# A STUDY ON THE ECOLOGY OF GRASSLANDS OF THE INDIAN PLAINS WITH SPECIAL REFERENCE TO THEIR ENDANGERED FAUNA

## THE DESERT NATIONAL PARK

Ravi Sankaran

Sponsored by
The Ministry of Environment, Govt. of India

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# THE THAR DESERT

The Thar or great Indian desert is the only hot desert in the Indian subcontinent. It covers an area of approximately 200,000 sq. km (Chouhan 1988), between 24°40'to 30°12' N and 69°31' to 76°0' E. It is bordered by the fertile Indus plains to the west, the Aravallis to the southeast, the Rann of Kutch to the south and the fertile Punjab plain to the north and north-east. Physiogeographically, the Thar desert is the eastern extension of the vast Saharo-Thar desert. This region is believed to have once been part of the Indian ocean as corroborated by the presence of marine fossils in many areas. The aridity is said to have been caused primarily by climatic oscillations after the last phase of glaciation during the pleistocene period (Bhandari 1990).

The arid and semi-arid areas associated with the Thar desert cover many districts of western Rajasthan. Only 4.47 % of the total area is true desert (or hyper arid zone) and occurs as a thin strip in western Jaisalmer district. Six districts, Jaisalmer, Barmer, Jodhpur, Nagaur, Bikaner, and Ganganagar fall fully or partly into an Arid Zone classification and cover nearly 65.52 % of the Indian desert. The semi-arid zone constitutes 31.22 %, and is confined to marginal desert areas that include, fully or partly, Churu, Jhunjhunu, Sikar, Pali and Jalore districts. The semi-arid . The southern part of Pali district is sub-humid; this climatic zone occurs only over 0.79 % of the Indian desert. (Source: Chouhan 1988).

The Thar is the most densely populated desert of the world. While most deserts of the world have a human population density of 3/sq. km, the Thar desert has 61/sq. km (Jain 1986). Western

Jaisalmer has the lowest human density (less than 10/sq. km; Chouhan 1988). As one moves east, northeast and south-east, population densities increase; at the foot of the Aravallis, in the eastern portion of the desert, population density ranges between 100-130/sq. km (Chouhan 1988). The overall human population growth rate in the Thar desert is 33.14%. In districts where improved irrigation has resulted in human immigration, growth rates are as high as 48.09% (e.g. Bikaner district). (Source: Chouhan 1988).

The primary source of livelihood is animal husbandry in the arid areas, while agriculture increasingly replaces it in semi-arid areas. The livestock population of the desert region has increased from 13.4 million in 1956 to 23.2 million in 1983, a rise of 73.38% in 27 years. This increase has been maximum in districts more dependent on animal husbandry, for example Bikaner (118.65%) and Jaisalmer (91.88%), while districts that are both densely populated and have greater agricultural bases the growth rate has been less (e.g. Jalore - 22.69%, Pali-18.63%). The livestock densities in the desert (1983) vary from 226/sq. km in Sikar district to 42/sq. km in Jaisalmer district. (Source: Chouhan 1988).

Biotic pressures have played a considerable role in the degradation and gradual desertification of the area. Nomadism, a near total dependence on animal husbandry and high population densities have resulted in extensive overgrazing. The supply of piped water to most villages prolongs the presence of livestock in the area, long after surface water has been exhausted. Thus, the increase in water availability seriously affects regeneration of vegetation and greatly threatens wildlife.

The arid grasslands of north-western India constitute one of the 5 major grassland types in India. The Thar desert in the extreme north-west, while not entirely grassland, is still largely a grassland habitat. The grass indicative of arid and semi arid areas of western India is Cenchrus biflorus and Cenchrus catharticus. Lasiurus hirustus (sindicus), a tussock forming perennial, that frequently forms stands over considerable areas and is typical of arid grasslands.

Only two notified wildlife preserves exist in the Thar desert. The 8 sq. km Talchapper wildlife sanctuary in Churu district created for the blackbuck, and the Desert National Park.

## THE DESERT NATIONAL PARK

For the long term health of the desert ecosystem, survival of representative flora and fauna, it is imperative that a cohesive and systematic effort is made. The Desert National Park (DNP) is a beginning in this direction.

The DNP (25° 47' to 26°46'N and 70°15' to 70°45'E), covers an area of 3162 sq. km in Jaisalmer and Barmer districts of north-western Rajasthan. While the creation of enclosures began in 1981, the area was demarcated and notified only in 1984. The Desert National Park is in reality still a Wildlife Sanctuary, as the legal preconditions for it to become a National Park have yet to be fulfilled. Primarily this means the shifting of 37 villages presently within the DNP to beyond its boundaries. The process of converting revenue land into forest land has once again been revived, the area now earmarked for such a transfer is approximately 325 sq. km and will result in the relocation of only 9 villages. This will form the core area of the Park. Currently the

DNP has 26 enclosures (5 enclosures are outside the Park in areas rich in wildlife) covering an area of 9882 hectares (Table 10). The primary conservation aim of this project in the Thar desert is to try and increase both the numbers and area of enclosures free of biotic pressures. This can be achieved by a scientific documentation of the value of such protected enclosures in the conservation of wildlife and the identification of areas where wildlife populations exist in relatively higher densities. Further studies can also establish management parameters for the key wildlife fauna of the Thar desert.

## A STUDY ON THE DESERT NATIONAL PARK

### Academic Objectives

1) To compare the vegetation and animal density and diversity between select protected enclosures and unprotected areas.
2) To survey all enclosures of the DNP.
3) To locate areas of animal abundance with the potential for creating more enclosures.

### Logistics Objectives

During the Endangered Species Project, field stations were established at most grassland types earmarked for intensive study in the Grassland Project (Great Indian Bustard - Nanaj, Rollapadu; Bengal Florican - Dudwa, Manas; Lesser Florican - Sailana & Dohad). However, the DNP was visited only briefly. Thus one of the primary needs of the Grassland Project was to establish a field station at the DNP, identify locations for intensive long-term study, understand broadly the Desert ecosystem and identify the various limitations in studying arid grasslands.

## Research Activity

The duration of the current study at the DNP was brief (July 15 - December 15 1991) and can therefore be considered as a preliminary study. The study can be divided into site specific studies and surveys.

The study was designed to answer quantitatively a specific question within a limited time frame: 'What role has the DNP closures played in the wildlife conservation of the Thar desert?'

An attempt has been made to answer this question by measuring the densities and abundance of birds and mammals within and outside enclosures. The vegetation inside and outside closures was compared. In addition, all closures of the DNP were surveyed and their status ascertained.

## Main Study Area

A base camp was set up at Sam, Jaisalmer district, and another transient camp at Sudasari, 15 km from Sam.

## Methods

One transect was laid inside the protected enclosure at Sam and one outside it. Two transects were laid inside two different protected enclosures at Sudasari and one transect outside protected enclosures.

| | |
|---|---|
| Sam A closure (Protected) | Length of Transect 1.4 km |
| Outside Sam closure (Unprotected) | Length of Transect 1.4 km |
| Sudasari A closure (Protected). | Length of Transect 2.0 km |

Sudasari B closure (Protected). Length of Transect 1.5 km
Outside Sudasari closure (Unprotected) Length of Transect 1.4 km

1) Both Avian density and diversity and Mammal density were measured using the open width line transect method. The start time for each run of a transect was within 10 minutes of sunrise.

