

Chapter 1

The Thar of Rajasthan (India): Ecology and Conservation of a Desert Ecosystem

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Abstract This paper highlights the Thar Desert and its ecosystem. The work reviews and presents the natural condition of the Thar Desert within Rajasthan State. The diversity of the vegetation and of higher animals is discussed on the basis of earlier works and surveys. Major problems and conservation issues are presented along with their possible solutions. Recommendations are made for the protection of this ecosystem.

1.1 Introduction

Among the six natural life-supporting ecosystem types of the earth, deserts occupy roughly one seventh of the land surface. Moisture is either absent or very low in deserts, and is dependent solely on the balance between precipitation and evaporation. Aridity results from evaporation being higher than precipitation. The tropics are the major belts in which deserts occur. The Hindi word for 'desert' is *marusthali* (region of death), stemming from the Sanskrit *mri*, 'to die', and *sthala*, 'arid or dry land'; in the dialect of those countries, the latter has become *thal*, the converse of the Greek *oasis*, denoting tracts which are particularly sterile (Tod 1920). Despite their inhospitable life conditions, deserts are characterized by often unique ecosystems, and the presence of an exclusive flora and fauna.

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1.1.1 The Great Indian Desert or Thar Desert

The Great Indian Desert, or Thar Desert, extends over about 0.32 million km² forming approx. 10% of the total geographic area of India. More than 60% of the desert lies in the State of Rajasthan, followed by 20% in Gujarat (Krishnan 1977). This desert forms the eastern extremity of the great arid and semi-arid belt of the world. It is one of the smallest deserts of the world but exhibits a wide variety of habitats and a high biodiversity, due to the juxtaposition of Palaearctic, Oriental and Saharan elements (Blanford 1901; Pocock 1939, 1941; Prakash 1963). It is the most densely populated desert of the world—the human population density is 84 per sq. km, compared to 3–9 per sq. km in other deserts (Baqri and Kankane 2001). Consequently, there is serious biotic pressure on its ecosystem and natural resources. Frequent droughts and a high livestock population contribute to the deterioration in ecosystem production and regeneration.

Owing to strong variations in climatic, edaphic, physiographic, topographic and geological characteristics, the State of Rajasthan shows a wide diversity of habitats. Indeed, there is much historical information highlighting the rich faunal resources of this state, formerly comprised of several princely states. Over time, however, ever increasing anthropogenic activities have been accompanied by changes in the traditional pattern of land use, resulting in substantial alterations of habitats. In more recent years, this has been due to the major impact associated with the construction of the Rajasthan Canal (Indira Gandhi Nahar Project, IGNP). Species most sensitive to these habitat alterations have become extinct; those better able to adapt have survived. Moreover, altered habitats have become an ideal home for many new species, leading to expanded distributional ranges.

1.2 Study Area

The State of Rajasthan lies between 23°04'–30°11'N and 69°29'–78°17'E, occupying 342,239 km² and 10.41% of the land area of the country. It is the largest state in India and the one with the highest proportion of land occupied by desert.

1.2.1 Physiography

Rajasthan State has four major physiographic regions, viz. the western desert (Thar Desert), the Aravalli hills, the eastern plains and the south-eastern plateau (Hadoti Plateau). About 62% of the state area consists of sandy plains, which is why it is known as the Desert State of India. The Aravalli (*a beam lying across*) hills running diagonally across the state form the geomorphic and climatic boundary of the desert in the east. The western part merges into the Pakistan desert.

The Aravalli Range is the major water divide in the state. The area in the east is well drained by several integrated drainage systems, whereas that in the west has only one, the Luni drainage system.

1.2.2 Climate

The climate is characterized by low rainfall with erratic distribution, extremes of diurnal and annual temperatures, low humidity and high wind velocity. The arid climate has marked variations in diurnal and seasonal ranges of temperature, characteristic of warm-dry continental climates. During summer (March to June), the maximum temperature generally varies between 40 and 45°C, with occasional highs reaching 51°C. Night temperatures decrease considerably, to 20–29°C. January is the coldest month. During winter (December to February), minimum temperatures may fall to –2°C at night. Occasional secondary Western disturbances, which cross mostly western, northern and eastern Rajasthan during the winter months, cause light rainfall and increased wind speeds which result in a wind-chill effect. The average annual rainfall ranges from less than 100 to 400 mm.

1.2.3 Divisions of the Thar

The Thar Desert can be subdivided into four sectors on the basis of rainfall and edaphic characteristics:

- the Luni basin, comprising Pali, Jalore, the south-eastern part of Barmer, the eastern part of Jodhpur, the western part of Ajmer, Sirohi, and the southern part of Nagaur;
- the northern drainage zone, comprising Sikar, Jhunjhunu and northern Nagaur;
- the agriculturally rich district of Sri Ganganagar and Hanumangarh adjoining Punjab and Haryana; and
- the true desert or *marusthali*, consisting of Jaisalmer in its entirety, northern Barmer, and the western parts of the Jodhpur, Bikaner and Churu districts.

1.3 Biotic Associations or Habitat Types and Vegetation

In the desert, the variety of biotic associations or habitats is very low. Blatter and Hallberg (1918–1921) recognized five formations. They defined each formation as a specific community of plants determined by certain soil characteristics. Krishna and Dave (1956) classified the Rajasthan Desert into three subregions according to climatological data and the occurrence of reptiles:

- *arid subregion*: rainfall 5" (13 mm), north-western sector of Jaisalmer District
- *semi-arid subregion*: rainfall 5–10" (13–25 mm), central desert
- *sub-humid subregion*: rainfall 10–15" (25–38 mm), southeast Barmer, northeast Jodhpur, Ganganagar, Sikar and Jhunjhunu districts.

