Journal of Arid Environments (1997) **36**: 687–703

Avifaunal changes in the Indian Thar Desert

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(*Received 28 June 1996, accepted 14 November 1996*)

The Indian Thar Desert is one of the smallest and most densely populated deserts of the world but due to its geographical location it has high avian and plant diversity. Nearly 300 bird species have been identified. A 649-km long irrigation canal, the Indira Gandhi Nahar Project (IGNP), is changing the ecology of the Thar by bringing water to arid areas. Beside the main canal, nearly 8000 km of distribution channels have been built. A massive afforestation scheme along the canal has attracted many new animal and bird species. Expansion of agriculture, overgrazing by livestock, change in cropping pattern, development of seepage wetlands and introduction of exotic plants have greatly affected desert birds such as the endangered Great Indian Bustard *Ardoetis nigriceps*, the migratory Houbara Bustard *Chlamydotis undulata* and the endemic White-browed Bushchat *Saxicola macrorhyncha*, while some species such as Common Crane *Grus grus* and Demoiselle Crane *Grus virgo* are spreading along the canal. This paper discusses the change brought about in the birdlife of the Thar by the development of IGNP and recommends urgent conservation measures.

Keywords: India; Thar Desert; irrigation canal; changes in avifauna

Introduction

The Thar Desert occupies nearly 9% of India's geographical area and covers 208,751 km^2 in Rajasthan alone (Fig. 1). The Aravalli Mountains, starting from Champaner in North Gujarat and extending up to Delhi, form the eastern boundary of the Thar. In the west are the Thar-Parkar, Cholistan and Thall Deserts of Pakistan. In the south, it extends into Gujarat, where one finds a further 62,180 km^2 (20%) of the Thar Desert. This paper deals only with the Thar Desert of Rajasthan (Fig. 1).

A huge irrigation project, the Indira Gandhi Nahar Project (IGNP), in the main portion of the Thar Desert, while increasing much needed agricultural production is also likely to create some environmental problems in the Thar. The Thar is rich in wildlife but no detailed study has been made, except for some work by Goyal & Bohra (1983), Ghosh *et al*. (1986), Rahmani (1986, 1990*a*,*b*), Rahmani & Sankaran (1991) and Rahmani (in press *a*,*b*). No environmental impact assessment of the IGNP covers

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all aspects: socio-economic, ecological and biological. In an earlier paper, Rahmani & Sankaran (1991) discussed the impact of IGNP on the status and distribution of Blackbuck (*Antilope cervicapra*) and Indian Gazelle (*Gazella bennetti*). In this paper we discuss the impact of IGNP on the birdlife of the Thar Desert. First we briefly describe the Thar Desert and the IGNP, and then we discuss the changes seen in the birdlife of the Thar.

The paper is based on observations by the first author during his various surveys of the Thar Desert from 1981 to 1994 (Rahmani, 1986, 1989*a*,*b*, 1990*a*,*b*; Rahmani & Manakadan, 1989; Rahmani & Sankaran, 1991) and on studies by the second author from 1979 to 1982 when he was posted at Jodhpur, and later as the Chief Conservator of Forest in-charge of afforestation along the IGNP from 1988 to 1996. The first author also studied the effect of the IGNP on wildlife during 1993 and 1994 (see Rahmani, 1994; Rahmani, in press *a*,*b*).

The nomenclature, both scientific and common, is based on Sibley & Monroe (1990). The status of birds (Appendix 1) is generally based on Collar *et al*. (1994), except in a few cases e.g. Indian Whiterumped Vulture *Gyps bengalensis* and Longbilled Vulture *Gyps indicus* which are abundant in India while noted as near-threatened by Collar *et al*. (1994).

The Thar Desert

The Thar Desert is the eastern extension of the vast Iranian-Arabian Desert, which joins the great Sahara Desert. It is about 640 km long and 160 km wide. It is covered by several metres of sand which is constantly being shifted by winds blowing from the

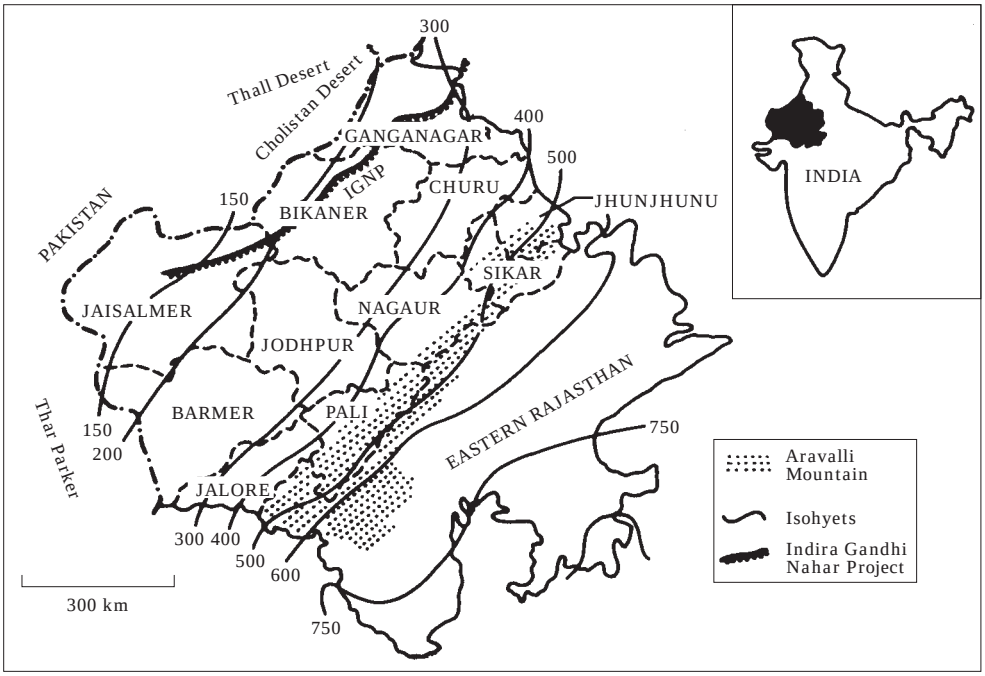

Figure 1. Eleven districts west of the Aravalli Mountains constitute the Thar Desert in Rajasthan state of India. The Thar Desert extends into Punjab and Haryana states in the north and Gujarat in the south. A part of the Thar Desert is present in Pakistan.