2) An attempt was made to count Reptiles during the transect counts and in the afternoon. This was unfruitful as reptiles were only occasionally seen, and these counts were abandoned.

3) Insect abundance was measured by the sweep net method. However, this was also unfruitful, both because of very low insect densities, (especially Sam) and the daily occurrence of high velocity winds that made wielding the net difficult. Alternate method for estimating insect abundance needs to be formulated for the desert.

4) Vegetation studies were done using the Line Intercept method. Perpendicular to either side of each 100 m point of the line transect, 30 m tape was laid, and the plant intercepting each 1 m mark was identified and measured. Thus, 60 data points were collected at 14 locations at 100 m intervals totaling 840 data points for each transect laid. Local assistance was used for plant identification; local names are available for most species seen. A herbarium was also prepared.

5) Bird, mammal and reptile lists were prepared.

6) Chinkara, fox and great Indian bustard counts were also done by road counts. Perpendicular distances were noted for each sighting for assessing densities.

## RESULTS AND DISCUSSIONS

### BIRD STUDY

The detailed analysis of the line transect studies on avifauna are given in Tables 1 to 4.

One of the primary questions addressed in this study was whether species composition varied between protected and unprotected areas. Due to the short duration of this study, a clear picture does not emerge from the data collected. Moreover, the study was done only during the monsoon, and information needs to be collected during other seasons as well before a comprehensive picture emerges. The salient findings of this study are reported and discussed below.

For the analysis of density from transect counts, a minimum of 20 (40) sightings of each species is required. Due to a natural sparseness of individuals, and the short duration of this study, this criterion could not be fulfilled. Only one exclusively desert species, the blackcrowned finch-lark, was sighted often enough for density calculations. Other species that were commonly sighted were rosy pastor, ring dove and common babbler. However, for the purpose of this study, I have calculated density for all species that were sighted a minimum of four times, this value being selected arbitrarily (Tables 1.1 to 1.5). Qualitatively speaking, barring one or two cases, the densities thus arrived at do not seem to be unrealistic.

The most frequently sighted species was the blackcrowned finch-lark, whose densities varied between study plots, from 51.8 to 187.8 per sq. km. Other common species, whose densities were

high were the Indian ring dove, rosy pastor, common babbler, rufous chat, Indian sandgrouse, bluecheeked bee-eater, plain wren-warbler, whitethroated munia, blackheaded bunting and lesser short-toed lark (Tables 1.1 to 1.5). Differences in species composition and abundance existed between study plots. For example, the whitethroated munia which was common in Sudasari 'A' was rare in the other protected enclosures and absent in unprotected ones (Tables 1.1. to 1.5).

Though Sudasari 'A' enclosure had the highest density of birds (Table 2), it varied significantly only from Sudasari 'B' and the unprotected study plots (Table 3). Both Sam 'A' and Sudasari 'A' enclosures did not vary significantly in bird density, this because of a high density of birds on one transect count in Sam 'A' (Table 2). As large flocks of rosy pastors wandered through the study area, and barring Sudasari 'A' were erratically seen elsewhere, such large variations in total avian densities are to be expected.

Species richness showed variations, Sudasari 'A' having the highest number of species seen, followed by Sam 'A' and Sudasari 'B', Sam 'UP' and Sudasari 'UP' (Table 4). The diversity indices are higher for the unprotected study sites than for protected enclosures (Table 4). This is because, the higher abundance of birds in the protected enclosures is not associated with a proportionate increase of species numbers.

If only those species seen during transect studies are considered, more species were unique to the Sudasari 'A' and Sam 'A' enclosures than the others (Table 5). However, if all field visits are considered (including other than transect studies), a different picture emerges. Almost all species were seen at all

study sites, with only two resident species (grey partridge and plain wren-warbler) unique to Sudasari 'A' enclosure. The white-throated munia was the only species that occurred (during transect counts) in protected enclosures only (Table 5). Thus, barring this one species, which is a common resident species in less arid parts of India, no other species of birds were unique to protected enclosures only. Those that appeared to be so, e.g. plain wrenwarbler, occurred only in Sudasari 'A' enclosure and not in the other protected study sites. Some migrants were seen only in Sudasari 'A' enclosure, for e.g. the bluethroat, but as this study was culminated at the early part of the migratory season no inferences can be drawn from this.

In conclusion, the avian studies reveal higher value indices for protected enclosures vis a vis species richness and significantly higher avian densities. However species diversity was significantly higher in unprotected areas. The exception to higher species density was the Sudasari 'B' enclosure, which had similar densities to unprotected areas. While Sam 'A' and Sudasari 'A' have been protected since 1982, Sudasari 'B' has been protected only since 1989. This indicates that a certain duration of time is required before protection changes avian densities significantly.

This study has revealed one major fact. The use of birds as indicators of protected areas in the desert, particularly of small areas (as is the case with the DNP) may not be useful. For example, Sudasari 'A' enclosure had the best vegetation profile of all enclosures in the DNP. Yet this was reflected only in avian population density and not in species diversity (see also Fig. 1). The increase in densities was mainly from larger populations of common species (e.g. blackcrowned finchlark and the

rosy pastor). Furthermore, only two species, the grey partridge and the plain wren-warbler were unique to this study site. Both species are common over much of India and have only limited conservation value.

## TABLE 1
## AVIAN DENSITY IN FIVE TRANSECTS IN THE DESERT NATIONAL PARK

Table 1.1

PROTECTED ENCLOSURE 1
SAM A

| COMMON NAME | SCIENTIFIC NAME | TOTAL SIGHTINGS | PDIS (m) | AVERAGE NUMBERS | DENSITY ($km^2$) |
|---|---|---|---|---|---|
| Indian white-backed vulture | Gyps bengalensis | 1 | 200.0 | 0.6 | |
| Great Indian bustard | Ardeotis nigriceps | 1 | 5.0 | 0.2 | |
| Indian sandgrouse | Pterocles exustus | 10 | 61.7 | 3 | 18.7 |
| Blue rock pigeon | Columba livia | 1 | 10.0 | 0.2 | |
| Indian ring dove | Streptopelia decaocto | 7 | 33.9 | 0.6 | 6.8 |
| Bluecheeked bee-eater | Merops superciliosus | 2 | 137.5 | 0.2 | |
| Bluecheeked bee-eater | Merops superciliosus | 1 | 150 | 0.2 | |
| Black crowned finch-lark | Eremopterix nigriceps | 73 | 24.9 | 9.8 | 151.1 |
| Lesser short-toed lark | Calandrella rufescens | 1 | 1.0 | 2.4 | |
| Grey shrike | Lanius excubitor | 4 | 77.5 | 0.6 | 3.0 |
| Rosy pastor | Sturnus roseus | 6 | 70.3 | 19.2 | 105.0 |
| Common wood shrike | Tephrodornis pondicerianus | 1 | 5.0 | 0.2 | |
| Whitecheeked bulbul | Pycnonotus leucogenys | 4 | 93.8 | 0.8 | 3.3 |
| Redvented bulbul | Pycnonotus cafer | 3 | 96.7 | 0.8 | |
| Common babbler | Turdoides caudatus | 14 | 38.3 | 3.8 | 38.2 |
| Lesser whitethroat | Sylvia curruca | 1 | 5.0 | 0.4 | |
| Rufous chat | Erythropygia galactotes | 5 | 14.0 | 0.6 | 16.5 |
| Isabelline chat | Oenanthe isabellina | 1 | 15.0 | 0.2 | |
| Pied chat | Oenanthe picata | 1 | 25.0 | 0.2 | |
| Purple sunbird | Nectarinia asiatica | 1 | 15.0 | 0.2 | |
| House sparrow | Passer domesticus | 1 | 5.0 | 0.2 | |
| Yellowthroated sparrow | Petronia xanthocollis | 1 | 1.0 | 0.2 | |
| Whitethroated munia | Lonchura malabarica | 2 | 3.0 | 0.6 | |
| Unidentified birds | | 4 | 30.5 | 0.6 | 7.6 |

