the area under Rann of Kutchch mangrove forests has reduced drastically. The annual rate of degradation in percentage has been calculated at about 11% for the mangroves.

The number of pearl oysters in the Gulf of Kutchch has drastically dwindled along with the fast depleting population of other marine animals. The coral reefs are also being over exploited for various reasons. The destruction of corals is to be stopped immediately because they are considered to be important component of the marine biodiversity.

The subspecies of Indian Wild Ass (*Equus hemionus khur*) found in the Little Rann of Kutchch is one of the rarest mammals surviving now in this desert. Its habitat has reduced drastically and also decline in its population.

The ever-multiplying number of salt pans in the Little Rann and increase in road traffic are also contributory factors to the decline of Wild Ass population. The excess growth of weeds in the natural habitat of the Wild Ass is also becoming a matter of concern. Though the Wild Ass populations are not under threat from the poachers, the Maldharis (nomadic cattle grazers) are indeed a real threat to them. These tribals are gradually encroaching their habitat, especially on the Bets (grassy islands) inside the Rann of Kutchch.

Thar is, presently under great pressure in order to meet the demand of food and fodder for increased human and livestock populations. During the post independence period, several developmental projects have been initiated in the region. In this respect, the Indira Gandhi Nahar Pariyojna (IGNP) of Rajasthan state and a distributory of Sardar Sarovar Project feeding Katchch area of Gujarat are worth mentioning here. The large scale irrigation projects transformed the desert grasslands into crop land. In the circumstances, the native biodiversity (xeric element) has become under threat. The populations of some animals, which were abundantly found only a few decades back, are dwindling very fast.

Conservation Efforts

The Government of India has started a centrally sponsored scheme under the title of Desert Development Programme based on watershed management with the objective to check spreading of desert and improve the living condition of people in desert.

The Rajasthan State Government has declared number of areas as protected in the Thar desert region. The objective of the Desert National Park is to protect the xeric elements of biodiversity. This provides protection especially to Chinkara, Nilgai, Jackal, Indian Fox, Desert Fox, Desert Cat, Jungle Cat, Great Indian Bustard, Houbara Bustard, Sandgrouse, White Browed Bushchat, etc. Some wildlife species, which are fast vanishing in other parts of India, are found in the desert in large numbers such as the Blackbuck (*Antilope cervicapra*) and the Indian Gazelle/Chinkara (*Gazella bennettii*). The protection provided to them by a local community, the Bishnois, is also a factor.

The state government of Gujarat has established a Wild Ass Sanctury and Gir National Park to protect two endangered endemic mammal species, *i.e.*, Wild Ass and Asiatic Lion. Besides, the establishment of Gaga Sanctuary by the Gujarat government is a great hope for the conservation of the Great Indian Bustard, an endangered majestic bird of the Thar region. The Gir National Park supports not only endemic and endangered species (Asiatic Lion) but also a few more threatened species like Leopard, Jungle Cat, Hyaena, Jackal, Mongoose, Civet Cat, Desert Cat, Chital, Rusty Spotted Cat, Sambar, Four-horned Antelope, Chinkara, Pangolin, Wild Boar, etc.

Since the Rann of Kutchch is a forest-poor area, wildlife is also limited. After realizing the importance of the rare and endangered species of animal in the area, the Government of Gujarat has taken an effective step to preserve this unique ecosystem by declaring an area of 7506 sq km in the Great Rann of Kutchch as "Kutchch Desert Wildlife Sanctuary" in 1987. In 2008, The Government of India has declared an area of 12,454 sq km of Great Rann of Kutchch as Biosphere Reserve. To save the Wild Ass, the Gujarat Government has declared an area of about 500 sq km in Little Rann and adjoining wasteland as "Wild Ass Sanctuary". Narayan Sarovar Sanctuary has been declared specially for the conservation of Chinkara. This sanctuary occupying an area of about 30,754 ha also supports other important animals, *viz.*, Caracal, Desert Cat, Indian Wolf, Pangolin, Grest Indian Bustard, Peafowl and a few other birds. Since the people of Rann of Kutchch are generally vegetarian in their feeding habit, the hunting or poaching threat is limited and the animals rather feel protected.

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