south-west (Krishnan, 1982). The sand covers an irregular rocky floor, but occasionally local prominences and ridges rise above the level of the sand. The Thar Desert extends into Pakistan but nearly 62% is situated in the 11 districts of western Rajasthan. Though moisture-bearing winds of the south-west monsoon blow over Rajasthan for 4 months (June to September) of the year, there are no hills across the direction of the winds to impede their progress and precipitate some rain. The Aravalli Mountains are aligned parallel to the direction of the winds and do not form a serious obstacle to their course across Rajasthan (Krishnan, 1982). The monsoon winds therefore bring very scanty rains. Rainfall in the Thar Desert varies from less than 150 mm in parts of Jaisalmer in the extreme west to 400 mm in the east towards the Aravalli Mountains (Fig. 1). Droughts lasting 3 to 4 years are common. The year can be divided into three seasons: winter (October to February), summer (March to June) and monsoon (July to September). June is the hottest month and January the coldest. The temperature varies from 0°C in winter to 50°C in summer (Ghosh, 1996). Nearly 85% of the rainfall is received during the monsoon period with most rain falling during only a few days. Total precipitation shows large inter-annual variations, with a coefficient of variation of 70%.

Vegetation of the Thar

Much of the Thar is occupied either by dry open grassland or by grassland interspersed with trees and thorny bushes (Gupta, 1975). The grass cover of the Thar is of the *Dichanthium–Lasuirus–Cenchrus* type (Dabadghao & Shankarnarayan, 1973). Nearly 58% of the Thar is covered with sand dunes and interdunal valleys (Shankarnarayan, 1988). Many shifting dunes are bare but stabilized dunes are generally covered with *Capparis decidua, Calotropis procera, Calligonum polygonoides, Acacia senegal, Prosopis cineraria, Aerva javanica, Aristida adscensionis, Aristida funiculata, Dactyloctenium aegyptium* and other psammophytic species (Shetty, 1994). At the base of the dunes and interdunal valleys which are comparatively moist, the vegetation may consist of trees and shrubs such as *Acacia senegal, A. jacquemontii, Prosopis cineraria, Tecomella undulata, Capparis* spp., *Salvadora oleoides* and *Zizyphus nummularia*.

There are many saline depressions in the Thar with characteristic halophytic vegetation consisting of *Salsola baryosma, Chenopodium* spp., *Haloxylon salicornicum* and *Suaeda fruticosa*. There is no perennial river in the Thar Desert. The Luni and its tributaries flow for only 3 to 4 months during the monsoon, although pools remain for a much longer period. *Tamarix ericoides* is the dominant plant of dry riverbeds and in some places covers the whole area. The grasses are generally represented by *Desmostachya bipinnata, Dactyloctenium aegyptium* and *Eragrostris ciliaris*, and the main sedge is *Cyperus rotundus* (Gupta, 1975; Bhandari, 1990; Shetty, 1994).

There are many village tanks and ponds in the Thar Desert which have typical aquatic vegetation. Ghaggar Depressions in Ganganagar district and three major water escape areas in Bikaner and Jaisalmer districts have created huge new bodies of water along the main IGNP. Many more seepage wetlands have developed beside the IGNP, which now harbour all sorts of aquatic flora and fauna. It is not uncommon to see tall stands of grasses such as *Saccharum spontaneum, Typha angustata, Arudno donax* and *Vetiveria zizaniodes* in some of the old seepage wetlands (Shetty, 1994). All these different habitats attract wildlife, some unique and localised, others more widespread and common.

Livestock population

The Thar Desert has one of the largest livestock densities of any desert. During the last

31 years, there has been a five-fold increase in livestock numbers from 10·27 million in 1951 to 49·48 million in 1982. The density of livestock varies from 42 km^{-2} in Jaisalmer to as high as 226 km^{-2} in Sikar district (Chouhan, 1988).

Human population

The Thar is the most populous desert in the world. While in other deserts the human density varies from 4 to 10 humans km^{-2}, in the Thar it is 83 km^{-2}! Moreover, the Thar