Table 1.2

UNPROTECTED LOCATION 1
OUTSIDE SAM ENCLOSURES

| COMMON NAME | SCIENTIFIC NAME | TOTAL SIGHTINGS | PDIS (m) | AVERAGE NUMBERS | DENSITY ($km^2$) |
|---|---|---|---|---|---|
| Montagu's harrier | Circus pygarus | 4 | 56.5 | 0.6 | 4.1 |
| Grey quail | Coturnix coturnix | 1 | 15.0 | 0.2 | |
| Great Indian bustard | Ardeotis nigriceps | 1 | 75.0 | 0.4 | |
| Indian sandgrouse | Pterocles exustus | 6 | 26.3 | 4.6 | 67.2 |
| Blue rock pigeon | Columba livia | 1 | 1 | 0.2 | |
| Indian ring dove | Streptopelia decaocto | 13 | 53.4 | 2.4 | 17.3 |
| Bluecheeked bee-eater | Merops superciliosus | 12 | 31.8 | 2.8 | 33.8 |
| European roller | Coracias garrulus | 1 | 50.0 | 0.2 | |
| Black crowned finch-lark | Eremopterix nigriceps | 34 | 23.1 | 4.6 | 76.4 |
| Lesser short-toed lark | Calandrella rufescens | 1 | 25.0 | 3.2 | |
| Grey shrike | Lanius excubitor | 4 | 46.8 | 0.4 | 3.3 |
| Brown shrike | Lanius cristatus | 2 | 10.0 | 0.2 | |
| Rosy pastor | Sturnus roseus | 5 | 22.6 | 8.8 | 149.8 |
| House crow | Corvus splendens | 3 | 24.0 | 0.4 | |
| Whitecheeked bulbul | Pycnonotus leucogenys | 1 | 60 | 0.8 | |
| Common babbler | Turdoides caudatus | 13 | 29.2 | 2.4 | 31.6 |
| Lesser whitethroat | Sylvia curruca | 1 | 1.0 | 0.2 | |
| Rufous chat | Erythropygia galactotes | 2 | 32.5 | 0.2 | |
| Isabelline chat | Oenanthe isabellina | 1 | 40.0 | 0.2 | |
| Desert wheatear | Oenanthe deserti | 4 | 20.0 | 0.4 | 7.7 |
| Blackheaded bunting | Emberiza leucocephalos | 1 | 55.0 | 2.4 | |
| Unidentified birds | | 4 | 27.5 | 0.6 | 8.4 |

Table 1.3

PROTECTED ENCLOSURE 2
SUDASARI A

| COMMON NAME | SCIENTIFIC NAME | TOTAL SIGHTINGS | PDIS (m) | AVERAGE NUMBERS | DENSITY ($km^2$) |
|---|---|---|---|---|---|
| Tawny eagle | Aquila rapax | 1 | 250.0 | 0.3 | |
| Montagu's harrier | Circus pygarus | 1 | 75.0 | 0.3 | |
| Grey partridge | Francolinus pondicerianus | 1 | 150.0 | 0.5 | |
| Great Indian bustard | Ardeotis nigriceps | 2 | 250.0 | 0.3 | |
| Indian sandgrouse | Pterocles exustus | 3 | 116.7 | 13.8 | |
| Indian ring-dove | Streptopelia decaocto | 30 | 12.1 | 6 | 123.6 |
| Green bee-eater | Merops orientalis | 1 | 15.0 | 0.3 | |
| European roller | Coracias garrulus | 5 | 28.0 | 1 | 8.9 |
| Hoopoe | Upupa epops | 1 | 10.0 | 0.3 | |
| Black crowned finch-lark | Eremopterix nigriceps | 74 | 22.3 | 16.8 | 187.8 |
| Lesser short-toed lark | Calandrella rufescens | 3 | 4.0 | 2.0 | |
| Grey shrike | Lanius excubitor | 4 | 33.8 | 0.5 | 3.7 |
| Baybacked shrike | Lanius vittatus | 2 | 32.5 | 0.3 | |
| Redbacked shrike | Lanius collurio | 4 | 25.0 | 0.8 | 7.5 |
| Brown shrike | Lanius cristatus | 1 | 30.0 | 0.3 | |
| Black drongo | Dicrurus adsimilis | 1 | 10.0 | 0.3 | |
| Rosy pastor | Sturnus roseus | 44 | 17.4 | 104.0 | 496.4 |
| House crow | Corvus splendens | 1 | 80.0 | 0.25 | |
| Whitecheeked bulbul | Pycnonotus leucogenys | 3 | 13.3 | 0.5 | |
| Common babbler | Turdoides caudatus | 20 | 23.5 | 6.5 | 69.2 |
| Plain wren-warbler | Prinia subflava | 9 | 22.4 | 1.5 | 16.7 |
| Lesser whitethroat | Sylvia curruca | 1 | 25.0 | 0.3 | |
| Rufous chat | Erythropygia galactotes | 19 | 11.7 | 3.5 | 74.6 |
| Bluethroat | Erithacus svecicus | 1 | 25.0 | 0.3 | |
| Pied bush chat | Saxicola caprata | 2 | 7.5 | 0.3 | |
| Pied chat | Oenanthe picata | 1 | 40.0 | 0.3 | |
| Yellowthroated sparrow | Petronia xanthocollis | 4 | 26.3 | 1.3 | 11.9 |
| Whitethroated munia | Lonchura malabarica | 14 | 9 | 14.3 | 35.8 |
| Blackheaded bunting | Emberiza leucocephalos | 7 | 21.4 | 3.3 | 37.9 |
| Unidentified birds | | 12 | 16.1 | 3.0 | 46.4 |