Prakash (1964) recognized the following associations and sub-associations in the Rajasthan Desert, based on the mammalian fauna:

- the sandy association: (1) sand dunes, (2) sand hills, (3) sandy plains and (4) artificial mines;
- the rocky association: (1) rocks, (2) lakes and surrounding gardens and (3) caves and tunnels;
- the ruderal association.

Furthermore, based on earlier work (Prakash 1963; Saxena 1972; Bhandari 1990), Prakash (1994a) recognized four major types of habitats in the Indian Desert, in terms of vegetation and fauna:

- aquatic habitats: rivers are mostly ephemeral. Canal, tanks and reservoirs are the primary aquatic habitats. The Rajasthan Canal has produced many new aquatic habitats in the form of small ponds and swampy areas. Blatter and Hallberg (1918–1921) described a number of species which were later classified by Shantisarup (1957) under three associations: *Eicchornia-Potamogeton*, *Hydrilla-Vallisnaria* and *Ceratophyllum-Vallisnaria*.
- sandy habitats: these occupy the largest proportion of the Thar Desert. Grasses are the predominant vegetation in these parts of the desert. *Lasiurus scindicus* occurs in the extreme desert where rainfall is below 150 mm annually. Mixed xeromorphic woodland is found in the vicinity of ephemeral rivers, and halophytic species on saline flats.
- hills and rocky outcrops: the Aravalli Range borders the Thar Desert on its eastern side, and isolated hills and rocky outcrops are scattered throughout this region. Smooth surfaces of hills are covered by a scrub community of mixed xeromorphic thorn forest (Satyanarayan 1963).
- ruderal habitats: Blatter and Hallberg (1918–1921) used the term 'ruderal' for the ecological association of vegetation near human settlements. This habitat type is associated with village complexes scattered throughout the desert—on rocky outcrops, sandy plains, sand dunes, saline flats and river banks, each with a distinct type of vegetation.

The major part of the Thar is occupied either by dry open grassland or by grassland interspersed with trees and thorny bushes (Gupta 1975). The vegetation falls under the category 'thorn forest type' or 'scrub forest type' (Mathur 1960; Champion and Seth 1968). The most common grass species of the Thar occur as a *Dicanthium-Lasiurus-Cenchrus* association (Dabadghao and Shankarnarayanan 1973). Most of the other vegetation consists of stunted, thorny or prickly shrubs and perennial herbs which are resistant to drought. Sand dunes form 58% of the desert. Stabilized dunes are covered mainly by *Capparis decidua*, *Calotropis procera*, *Calligonum*

polygonoides, *Acacia senegal*, *Prosopis cineraria*, *Aerva javanica*, *Aristida adscensionis* and other psammophytic species (Shetty 1994). Saline depressions—notably, Talchappar, Didwana, Pachpadra, Lunkaransar and Kuchaman—contain halophytic vegetation. The major grasses and sedges in these depressions are *Eleusine compressa*, *Eragrostis ciliaris* and *Dactyloctenium aegyptium*.

1.4 Protected Areas and Fauna

Protected areas in Rajasthan consist of two national parks and 25 wildlife sanctuaries along with 32 closed areas (Anon. 2003). Additionally, 24 sites are recognized as Important Bird Areas (Islam and Rahmani 2004).

The desert area of the state has two wildlife sanctuaries, viz. the Desert (Barmer, Jaisalmer) and Tal Chappar (Churu) sanctuaries (Anon 2003). The Desert Wildlife Sanctuary has an area of 3,162 km² and was established in 1981. In addition to the desert flora and fauna, the main purpose was to protect the Great Indian Bustard, *Ardeotis nigriceps*. Indeed, 70% of the country's population of this bird is found in this protected area (Rahmani 1986). It also holds significant populations of chinkara gazelles, *Gazella bennettii*, and of the sand lizard, *Uromastyx hardwickii*. The Tal Chappar Wildlife Sanctuary has an area of 7.19 km² and is known for its population of blackbuck, *Antelope cervicapra*—in fact, it is commonly called the Tal Chappar Blackbuck Wildlife Sanctuary. There are 19 closed areas in this desert region (Table 1.1).

In the desert, one new site (Khichan, Jodhpur), the two sanctuaries (Desert and Tal Chappar) and one closed area (Diyatra, Bikaner) are recognized as International Birdlife Areas by the Bombay Natural History Society, Mumbai in the worldwide programme of Birdlife International. These are sites of high priority for avifaunal conservation (Islam and Rahmani 2004).

1.4.1 Faunal Diversity (Higher Vertebrate Groups)

The fauna of any area depends on the characteristics of the habitat. To avoid the high daytime temperatures of desert ecosystems, smaller animals commonly adopt nocturnal and subterranean life modes, also in the Thar Desert (Prakash 1964). Indeed, scarcity of water is a more acute problem than that of food. Many animals cover their water requirements via their food (vegetation or other animals; Prakash 1964). For instance, gerbils (*Tatera indica indica*, *Meriones hurrianae*), hare (*Lepus nigricollis dayanus*), squirrel (*Funambulus pennanti*) and porcupine (*Hystrix indica indica*) feed on seeds, roots and stems of desert plants. Larger animals usually remain in rather close proximity to water sources; thus, water becomes a key factor restricting their activities.

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