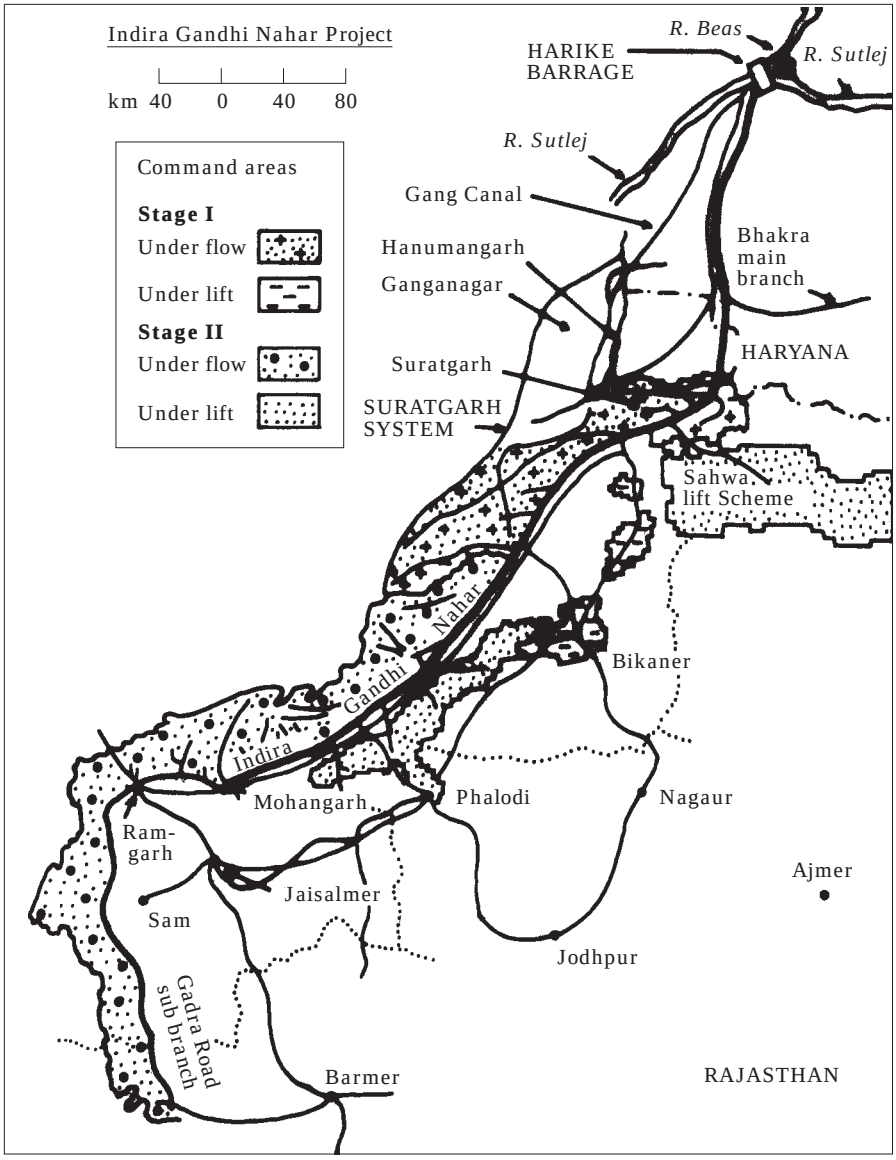

Figure 2. The main canal of Indira Gandhi Nahar (canal) Project (IGNP) starts from Harike reservoir in Punjab and ends after 649 km in Mohangarh in Jaisalmer district of Rajasthan. The IGNP has a network of distributaries and channels totalling nearly 8000 km.

has shown a very high rate of population growth. While in India as a whole the growth rate between 1901 and 1981 was 187%, in the Thar it was 249% (Malhotra, 1988).

Agriculture

Agriculture and animal husbandry are the most important occupations of the people of the Thar. Pearl millet or bajra (*Pennisetum typhoides*) is the main monsoonal crop. The other common crops are mong (*Phaseolus radiatus*), moth (*Vigna aconitifolia*), guar (*Cyamopsis tetragonoloba*) and til (*Sesamum indicum*). In the IGNP command areas, these traditional crops are being replaced by cash crops such as groundnut (*Arachis hypogea*), cotton (*Gossypium* spp.), rice (*Oryza sativa*), sugarcane (*Saccharum officinarum*), wheat (*Triticum sativum*) and barley (*Hordeum vulgare*) (Chatterji & Saxena, 1988).

Irrigated area

During good rainfall years, vast areas in Jodhpur, Bikaner, Nagaur and Pali are brought under cultivation. However, the irrigated area in the Thar is limited to 14% of the total cropped area. Nearly 54% of the total irrigated area is fed by canals, 45% by wells and tubewells, and only 0·87% by tanks (Chouhan, 1988). However, with the development of IGNP, the scene is changing fast.

Indira Gandhi Nahar Project

When India became independent in 1947, plans were developed to bring marginal areas under cultivation to feed the growing population. The Thar with its vast, thinly populated areas was considered a 'land bank' which could be brought to some use. An ambitious plan was prepared to bring water through canals. Work on the IGNP, earlier known as Rajasthan Canal, was started in 1958 but the actual excavation commenced only in 1960 after the signing of Indus Water Treaty with Pakistan, through which India became entitled to the exclusive use of the three eastern rivers of the Indus system: Ravi, Beas and Sutlej. The total length of the main canal is 649 km from Harike barrage in Punjab to Mohangarh in Jaisalmer (Fig. 2). In addition to the main canal, branches and distribution channels, including lift canals, about 8000 km in length, have been constructed or are under construction. The IGNP is in two stages: while Stage I is complete, work on Stage II is continuing and hopefully will be complete in a couple of years (Fig. 2).

When the IGNP and its irrigation channels are complete, nearly 11% of western Rajasthan will be irrigated. The IGNP is one of the largest irrigation systems of dry areas in the world. Despite the fact that IGNP is one of the largest canals in India, and brings water to areas where surface water was not present, no detailed environmental impact assessment (EIA) was ever made. It was conceived in the 1950s when EIA was not considered important.

Arrival of water in the Thar has opened up land for colonization as in the Ganganagar district, parts of Bikaner, Jaisalmer and Jodhpur districts (Fig. 1). As a result of immigration to the new irrigated areas and the natural increase of the local people, there has been an unprecedented rise in the human population.

Table 1. *Major waterbodies formed due to seepage along the Indira Gandhi Nahar Project (IGNP)*

District	Nearest	Location	Length (m)	Waterspread area (ha)
Hanumangarh	Badopal	10 depressions and channels on west of IGNP between RD100 and RD 190	1000 each	1200
Ganganagar	Suratgarh	8 depressions and 2 other waterbodies on west of IGNP between RD 190 and RD 270	1000 each	1000
Bikaner	Ghaghara	RD 507	2000	300
	Amarpura	RD 750	3000	500
	Bajju	RD 954	500	25
	Bikampur	RD 1070	300	5
Jaisalmer	Madasa	RD 1120	500	25
	Nachana	RD 1355	2000	300

RD = Reduced distance; 1 RD = 305 m (Canal terminology).