Table 1.4

PROTECTED ENCLOSURE 3
SUDASARI B

| COMMON NAME | SCIENTIFIC NAME | TOTAL SIGHTINGS | PDIS (m) | AVERAGE NUMBERS | DENSITY ($km^2$) |
|---|---|---|---|---|---|
| Tawny eagle | Aquila rapax | 4 | 143.8 | 0.3 | 0.6 |
| Montagu's harrier | Circus pygarus | 1 | 50.0 | 0.3 | |
| Grey quail | Coturnix coturnix | 1 | 1.0 | 0.3 | |
| Great Indian bustard | Ardeotis nigriceps | 3 | 50.7 | 1.0 | |
| Creamcoloured courser | Cursorius cursor | 2 | 25.0 | 1.3 | |
| Indian sandgrouse | Pterocles exustus | 1 | 1.0 | 0.5 | |
| Indian ring dove | Streptopelia decaocto | 19 | 54.5 | 5.3 | 32.1 |
| Bluecheeked bee-eater | Merops superciliosus | 1 | 75.0 | 0.3 | |
| Green bee-eater | Merops orientalis | 1 | 75.0 | 0.3 | |
| Black crowned finch-lark | Eremopterix nigriceps | 27 | 33.8 | 5.4 | 51.8 |
| Lesser short-toed lark | Calandrella rufescens | 5 | 21.4 | 14.0 | 218.1 |
| Grey shrike | Lanius excubitor | 9 | 56.7 | 1.3 | 7.4 |
| Rosy pastor | Sturnus roseus | 20 | 39.4 | 31.5 | 266.5 |
| House crow | Corvus splendens | 2 | 62.5 | 0.5 | |
| Whitecheeked bulbul | Pycnonotus leucogenys | 2 | 45.0 | 0.5 | |
| Redvented bulbul | Pycnonotus cafer | 1 | 75.0 | 0.3 | |
| Common babbler | Turdoides caudatus | 13 | 51.2 | 4.5 | 29.3 |
| Rufous chat | Erythropygia galactotes | 3 | 31.7 | 0.3 | |
| Isabelline chat | Oenanthe isabellina | 2 | 20.0 | 0.5 | |
| Pied chat | Oenanthe picata | 6 | 33.3 | 0.8 | 7.5 |
| Yellowthroated sparrow | Petronia xanthocollis | 5 | 36.0 | 0.8 | 6.9 |
| Whitethroated munia | Lonchura malabarica | 2 | 10.0 | 0.8 | |
| Blackheaded bunting | Emberiza leucocephalos | 1 | 1.0 | 2.8 | |
| Unidentified birds | | 4 | 9.3 | 2.8 | 99.1 |

Table 1.5

UNPROTECTED LOCATION 2
OUTSIDE SUDASARI ENCLOSURES

| COMMON NAME | SCIENTIFIC NAME | TOTAL SIGHTINGS | PDIS (m) | AVERAGE NUMBERS | DENSITY ($km^2$) |
|---|---|---|---|---|---|
| White-eyed buzzard-eagle | Butastur teesa | 1 | 25.0 | 0.3 | |
| Montagu's harrier | Circus pygarus | 1 | 150.0 | 0.3 | |
| Indian sandgrouse | Pterocles exustus | 2 | 75.5 | 1.5 | |
| Indian ring dove | Streptopelia decaocto | 9 | 22.9 | 2.5 | 39.0 |
| European roller | Coracias garrulus | 1 | 5.0 | 0.3 | |
| Black crowned finch-lark | Eremopterix nigriceps | 22 | 30.7 | 6.8 | 78.5 |
| Lesser short-toed lark | Calandrella rufescens | 4 | 9.3 | 2.3 | 86.9 |
| Crested lark | Galerida cristata | 1 | 5.0 | 0.3 | |
| Grey shrike | Lanius excubitor | 6 | 49.2 | 0.8 | 5.4 |
| Rosy pastor | Sturnus roseus | 7 | 67.1 | 6.8 | 35.9 |
| Common babbler | Turdoides caudatus | 5 | 37.2 | 1.0 | 9.6 |
| Lesser whitethroat | Sylvia curruca | 2 | 15.0 | 0.3 | |
| Rufous chat | Erythropygia galactotes | 8 | 22.8 | 0.8 | 11.8 |
| Isabelline chat | Oenanthe isabellina | 7 | 7.4 | 2.3 | 108.2 |
| Desert wheatear | Oenanthe deserti | 2 | 25.0 | 0.5 | |
| Pied chat | Oenanthe picata | 4 | 23.8 | 0.3 | 3.8 |
| Yellowthroated sparrow | Petronia xanthocollis | 2 | 35.0 | 0.3 | |
| Blackheaded bunting | Emberiza leucocephalos | 1 | 75.0 | 1.5 | |
| Unidentified birds | | 6 | 10.2 | 1.8 | 61.5 |

Note before

1) TOTAL SIGHTINGS : These are the sums of the number of times a species was seen on each transect count, a flock being considered one sighting.
2) PDIS (m) : The average of the perpendicular distances from the transect line that each species was seen.

3) AVERAGE NUMBERS : The total number of individuals of a species seen divided by the number of times that particular transect was traversed.
4) DENSITY : From the formula D = n/(2lw), where n is the average number seen, l is the length and w the width of the transect. Values are given only for those species that were sighted a minimum of 4 times during the study.

Method of calculating density :

1) The field data was collected using the open width line transect method.
2) The density of each species was estimated by calculating the optimal width at which they were sighted. This was done by averaging the perpendiclar distances and then discarding records beyond the average distance. The density was then arrived at from the total number of individuals within the average sighting distance, the length of the transect and the width which was the average sighting distance for each species.

TABLE 2

TOTAL AVIAN DENSITIES ON 5 TRANSECTS AT THE DESERT NATIONAL PARK

| S.NO | TRANSECT | NOS | ST.TERM | DENSITY | SE D | AVG. NOS | DENSITY |
|---|---|---|---|---|---|---|---|
| 1 | saa1 | 42 | 8 | 0.0003640 | 0.000083 | 1.5 | 546.00 |
| 2 | saa2 | 33 | 19 | 0.0005857 | 0.001097 | 1.18 | 692.19 |
| 3 | saa3 | 34 | 10 | 0.0003457 | 0.000091 | 7.67 | 2653.76 |
| 4 | saa4 | 21 | 6 | 0.0001749 | 0.000048 | 1.80 | 316.49 |
| 5 | saa5 | 16 | 9 | 0.0001856 | 0.000066 | 2 | 371.20 |
| 6 | sao1 | 20 | 5 | 0.0001949 | 0.000059 | 2.2 | 428.78 |
| 7 | sao2 | 22 | 14 | 0.0004486 | 0.001612 | 2.09 | 937.98 |
| 8 | sao3 | 30 | 8 | 0.0004448 | 0.000111 | 2.73 | 1215.79 |
| 9 | sao4 | 30 | 3 | 0.0001497 | 0.000043 | 1.33 | 199.60 |
| 10 | sao5 | 13 | 6 | 0.0001752 | 0.000059 | 5.15 | 902.95 |
| 11 | sua1 | 84 | 9 | 0.0004576 | 0.000080 | 5.52 | 2527.69 |
| 12 | sua2 | 80 | 8 | 0.0005120 | 0.000075 | 5.95 | 3046.40 |
| 13 | sua3 | 65 | 17 | 0.0008329 | 0.000919 | 2.52 | 2101.47 |
| 14 | sua4 | 43 | 16 | 0.0004105 | 0.000968 | 2.41 | 992.84 |
| 15 | sub1 | 32 | 3 | 0.0001578 | 0.000038 | 2.43 | 384.64 |
| 16 | sub2 | 44 | 3 | 0.0001952 | 0.000042 | 5.02 | 980.44 |
| 17 | sub3 | 29 | 3 | 0.0001473 | 0.000036 | 2.03 | 299.68 |
| 18 | sub4 | 30 | 3 | 0.0001668 | 0.000039 | 4.86 | 807.87 |
| 19 | suo1 | 19 | 8 | 0.0002342 | 0.000075 | 1.94 | 456.07 |
| 20 | suo2 | 26 | 7 | 0.0002140 | 0.000065 | 4.19 | 897.15 |
| 21 | suo3 | 23 | 4 | 0.0001520 | 0.000043 | 1.30 | 198.26 |
| 22 | suo4 | 23 | 7 | 0.0003187 | 0.000084 | 2.43 | 204.52 |

saa=Sam A, sao=Sam Up, sua=Sudasari A, sub=Sudasari B, suo=Sudasari UP (UP=unprotected); saa1, saa2 etc. = different transect counts.

TABLE 3

Paired T-test for differences between avian densities on 5 transects in the DNP

| | SUDASARI A | | SUDASARI B | | SAM A | | SAM UP | |
|---|---|---|---|---|---|---|---|---|
| | t | P | t | P | t | P | t | P |
| SUD UP | 5.444 | 0.012 | 1.222 | 0.309 | 0.992 | 0.395 | 1.010 | 0.387 |
| SAM UP | -4.027 | 0.028 | 0.246 | 0.822 | 0.530 | 0.624 | | |
| SAM A | -1.684 | 0.191 | 0.663 | 0.555 | | | | |
| SUD B | 3.364 | 0.044 | | | | | | |

TABLE 4

AVIAN RICHNESS, DIVERSITY AND EQUITABILITY INDICES COMPUTED USING DIFFERENT FORMULAS FROM 5 LOCATIONS IN THE DESERT NATIONAL PARK

| LOCATION | N0 | R1 | R2 | LAMBDA | H' | N1 | N2 | E1 | E2 | E3 | E4 | E5 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SUDASARI UP | 19 | 4.450 | 2.514 | 0.154 | 2.229 | 9.292 | 6.492 | 0.757 | 0.489 | 0.461 | 0.699 | 0.662 |
| SUDASARI B | 24 | 4.770 | 2.154 | 0.248 | 1.927 | 6.867 | 4.034 | 0.606 | 0.286 | 0.255 | 0.587 | 0.517 |
| SUDASARI A | 28 | 4.897 | 1.778 | 0.474 | 1.388 | 4.009 | 2.110 | 0.417 | 0.143 | 0.111 | 0.526 | 0.369 |
| SAM A | 23 | 4.939 | 2.480 | 0.301 | 1.721 | 5.593 | 3.324 | 0.549 | 0.243 | 0.209 | 0.594 | 0.506 |
| SAM UP | 22 | 5.250 | 2.977 | 0.108 | 2.383 | 10.837 | 9.294 | 0.771 | 0.493 | 0.468 | 0.858 | 0.843 |

R1 = Margalef index (1958). R1 = S-1/LN(n)
R2 = Menhinick index (1964). R2 = $S/\sqrt{n}$
(where S = total no. of species, n = total nos. of individuals.
H' = Shanon Weiner's diversity index (1949). $H' = \Sigma(PiLNPi)$, i = 1 to s.
(where Pi = Proportion of $i^{th}$ species
LAMBDA = $\Sigma\ ni(ni-1)/n(n-1)$
(where n = total number of individuals in the sample)
N0, N1, N2 = Hill's diversity indices. (Hill 1973).
N0 = Total number of species
N1 = e^H'
(where H' is the Shannon Weiner's diversity index, e = exponential).
N2 = 1/Lambda
E1, E2, E3, E4 = Equitability (Evenness) indices
E1 (or J') = Pielou's index (1975, 1977). H'/LN(S)
E2 = Sheldon's index. (Sheldon 1969). e^H'/S
E3 = Heip's index. (Hiep 1974). (e^H'-1)/(S-1)
E4 = Hill's evenness index. (Hill 1973). (1/lambda)/(e^H')
E5 = Modified Hill's ratio. (Alatalo 1981). (1/lamda)-1/(e^H'-1).

TABLE 5
OCCURRENCE OF BIRDS IN DIFFERENT CLOSURES

| COMMON NAME | SCIENTIFIC NAME | LOCATION | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| White-eyed buzzard-eagle | Butastur teesa | - | - | - | - | + |
| Tawny eagle | Aquila rapax | - | - | + | + | - |
| Indian white-backed vulture | Gyps bengalensis | + | - | - | - | - |
| Montagu's harrier | Circus pygarus | - | + | + | + | + |
| Grey partridge | Francolinus pondicerianus | - | - | + | - | - |
| Grey quail | Coturnix coturnix | - | + | - | - | - |
| Great Indian bustard | Ardeotis nigriceps | + | + | - | - | - |
| Creamcoloured courser | Cursorius cursor | - | - | - | + | - |
| Indian sandgrouse | Pterocles exustus | + | + | + | + | + |
| Blue rock pigeon | Columba livia | + | + | - | - | - |
| Indian ring dove | Streptopelia decaocto | + | + | + | + | + |
| Bluecheeked bee-eater | Merops superciliosus | + | + | - | + | - |
| Green bee-eater | Merops orientalis | - | - | + | + | - |
| European roller | Coracias garrulus | - | + | + | - | + |
| Hoopoe | Upupa epops | - | - | + | - | - |
| black crowned finch-lark | Eremopterix nigriceps | + | + | + | + | + |
| Lesser short-toed lark | Calandrella rufescens | + | + | + | + | + |
| Crested lark | Galerida cristata | - | - | - | - | + |
| Grey shrike | Lanius excubitor | + | + | + | + | + |
| Baybacked shrike | Lanius vittatus | - | - | + | - | - |
| Redbacked shrike | Lanius | - | - | + | - | - |
| Brown shrike | Lanius cristatus | - | + | + | - | - |
| Black drongo | Dicrurus adsimilis | - | - | + | - | - |
| Rosy pastor | Sturnus roseus | + | + | + | + | + |
| House crow | Corvus splendens | - | + | + | + | - |
| Common wood shrike | Tephrodornis pondicerianus | + | - | - | - | - |
| Whitecheeked bulbul | Pycnonotus leucogenys | + | + | + | + | - |
| Redvented bulbul | Pycnonotus cafer | + | - | - | + | - |
| Common babbler | Turdoides caudatus | + | + | + | + | + |
| Plain wren-warbler | Prinia subflava | - | - | + | - | - |
| Lesser whitethroat | Sylvia curruca | + | + | + | - | + |
| Rufous chat | Erythropygia galactotes | + | + | + | + | + |
| Bluethroat | Erithacus svecicus | - | - | + | - | - |
| Pied bush chat | Saxicola caprata | - | - | + | - | - |
| Isabelline chat | Oenanthe isabellina | + | + | - | + | + |
| Desert wheatear | Oenanthe deserti | - | + | - | - | + |
| Pied chat | Oenanthe picata | + | - | + | + | + |
| Purple sunbird | Nectarinia asiatica | + | - | - | - | - |
| House sparrow | Passer domesticus | + | - | - | - | - |
| Yellowthroated sparrow | Petronia xanthocollis | + | - | + | + | + |
| Whitethroated munia | Lonchura malabarica | + | - | + | + | - |
| Blackheaded bunting | Emberiza leucocephalos | - | + | + | + | + |

1 = Sam A; 2 = Sam Unprotected (UP); 3 = Sudasari A; 4 = Sudasari B; 5 = Sudasari UP; + = sighted during transect counts; - = Not sighted during transect counts.