Afforestation in the IGNP area

The greater part of the 649-km long main canal suffers from windblown sand and shifting sand dunes which block the waterways, roads, habitations and farmlands. To prevent this and to stabilize shifting sand dunes, the Government of Rajasthan has started to afforest up to 1 km from the canals.

Afforestation in Stage I was started in 1962, and was taken up on a large scale from 1974–75 under International Development Agency funds. By 1989, nearly 100,000 ha have been planted along canals and roads, and under sand dune stabilization, pasture development and village fuelwood schemes. Afforestation in Stage II was started in 1985–86 on a small scale with funds from the World Food Programme and later on a large scale from funds of Command Area Development and Desert Development Programme. Up to 1995, over 50,000 ha had been planted.

The main species planted are *Acacia nilotica, A. tortilis, Dalbergia sissoo, Eucalyptus camaldulensis, Prosopis cineraria, Tecomella undulata* and *Zizyphus mauritiana*. Many of these plantations in Stage I are already mature for harvesting. Some 10,000 ha have been identified for felling and replanting during the next 10 years.

Some of these plantations are now dense, with a good understorey which hides wild boar (*Sus scrofa*), nilgai (*Boselephus tragocamelus*), jackal (*Canis aureus*) and fox (*Vulpes bengalensis*). These linear plantations provide corridors for the movement of resident forest birds such as Jungle Babbler (*Turdoides striatus*), White-browed Fantail (*Rhipidura aureola*), Asian Paradise Flycatcher (*Terpsiphone paradisi*) and Yellow-legged Green Pigeon (*Treron phoenicoptera*). As the trees mature and the plantations become more dense, many birds which are new to the Thar are gradually coming in and spreading.

Waterlogging and development of waterbodies

Waterlogging has become a major problem in some areas along the canal (Table 1), so much so that some villages such as Dabli Kalan in Ganganagar district had to be abandoned. One of the major causes of waterlogging is over-irrigation by farmers when earlier the water allowance was kept high. According to one study, if surface drainage

is not introduced promptly in the waterlogged areas of Ganganagar district, thousands of hectares of land from the first phase of the IGNP will be submerged and salinized in 25 to 30 years. However, a far more serious waterlogging problem awaits Stage II of IGNP. Owing to an underground hard substratum of gypsum in about 34% of the gross command area of 3544 km^2, water collected in low lying areas does not seep down. Due to reverse capillary action, the water comes to the surface with dissolved salts and evaporates, leaving the salts behind, thus making the land saline. However, proper and controlled irrigation methods such as sprinkler and drip systems can avert this problem and this mega irrigation project can continue to enhance agricultural production on a sustainable basis. Part of the shallow lands, having the hard pan beneath, could also be better used for afforestation.

Spread of weeds

Waterlogging has caused spread of weeds and has also brought mosquitoes and several waterborne diseases which were unknown earlier. Interdunal water reservoirs which store excess flood waters of the Ghaggar river have been colonized by hydrophytes and mesophytes such as *Typha angustate, Arundo donax, Vitevaria zizaniodes, Eichhornia crassipes, Imperata cylindrica, Phragmites* and *Saccharum spontaneum*. This leads to faster evapo-transpiration of the stored water.

Many new weeds are now seen in the irrigated areas. The Water Hyacinth (*Eichhornia crassipes*) is perhaps the most apparent in the main canal and channels. Harike barrage in Punjab state from where the IGNP gets water is infested with this pernicious weed, which also floats down the canal.

Changing avifauna of the Thar Desert

Located at the junction of the Palaearctic and Oriental biogeographic regions, the Thar Desert shows high avian diversity. Nearly 300 species of birds have been recorded (Adam, 1873, 1874; Barnes, 1886; Ticehurst, 1922; Whistler, 1938; Rahmani, in press *a*).

Owing to development of the IGNP, tremendous environmental changes are taking place in the Thar Desert. These changes are detrimental to some extent for desert birds (Table 2), especially endangered species such as the Great Indian Bustard (*Ardeotis nigriceps*), Houbara Bustard (*Chlamydotis undulata*) and Whitebrowed Bushchat (*Saxicola macrorhyncha*). However, common and adaptable birds of forest (Table 3) and scrub land are increasing along the IGNP, thanks to plantations and seepage wetlands. Many species of waterfowl are also seen in the canal and/or in the waterbodies beside the canal (Appendix).

Important endangered birds of the Thar

Great Indian Bustard

During studies on bustards in the 1980s, it was estimated that more than half of the Great Indian Bustards in India are present in Rajasthan, mainly in the Thar Desert (Rahmani & Manakadan, 1990). The bustards were found in nine districts: Kota, Ajmer, Bhilwara, Jalore, Pali, Bikaner, Jodhpur, Jaisalmer and Barmer (Goriup & Vardhan, 1980). The populations appeared to be secure, leading to complacency for their conservation. During surveys in 1993–94 (Rahmani, 1994) it was discovered that all over the Thar Desert the bustard population had drastically declined. In some

Table 2. *Important birds of the Thar Desert*

Name	Status
Redheaded Vulture *Sarcogyps calvus*	Uncommon resident
Cinereous Vulture *Aegypius monachus*	Uncommonly seen in winter
Falcons *Falco* spp.	Declining due to trapping in neighbouring countries
Demoiselle Crane *Grus virgo*	Abundant in Taal Chhaper and Kheechan. Now also found around new waterbodies and agricultural fields
Common Crane *Grus grus*	Spreading with IGNP
Great Indian Bustard *Ardeotis nigriceps*	Declining due to ineffective protection
Houbara Bustard *Chlamydotis undulata*	Declining (?) due to excessive hunting
Cream-coloured Courser *Cursorius cursor*	Common
Pintail Sandgrouse *Pterocles alchata*	Status unknown
Imperial Sandgrouse *Pterocles orientalis*	Declining (?). Earlier very large flocks were found in Gajner and some tanks of Jaisalmer but now more spread out along the IGNP
Whitebrowed Bushchat *Saxicola macrorhyncha*	Rare and local, some places common
Whitewinged Tit *Parus nuchalis*	Rare and local, mainly found near Aravalli Mountains

Table 3. *Number of common, vulnerable, near-threatened and endangered birds found in different habitat types in the Thar Desert*

Status	Wetland	Forest	Grassland	Grass/Desert	Desert	Miscellaneous
Common	89	21	20	8	29	48
Vulnerable	–	1	1	–	3	1
Near-threatened	4	–	–	2	3	1
Endangered	–	–	–	1	–	–
Total	93	22	21	11	35	50

areas, bustard numbers have halved, e.g. Diyatra, Bap, Sam, Sudasari, or disappeared, e.g. Khuri.

The bustard is still reported from a large area in the western Thar Desert (mainly Jaisalmer district) but wherever we went (e.g. Nachna, Ramgarh) villagers told us of bustard poaching by outsiders. Most of these rich poachers come for Houbara and Sandgrouse but shoot Great Indian Bustard as well if they find them.

Houbara Bustard

The Houbara is a migrant from Central Asia, and moves to India via Pakistan. Although fully protected in India, some poaching does occur, and moreover, a couple of thousands are slaughtered every year by Arab Shaikhs in Pakistan. No baseline data are available on Houbara distribution and density in the Thar. Knowing of its unrestricted killing in Pakistan, one may suppose that its population must be declining sharply.

Cranes

Three species of cranes are seen in the Thar Desert. The Sarus (*Grus antigone*) is confined to the Luni basin and around artificial wetlands in Jodhpur and Pali districts. The Common Crane (*Grus grus*) and Demoiselle Crane (*Grus virgo*) are winter visitors. Due to development of IGNP and resultant seepage and water escape tanks and crop fields (mainly groundnut), these cranes now have more areas for wintering in the Thar. Near Kheechan village in Jodhpur district 5000–6000 Demoiselle Cranes are seen and villagers give food to them. About 1000 are found in Taal Chhaper sanctuary where they feed on tubers of *Cyperus*. They are also reported from the environs of Sambhar Lake in Nagaur and Jaipur districts, and from many parts of Jodhpur and Barmer districts. The Common Crane is more widespread and has greatly benefited by the IGNP.

White-browed Bushchat

The White-browed Bushchat or Stoliczka's Whinchat is a small endemic and localized bird of the arid and semi-arid areas of north-west India (Ali & Ripley, 1983).

During the last few decades, there have been very few sightings of this small rare bird (Rahmani, 1993). It was supposed to be extinct in Pakistan (Roberts, 1992) but during four surveys in 1993–94, the first author saw 86 individuals on 18 sites (Rahmani, 1994, in press *b*).

Increase in wetland birds in the Thar

Out of the 232 species seen by us in the Thar Desert, 215 are quite common and do not need any conservation action at present, except for protection of their habitat. Only six species, Imperial Eagle, Palebacked Pigeon, Greater Hoopoe Lark, Whitebellied Minivet, Whitebrowed Bushchat and Rufoustailed Wheatear, are vulnerable, and only one species, the Great Indian Bustard, is endangered. We also found that 10 species are near-threatened and will become endangered if they continue to decline. Adding all the endangered, vulnerable, and near-threatened species, the total comes to 17, or about 7%.

Analysing the number of species in different habitats (Table 3) we find that 93

species are found in wetland. Most of them are quite common, except for four species (Black Stork, Blacknecked Stork, Lesser Flamingo and Greater Spotted Eagle). There are only 35 true desert species, but this group has six (or 17%) species which need conservation action for their survival. This further proves the importance of protecting the desert environment for the conservation of the flora and fauna of the Thar. Interestingly there are 11 species in the desert/grassland habitat, of which one is endangered (Great Indian Bustard) and two are near-threatened (Redheaded Falcon and Houbara Bustard). The pure grasslands of the Thar have 21 bird species — almost all of them quite common, except the Imperial Eagle.

Besides wetland, planted forest is another habitat which is new to the Thar Desert. We found that 22 species have colonised this man-made habitat, and only one (Whitebellied Minivet) is rare. As expected, the second largest number of species (50) were found in mixed or miscellaneous habitat (fields, urban areas, scrubland, hedgerows, ditches, etc.) but only one (Redheaded Vulture) is near-threatened, and one (Palebacked Pigeon) is vulnerable.

Conservation of desert avifauna

India has more than 500 sanctuaries and national parks, but in the Thar Desert of Rajasthan there are only three protected areas: the 7 km^2 Tal Chaper Blackbuck Sanctuary in Churu district, the 26 km^2 Gajner in Bikaner district, and the 3162 km^2 Desert National Park (DNP) in Jaisalmer and Barmer districts (Rahmani, 1989*b*, 1994). They constitute less than 1·5% of the total Thar area of nearly 208,751 km^2. The first two protected areas are very small and do not contribute much to the long-term protection of the desert fauna (Rahmani, 1994), while the DNP which was established in 1984 to protect desert wildlife is now partly threatened by major ecological changes once the Gadra-Road sub-branch of the IGNP is completed. This canal will pass through part of the Park, and will change the land use pattern and bring in settlers (Rahmani, 1989*b*, 1994). It is likely that the typical desert birds such as the Great Indian Bustard, Houbara Bustard, Cream-coloured Courser, Great Hoopoe Lark and White-browed Bushchat will be adversely affected in the command area of the IGNP, which is approximately 10% of the total Thar area. Even within the command area, there are large patches of uncommand areas and high sand dunes which will remain almost unchanged and hence will be able to support small populations of desert species if not disturbed by human beings.