## MAMMAL STUDIES

Within the principal study area, i.e. the DNP closures of Sam and Sudasari, and adjacent unprotected areas, the principal herbivorous species was the chinkara. The studies on mammals mainly focused on ascertaining densities of chinkara. The commonest predators, the desert and Indian fox, were sighted infrequently during transect studies and so accurate pictures of their densities do not emerge. Many of the remaining species of mammals e.g. longeared hedgehogs and gerbils are nocturnal and hence fell outside the scope of the study.

Though chinkara are seen throughout the study area, they are commonest in the enclosures at Sudasari (Table 6). Sudasari 'A' enclosure usually had the highest number of chinkara and several territories of males, marked by middens, were present. There was however considerable movement of these antelopes between closures and often Sudasari 'C' had higher densities than Sudasari 'A' (e.g. Table 11). I estimate that between 365 and 558 chinkara are present in the complex of three protected enclosures at Sudasari that total 1400 ha. At Sam, chinkara numbers are much lower, and perhaps only about 50-60 chinkara are present in the two closures at Sam that total 1100 ha.

Movement of chinkara was seen between closures and unprotected areas. However due to high levels of domestic livestock pressures on the unprotected areas and their continuous presence for the duration of this study, possibly the occurrence of chinkara outside protected areas was not as high as it could have been. Some crop raiding by chinkara was also evidenced, as several crop fields, primarily cluster beans and bajra, were present adjacent to the protected enclosure. The extent of crop raiding and the degree of damage to the crops could not be ascertained.

The Indian fox was never seen in Sam enclosures and also in immediately adjacent unprotected areas; only the desert fox was present at Sam. At Sudasari both species were present and appeared to be equally abundant. I do not have a plausible explanation for this as yet, particularly when viewed with the fact that both Sam and Sudasari are barely 15 km apart.

TABLE 6
TOTAL NUMBER OF CHINKARA SEEN IN DIFFERENT TRANSECTS

| | July | August | | | October |
|---|---|---|---|---|---|
| Weeks - | 1 | 1 | 2 | 3 | 1 |
| Sam A | 23 | 4 | 5 | 0 | 2 |
| | (39.4) | (6.4) | (7.8) | (0) | (28.6) |
| Sudasari A | - | 53 | 83 | 9 | 36 |
| | - | (88.0) | (123.1) | (39.4) | (42.3) |
| Sudasari B | - | 2 | 9 | 15 | 8 |
| | - | (3.8) | (21.5) | (50.0) | (34.78) |
| Sam Unprotected | 0 | 3 | 6 | 1 | 1 |
| | (0) | (5.7) | (34.0) | (7.1) | (4.8) |
| Sudasari Unprotected | - | 0 | 3 | 9 | 10 |
| | - | (0) | (14.3) | (85.7) | (46.7) |

(Values in parenthesis density per sq. km; however, the density values are not realistic as evidenced from visual estimates).

## VEGETATION STUDIES

The most significant result of protection in the DNP has been in the quality and quantity of vegetation. The vegetation of protected enclosures is of greater species diversity and richness and greater abundance than in unprotected enclosures (Table 7).

Protection of desert areas not only resulted in greater abundance and diversity, but also resulted in the quality of the vegetation cover being superior. Tussock forming perennials e.g. Lasiurus hirustus had significantly greater circumferences and heights than those in unprotected areas, which were usually grazed to the base of the stems. Prostrate species like Tribulus pentandrus or Dactyloctenium spp. were also significantly larger

than in unprotected plots.

Sudasari 'A' closure was the most densely vegetated (Tables 8 and 9). However, caution must be exercised while interpreting the data in Tables 8 and 9. The occurrence of vegetation largely depends on the topography and the composition of the soil. Areas that are sandy or dunal or rocky have lesser vegetation than other sites. Also, the occurrence of large areas of thalar, flat hard soil, which is usually bare, will also determine vegetation abundance. Lastly variations in rainfall patterns will also determine vegetation abundance.

All study sites varied in topography and soil characteristics. Sam was the most sandy and had dunal and rocky areas, Sudasari 'A' was flat, had tracts of thalar and rocky areas as well, Sudasari 'B' had a combination of most of the above characters. Furthermore while Sudasari 'A' had fairly good rains, Sam 'A' was in drought and Sudasari 'B' was inbetween. Thus until a more detailed vegetation profile is drawn caution must be used in drawing inferences from the data in Tables 8 and 9.

TABLE 7
VEGETATION DIVERSITY IN PROTECTED AND UNPROTECTED GRASSLANDS

Estimated by line intercept method; 60 readings at 1 m interval at 14 points at 100 m intervals along transect route.

PROTECTED GRASSLANDS

| | Sudasari A closure | Sudasari B closure | Sam A closure |
|---|---|---|---|
| Av. total no. | 246 | 90 | 40 |
| No. of species | 25 | 13 | 8 |
| Shannon Weiner Diversity index | 1.134 | 0.84 | 0.664 |

UNPROTECTED GRASSLANDS

| | Outside Sudasari closures | Outside Sam closures |
|---|---|---|
| Total no. | 192 | 100 |
| No. of species | 23 | 7 |
| Shannon Weiner Diversity index | 0.99 | 0.564 |

TABLE 8
PERCENTAGE OCCURRENCE OF VEGETATION AND BARE GROUND

| | SUD.A | SUD.B | SUD.UP | SAM A | SAM UP |
|---|---|---|---|---|---|
| VEGETATION | 58.57 | 21.43 | 45.95 | 33.33 | 24.39 |
| BARE/LITTER/ANIMAL DUNG | 41.43 | 78.57 | 54.29 | 66.67 | 76.59 |