Despite the fact that the IGNP is having a substantial impact on the flora and fauna of the Thar Desert, there has been no detailed study of the ecological impact of seepage wetlands and large-scale plantations on both sides of the canal. In order to take appropriate conservation measures to stop further decline in typical desert birds (and other wildlife), and also to assess the positive impact on certain species, the following measures are urgently required; (1) Studies on the impact of IGNP on the distribution and abundance of avifauna, with special emphasis on the distribution of water birds in the seepage wetlands and colonization of plantations by forest birds; (2) Studies on the present status and distribution of the Great Indian Bustard, Houbara Bustard, Imperial Sandgrouse, Spotted Sandgrouse, White-browed Bushchat, Laggar Falcon, Redheaded Vulture and major raptor species; (3) Based on the above studies, identification of conservation priority areas in the Thar Desert, especially beside the IGNP, for establishment of more sanctuaries for desert flora and fauna; (4) Studies on the impact of the Gadra-Road tributary of the IGNP on the Desert National Park, and strict implementation of measures recommended by this study; (5) A general Environmental Impact Analysis of the IGNP on the common flora and fauna.

Initial studies by the first author from 1981 to 1990 were made under the Endangered Species Project, funded by the U.S. Fish & Wildlife Service. The first of the major surveys in 1993 and

1994 was funded by a donation of £500 by Cygnus Wildlife Holidays through the Oriental Bird Club, and the second and third by the World Wide Fund for Nature–India through their Community Biodiversity Conservation Movement Programme. Parts of the surveys were also funded by the U.S. Fish & Wildlife Service Grant No. 14-16-0009-90-1253 14FT 566(16). We are grateful to Mr V.D. Sharma, Principal Chief Conservator of Forests, and to Mr R.S. Bhandari, Chief Conservator of Forests (Wildlife), of Rajasthan for permission for the first author to visit the Desert National Park and other areas.

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Appendix I. *List of birds seen in the Thar Desert between 1981 and 1994*

Name	Habitat†	Status‡
Little Grebe *Tachybaptus ruficollis*	W	C
Blacknecked Grebe *Podiceps nigricollis**	W	C
Great Cormorant *Phalacrocorax carbo**	W	C
Indian Cormorant *Phalacrocorax fuscicollis**	W	C
Little Cormorant *Phalacrocorax niger*	W	C
Oriental Darter *Anhinga melanogaster**	W	C
Cinnamon Bittern *Ixobrychus cinnamomeus**	W	C
Striatus Heron *Butorides striatus**	W	C
Indian Pond Heron *Ardeola grayii*	W	C
Cattle Egret *Bubulcus ibis*	W	C
Little Egret *Egretta garzetta*	W	C
Intermediate Egret *Mesophoyx intermedia*	W	C
Large Egret *Casmerodius alba**	W	C
Grey Heron *Ardea cinerea*	W	C
Purple Heron *Ardea purpurea*	W	C
Painted Stork *Mycteria leucocephala**	W	C
Asian Openbill Stork *Anastomus oscitans*	W	C
Black Stork *Ciconia nigra*	W	NT
Woolly-necked Stork *Ciconia episcopus*	W	C
Blacknecked Stork *Ephippiorhynchus asiaticus**	W	NT
Black Ibis P*seudibis papillosa*	D	NT
White Ibis *Threskiornis melanocephalus**	W	C
Eurasian Spoonbill *Platelea leucorodia**	W	C
Greater Flamingo *Phoenicopterus ruber**	W	C
Lesser Flamingo *Phoeniconaias minor*	W	NT
Greylag Goose *Anser anser*	W	C
Barheaded Goose *Anser indicus**	W	C
Ruddy Shelduck *Tadorna ferruginea**	W	C
Common Shelduck *Tadorna tadorna*	W	C
Eurasian Wigeon *Anas penelope**	W	C
Gadwall *Anas strepera**	W	C
Common Teal *Anas crecca**	W	C
Mallard *Anas platyrhynchos**	W	C
Spotbilled Duck *Anas poecilorhyncha**	W	C
Northern Pintail *Anas acuta**	W	C
Garganey *Anas guerquedula*	W	C
Northern Shoveler *Anas clypeata**	W	C
Redcrested Pochard *Netta rufina**	W	C
Common Pochard *Aythya ferina**	W	C
Ferruginous Pochard *Aythya nyroca**	W	C
Tufted Duck *Aythya fuligula**	W	C
Demoiselle Crane *Grus virgo**	W	C
Common Crane *Grus grus**	W	C
Black-shouldered Kite *Elanus caeruleus*	D/G	C
Oriental Honey Buzzard *Pernis ptilorhynchus***	F	C
Black Kite *Milvus migrans govinda*	M	C
Blackeared Kite *Milvus migrans lineatus*	M	C
Redheaded Vulture *Sarcogyps calvus*	M	NT
Cinereous Vulture *Aegypius monachus*	D	C
Eurasian Griffon *Gyps fulvus*	D	C
Longbilled Vulture *Gyps indicus*	D	C
Indian Whiterumped Vulture *Gyps bengalensis*	D	C

Appendix I. (*Continued*)