TABLE 9
COMPARISON OF VEGETATION IN 5 LOCATIONS IN THE DNP

| | SUDASARI A | | | SUDASARI B | | | SUDASARI UNPROTECTED | | | SAM A | | | SAM UNPROTECTED | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SPECIES | A | B | C | A | B | C | A | B | C | A | B | C | A | B | C |
| Bare ground | 172 | 975.06 | 40.95 | 323 | 1831.07 | 76.90 | 218 | 1235.83 | 51.90 | 261 | 1479.59 | 62.14 | 250 | 1417.23 | 59.52 |
| Aristida funiculata | 44 | 249.43 | 10.48 | 1 | 5.67 | 0.24 | 25 | 141.72 | 5.95 | 1 | 5.67 | 0.24 | 1 | 5.67 | 0.24 |
| Blepharis sindica | 11 | 62.36 | 2.62 | 1 | 5.67 | 0.24 | | | | | | | | | |
| Boerhavia elegans | 2 | 11.34 | 0.48 | | | | | | | | | | | | |
| Boerhavia diffusa | 3 | 17.01 | 0.71 | 2 | 11.34 | 0.48 | 3 | 17.01 | 0.71 | 16 | 90.70 | 3.81 | | | |
| Capparis decidua | 1 | 5.67 | 0.24 | 3 | 17.01 | 0.71 | 3 | 17.01 | 0.71 | | | | | | |
| Cenchrus catharticus | 6 | 34.01 | 1.43 | | | | 2 | 11.34 | 0.48 | | | | | | |
| Cenchrus pennisetiformis | 1 | 5.67 | 0.24 | | | | 1 | 5.67 | 0.24 | | | | | | |
| Cleome gynandra | 6 | 34.01 | 1.43 | | | | 3 | 17.01 | 0.71 | | | | | | |
| Cymbopogon jwarancusa | 1 | 5.67 | 0.24 | | | | 1 | 5.67 | 0.24 | | | | | | |
| Dactyloctenium aegypticum | 4 | 22.68 | 0.95 | | | | | | | | | | | | |
| Dicoma tomentosa | 6 | 34.01 | 1.43 | | | | | | | | | | | | |
| Euphorbia granulata | 1 | 5.67 | 0.24 | | | | 1 | 5.67 | 0.24 | 1 | 5.67 | 0.24 | | | |
| Dactyloctenium sp. (?) | 21 | 119.05 | 5.00 | 29 | 164.40 | 6.90 | 12 | 68.03 | 2.86 | 13 | 73.70 | 3.10 | 52 | 294.78 | 12.68 |
| Heliotropium sp. | 1 | 5.67 | 0.24 | 2 | 11.34 | 0.48 | 1 | 5.67 | 0.24 | | | | | | |
| Lasiurus hirsutus | 29 | 164.40 | 6.90 | 12 | 68.03 | 2.86 | 3 | 17.01 | 0.71 | 71 | 402.49 | 16.90 | 20 | 113.38 | 4.88 |
| Mollugo cerviana | 1 | 5.67 | 0.24 | | | | 5 | 28.34 | 1.19 | | | | | | |
| Mollugo cerviana | 10 | 56.69 | 2.38 | | | | | | | | | | | | |
| Seetzenia lanata | 3 | 17.01 | 0.71 | 7 | 39.68 | 1.67 | 12 | 68.03 | 2.86 | | | | | | |
| Tephrosia strigosa | 30 | 170.07 | 7.14 | | | | | | | | | | | | |
| Tragus roxburghii | 9 | 51.02 | 2.14 | | | | 43 | 243.76 | 10.24 | | | | | | |
| Tribulus rajasthanensis | 29 | 164.40 | 6.90 | 2 | 11.34 | 0.48 | 2 | 11.34 | 0.48 | 9 | 51.02 | 2.14 | 2 | 11.34 | 0.49 |
| Urochloa panicoides | 1 | 5.67 | 0.24 | | | | | | | | | | | | |
| Haloxylon salicornicum | | | | 3 | 17.01 | 0.71 | 5 | 28.34 | 1.19 | 13 | 73.70 | 3.10 | 19 | 107.71 | 4.63 |
| Letipes senegalensis | | | | 2 | 11.34 | 0.48 | | | | | | | | | |
| Enneapogon schimperanus | | | | | | | 5 | 28.34 | 1.19 | | | | | | |
| Prosopis cineraria | | | | | | | 1 | 5.67 | 0.24 | | | | | | |
| Fagonia schweinfurthii | | | | | | | | | | | | | 1 | 5.67 | 0.24 |
| Indigofera cordifolia | 21 | 119.05 | 5.00 | 24 | 136.05 | 5.71 | 54 | 306.12 | 12.86 | 16 | 90.70 | 3.81 | 5 | 28.34 | 1.22 |
| Indigofera sp. | 4 | 22.68 | 0.95 | 2 | 11.34 | 0.48 | 7 | 39.68 | 1.67 | | | | | | |
| Amaranthus tricolor | | | | | | | 1 | 5.67 | 0.24 | | | | | | |
| Ziziphus nummularia | | | | | | | 1 | 5.67 | 0.24 | | | | | | |
| SOOIYA | | | | | | | 1 | 5.67 | 0.24 | | | | | | |
| BOLAPYAJ | | | | | | | 1 | 5.67 | 0.24 | | | | | | |
| SAAMBH GHAS | 1 | 5.67 | 0.24 | | | | | | | | | | | | |
| Sheep dung | | | | 1 | 5.67 | 0.24 | 3 | 17.01 | 0.71 | 1 | 5.67 | 0.24 | 45 | 255.10 | 10.98 |
| Cattle dung | | | | 1 | 5.67 | 0.24 | 1 | 5.67 | 0.24 | 5 | 28.34 | 1.19 | 2 | 11.34 | 0.49 |
| Chinkara droppings | | | | 1 | 5.67 | 0.24 | | | | | | | | | |
| Camel dung | 2 | 11.34 | 0.48 | 2 | 11.34 | 0.48 | 4 | 22.68 | 0.95 | 2 | 11.34 | 0.48 | 2 | 11.34 | 0.49 |
| Exposed roots/ Litter | | | | 2 | 11.34 | 0.48 | 1 | 11.34 | 0.48 | 11 | 62.36 | 2.62 | 21 | 119.05 | 5.12 |

A = Total count in 420 sampling points; B = Frequency occurence per. sq. km; C = % occurence

## SURVEY OF THE PROTECTED ENCLOSURES OF THE DESERT NATIONAL PARK

A detailed profile of the protected enclosures in the DNP is given in Table 10.

The DNP has been divided into three forest ranges, Jaisalmer, Miyajlar and Barmer. A few enclosures, that come within the jurisdiction of Jaisalmer range are outside the borders of the DNP, these being Rasla, Ramdevra and Ujala. The enclosures of Jaislamer range are dispersed, while most of the enclosures of Barmer range lie close to each other; Bandhda 'A' & 'B', Sundhra and Piparli are contiguous. In Miyajlar range the enclosures are dispersed.

The efficiency of protection, and the condition of the barbed wire fencing varied from range to range. In Jaisalmer range the condition of fencing and quality of protection has been good. Unfortunately this was not true for Barmer and Miyajlar ranges. One of the primary reasons for this was the lack of a DFO for the Park, In August 1991, a DFO was transferred to the DNP, and considerable progress was being made while this study was underway. The second problem faced b the DNP was the lack of adequate funds to sustain maintenance of the fencing etc., this also resulting in the general rundown condition of many of the protected enclosures.