Name	Habitat†	Status‡
Egyptian Vulture *Neophron percnopterus*	D	C
Northern Harrier *Circus cyaneus*	D/G	C
Pallid Harrier *Circus macrourus*	D/G	C
Montagu's Harrier *Circus pygargus*	D/G	C
Western Marsh Harrier *Circus aeruginosus**	W	C
Short-toed Snake Eagle *Circaetus gallicus*	D/G	C
Longlegged Buzzard *Buteo rufinus*	D	C
Desert Buzzard *Buteo buteo vulpinus*	D	C
Eurasian Tawny Eagle *Aquila vindhiana*	D	C
Steppe Eagle *Aquila nipalensis*	D	C
Lesser Spotted Eagle *Aquila pomarina*	D	C
Greater Spotted Eagle *Aquila clanga**	W	NT
Imperial Eagle *Aquila heliaca*	G	V
Shikra *Accipiter badius***	F	C
White-eyed Buzzard *Butastur teesa*	D/G	C
Saker Falcon *Falco cherrug*	D	NT
Laggar Falcon *Falco biarmicus jugger*	D	NT
Redheaded Falcon *Falco chicquera*	D/G	NT
Common Kestrel *Falco tinnunculus*	D/G	C
Hobby *Falco subbuteo*	G	C
Osprey *Pandion haliaetus**	W	C
Grey Francolin *Francolinus pondicerianus*	D/G	C
Black Francolin *Francolinus francolinus***	G	C
Common Quail *Coturnix coturnix*	G	C
Rain Quail *Coturnix coromandelica*	G	C
Indian Peafowl *Pavo cristatus*	M	C
Coot *Fulica atra**	W	C
Purple Swamphen *Porphyrio porphyrio**	W	C
Common Moorhen *Gallinula chloropus**	W	C
Whitebreasted Waterhen *Amaurornis phoenicurus*	W	C
Great Indian Bustard *Ardeotis nigriceps*	D/G	E
Houbara Bustard *Chlamydotis undulata*	D/G	NT
Lapwing *Vanellus vanellus*	W	C
Redwattled Lapwing *Vanellus indicus**	W	C
Yellow-wattled Lapwing *Vanellus malabaricus*	G	C
Whitetailed Lapwing *Banellus leucurus**	W	C
Cream-coloured Courser *Cursorius cursor*	D	C
Indian Courser *Cursorius coromandelicus*	G	C
Collared Pratincole *Glareola pratincola**	W	C
Small Indian Pratincole *Glareola lactea**	W	C
Painted Snipe *Rostratula benghalensis**	W	C
Stone Curlew *Burhinus oedicnemus*	D	C
Great Stone Plover *Esacus magnirostris*	W	C
Little Stint *Calidris minuta**	W	C
Temminck's Stint *Calidris temminckii**	W	C
Redshank *Tringa totanus**	W	C
Spotted Redshank *Tringa erythropus**	W	C
Common Greenshank *Tringa nebularia**	W	C
Green Sandpiper *Tringa ochrupus**	W	C
Wood Sandpiper *Tringa glareola**	W	C
Common Sandpiper *Tringa hypoleucos**	W	C
Ruff & Reeve *Philomachus pugnax**	W	C
Blackwinged Stilt *Himantopus himantopus**	W	C

Appendix I. (*Continued*)

Name	Habitat†	Status‡
Blacktailed Godwit *Limosa limosa**	W	C
Little Ringed Plover *Charadrius dubius**	W	C
Kentish Plover *Charadrius alexandrinus**	W	C
Mongolian Plover *Charadrius mongolus**	W	C
Common Snipe *Gallinago gallinago**	W	C
Pied Avocet *Recurverostra avosetta**	W	C
Indian River Tern *Sterna aurantia**	W	C
Whiskered Tern *Chlidonias hybrida**	W	C
Common Blackheaded Gull *Larus ridibundus**	W	C
Great Blackheaded Gull *Larus ichthyaetus**	W	C
Brownheaded Gull *Larus brunnicephalus**	W	C
Chestnutbellied Sandgrouse *Pterocles exustus*	D	C
Spotted Sandgrouse *Pterocles senegallus*	D	?
Imperial Sandgrouse *Pterocles orientalis*	D	C
Rock Pigeon *Columba livia*	M	C
Palebacked Pigeon *Columba eversmanni*	M	V
Eurasian Collared Dove *Streptopelia decaocto*	M	C
Red Collared Dove *Streptopelia tranquebarica***	F	C
Laughing Dove *Streptopelia senegalensis*	M	C
Yellowlegged Green Pigeon *Teron phoenicoptera***	F	C
Alexandrine Parakeet *Psaittacula eupatria*	F	C
Roseringed Parakeet *Psittacula krameri***	M	C
Pied Cuckoo *Oxylophus jacobinus*	M	C
Crow-Pheasant *Centropus sinensis***	F	C
Asian Koel *Eudynamys scolopacea***	M	C
Great Horned Owl *Bubo bubo*	G	C
Shorteared Owl *Asio flammeus*	G	?
Spotted Owlet *Athene brama*	M	C
India Scops Owl *Otus bakkamoena***	F	C
Eurasian Nightjar *Caprimulgus europaeus*	M	C
House Swift *Apus affinis*	M	C
Little Green Bee-eater *Merops orientalis*	D	C
Bluecheeked Bee-eater *Merops persicus*	D	C
European Roller *Coracias garrulus!*	D/G	C
Indian Roller *Coracias benghalensis*	*M*	C
Whitebreasted Kingfisher *Halcyon smyrnensis**	W	C
Blackcapped Kingfisher *Halcyon pileata*	W	C
Common Kingfisher *Alcedo atthis**	W	C
Pied Kingfisher *Ceryle rudis*	W	C
Eurasian Hoopoe *Upupa epops*	G	C
Eurasian Wryneck *Jynx torquilla*	F	C
Yellowcrowned Woodpecker *Dendrocopus mahrattensis*	F	C
Blackrumped Flameback *Dinpopium benghalense*	F	C
Indian Lark *Mirafra erythroptera*	G	C
Ashycrowned Sparrow Lark *Eremopterix grisea*	G	C
Blackcrowned Sparrow Lark *Eremopterix nigriceps*	D	C
Rufoustailed Lark *Ammomanes phoenicurus*	G	C
Greater Hoopoe Lark *Alaemon alaudipes*	D	V
Short-toed Lark *Calandrella brachydactyla*	G	C
Bimaculated Lark *Melanocorypha bimaculata*	G	C
Crested Lark *Galerida cristata*	G	C
Oriental Skylark *Alauda gulgula*	G	C
Plain Sand Martin *Riparia paludicola*	M	C

Appendix I. (*Continued*)

Name	Habitat†	Status‡
Swallow *Hirundo rustica*	M	C
Wiretailed Swallow *Hirundo smithii*	W	C
Indian Cliff Swallow *Hirundo fluvicola*	M	C
Common Wood Shrike *Tephrodornis pondicerianus*	F	C
Small Minivet *Pericrocotus cinnamomeus***	F	C
Whitebellied Minivet *Pericrocotus erythropygius*	F	V
White-eared Bulbul *Pycnonotus leucotis*	F	C
Redvented Bulbul *Pycnonotus cafer*	M	C
Black Drongo *Dicrurus macrocercus*	M	C
Rufous Tree Pie *Dendrocitta vagabunda*	F	C
House Crow *Corvus splendens*	M	C
Common Raven *Corvus corax*	D	C
Common Babbler *Turdoides caudatus*	D	C
Large Grey Babbler *Turdoides malcolmi*	M	C
Jungle Babbler *Turdoides striatus***	F	C
Striated Babbler *Turdoides earlei**	W	C
Bluethroat *Erithacus svecicus*	M	C
Rufoustailed Scrub Robin *Erythropygia galactotes!*	M	C
Black Redstart *Phoenicurus ochruros*	M	C
Magpie Robin *Copsychus saularis***	M	C
Indian Chat *Cercomela fusca*	M	C
Indian Robin *Saxicoloides fulicata***	M	C
Whitebrowed Bushchat *Saxicola macrorhyncha*	D	V
Common Stonechat *Saxicola torquata*	M	C
Pied Bushchat *Saxicola caprata*	M	C
Isabelline Wheatear *Oenanthe isabellina*	D	C
Desert Wheatear *Oenanthe deserti*	D	C
Variable Chat *Oenanthe picata*	D	C
Rufoustailed Wheatear *Oenanthe xanthoprymna*	D	V
Great Reed Warbler *Acrocephalus stentoreus**	W	C
Rufous-fronted Prinia *Prinia buchanani*	M	C
Graceful Prinia *Prinia gracilis*	M	C
Ashy Prinia *Prinia socialis***	M	C
Plain Prinia *Prinia subflava*	M	C
Orphean Warbler *Sylvia hortensis jerdoni*	M	C
Desert Lesser Whitethroat *Sylvia curruca minula*	D	C
Desert Warbler *Sylvia nana*	D	C
Zitting Cisticola *Cisticola juncidis*	G	C
Booted Warbler *Hippolais caligata*	M	C
Chiffchaff *Phylloscopus collybita tristis*	M	C
Common Tailor Bird *Ortthotomus sutorius*	M	C
Northern Shrike *Lanius excubitor*	M	C
Baybacked Shrike *Lanius vittatus*	M	C
Longtailed Shrike *Lanius schach*	M	C
Rufoustailed Shrike *Lanius collurio*	M	C
Whitebrowed Fantail *Rhipidura aureola***	F	C
Asian Paradise Flycatcher *Terpsiphone paradisi***	F	C
Tawny Pipit *Anthus campestris*	G	C
Longbilled Pipit *Anthus similis*	G	C
Yellow Wagtail *Motacilla flava*	W	C
Blackheaded Yellow Wagtail *Motacilla melanogrisea**	W	C
Yellowhooded Wagtail *Motacilla citreola*	W	C
Grey Wagtail *Motacilla cinerea**	W	C

Appendix I. (*Continued*)

Name	Habitat†	Status‡
White Wagtail *Motacilla alba**	W	C
Whitebrowed Wagtail *Motacilla maderaspatensis*	W	C
Brahminy Starling *Sturnus pagodarum*	M	C
Rosy Starling *Sturnus roseus*	F	C
Common Starling *Sturnus vulgaris*	F	C
Asian Pied Starling *Sturnus contra*	M	C
Bank Myna *Acridotheres ginginianus*	M	C
Common Myna *Acridotheres tristis*	M	C
Purple Sunbird *Nectarinia asiatica*	M	C
Whitethroated Munia *Lonchura malabarica*	M	C
Spotted Munia *Lonchura punctulata*	M	C
Green Munia *Amandava formosa*	F	C
House Sparrow *Passer domesticus*	M	C
Spanish Sparrow *Passer hispaniolensis*	G	C
Chestnutshouldered Petronia *Petronia xanthocollis*	M	C
Baya Weaver *Ploceus philippinus**	W	C
Streaked Weaver *Ploceus manyar*	W	C
Common Rosefinch *Carpodacus erythrinus*	M	C
Redheaded Bunting *Emberiza bruniceps*	D	C
Greynecked Bunting *Emberiza buchanani*	D	C
House Bunting *Emberiza striolata*	D	C

†W = wetland; F = forest or plantation; D = desert; M = miscellaneous habitat including crop fields, urban areas, scrub land, hedgerows, etc.; G = grassland.

‡E = endangered; V = vulnerable; NT = near-threatened; C = common.

! = Passage migrant.

* = Mainly seen near IGNP.

** = Seen in forest plantations beside IGNP.