The best protected range, Jaisalmer, also had the largest numbers of Chinkara, fox and great Indian bustards (Table 10). In the three enclosures at Sudasari chinkara densities varied between 19 and 75 per sq. km (Table 11). At Ramdevra, due to a very high population of spiny tailed lizards, Indian fox density was an incredibly high 22/sq. km, while the Tawny eagle were 25/sq.

km (Table 11). This unusually high density of apex avian and mammalian predators were not seen in any other enclosure in the DNP, for that matter not in any of the desert areas visited.

While there are other areas that have potential for protection, more detailed studies are required to confirm the suitability and feasibility of creating protected enclosures. However I believe that the existing protected enclosures need expanding. Thus the expanded protected enclosures will provide a nucleus for the expansion of wildlife populations. The following locations need focusing on; Sudasari, Sam, Rasla and Ramdevra these being areas where wildlife is abundant.

## TABLE 10

## A SURVEY OF THE PROTECTED CLOSURES OF THE DESERT NATIONAL PARK

| | Name of closure | Year of construction | Area in ha. | Number/Density Chinkara seen | Status of: Great Indian Bustard | Status of: Fox | Status of: Desert Cat | Vegetation: Woody sp. | Vegetation: Grasses, herbs & shrubs |
|---|---|---|---|---|---|---|---|---|---|
| **Jaisalmer Range** | | | | | | | | | |
| 1 | Sudasari 'A' | 1980-81 | 700 | 3.28/km | Resident; two traditional display sites | Indian more common than Desert | V. rarely seen | Caparis decidua<br>Prosopis cinererea<br>Zizyphus sp. | Lasiurus sindicus<br>Cymbopogon martini<br>Aristida spp.<br>Cenchrus biflorus<br>Dactyloctenium spp.<br>Indigofera sp.<br>Tribulus sp. |
| 2 | Sudasari 'B' | 1987-88 | 350 | 4.05/km | Resident; no display sites | Both species present | - | Caparis decidua<br>Haloxylon salicornicum<br>Prosopis cinererea<br>Zizyphus sp. | -do- |
| 3 | Sudasari 'C' | 1988-89 | 350 | 10.14/km | Resident; 7 displaying males seen once. | Desert more common than Indian | - | Caparis decidua<br>Prosopis cinererea | -do- |
| 4 | Sam 'A' | 1981-1982 | 800 | <40 animals | Transient; mainly after October | Desert fairly common Indian not seen | Not recorded | Haloxycon salicornicum<br>Caparis decidua<br>Calotropis procera<br>Zizyphus sp. | Lasiurus sindicus<br>Indigofera sp.<br>Tribulus sp.<br>Dactyloctenium sp. |
| 5 | Sam 'B' | 1981-82 | 300 | <20 animals | Infrequently seen; mainly after October | Desert present; Indian not seen | - | Caparis decidua<br>Calotropis decidua<br>Haloxylon salicornicum | -do- |
| 6 | Ramdevra 'A' | 1986-87 | 640 | 4.53/km | Few seen in summer | Indian very common 2.12/km | - | Salvadora persica<br>Zizyphus sp.<br>Caparis decidua<br>Prosopis cinererea<br>Calotropis procera<br>Prosopis juliflora (one plant) | Dactyloctenium sp.<br>Lasiurus sindicus (very few clumps) |
| 7 | Ramdevra 'B' | 1987-88 | | | | | | | |
| 8 | Rasla 'A' | 1988-89 | 500 | 7.22/km | Resident; Display sites present | Present | - | Caparis decidua<br>Zizyphus sp.<br>Acacia senegal<br>Salvadora persica<br>Calotropis procera<br>Caparis decidua<br>Prosopis juliflora | Lasiurus sindicus<br>Cenchrus biflorus<br>Cymbopogon martini<br>Scanty vegetation |
| 9 | Rasla 'B' | 1990-91 | 100 | | | | | | |
| 10 | Ujala | 1988 | 250 | 4 animals seen | Rarely seen | 1 Desert fox seen | - | | |

| Name of closure | Year of construction | Area in ha. | Number of Chinkara seen | Status of: Great Indian Bustard | Fox | Desert Cat | Vegetation: Woody sp. | Grasses, herbs & shrubs |
|---|---|---|---|---|---|---|---|---|
| **Barmer range** | | | | | | | | |
| 11 Banddha 'A' | 1981-82 | 235 | 8 seen | Rarely visit | Present | - | Salvadora persica<br>Caparis decidua<br>Calligonium polygonoides<br>Zizyphus sp.<br>Acacia senegal<br>Prosopis cinererea | Lasiurus sindicus<br>Aerva persica<br>(drought year) |
| 12 Banddha 'B' | 1981-82 | 422 | 1 seen | | | | | |
| 13 Piparli | 1983-84 | 260 | 10 seen | Rare | Present | - | Caparis decidua<br>Salvadora persica<br>Zizyphus sp.<br>Calotropis procera | -do- |
| 14 Sundra | 1981-82 | 700 | 7 seen | Winter visitor | Present | - | -do- | -do- |
| 15 Manihari 'A' | 1986-87 | 40 | 8 seen | Rare | Present | - | -do- | -do- |
| 16 Manihari 'B' | 1987-88 | 70 | | | | | | |
| 17 Kundal | 1983-84 | 250 | 9 seen | Winter visitor | Present | - | Caparis decidua<br>Calligonium polygonoides<br>Salvadora persica<br>Prosopis cinererea | -do- |
| 18 Khabdala 'A' | 1988-89 | 450 | 11 seen | - | 1 Desert seen | - | -do- | -do- |
| 19 Khabdala 'B' | 1989-90 | 300 | 3 seen | - | Present | - | -do- | -do- |
| 20 Dagari | 1986-87 | 400 | 6 seen | - | Present | - | Calligonium decidua<br>Salvadora persica<br>Prosopis cinererea<br>Caparis decidua | -do- |
| **Miyajlar Range** | | | | | | | | |
| 21 Miyajlar | 1980-81 | 530 | 40 seen | 1 male seen; a few seen frequently | 1 Desert seen | Rarely seen | Prosopis cinererea<br>Caparis decidua<br>Salvadora persica<br>Calligonium polygonoides<br>Tecomella undulata<br>Acacia senegal | Lasiurus sindicus<br>(other ephemereals) |
| 22 Phulia | 1981-82 | 400 | 18 seen | - | 1 Indian seen | - | Calligonium polygonoides<br>Caparis decidua<br>Prosopis cinererea<br>Salvadora persica | Lasiurus sindicus<br>(other ephemereals) |
| 23 Dav | 1988-89 | 500 | 2 seen | - | 2 Desert seen | 1 seen (?) | -do- | -do- |
| 24 Dabdi | 1989-90 | 450 | signs seen | - | Present | - | Haloxylon salicornium<br>Calotropis procera<br>Zizyphus sp. | Aerva persica<br>Brachiaira ramosa<br>(sparsely vegetetated |
| 25 Koriya | 1989-90 | 375 | 14 seen | Rarely seen | Present | - | Caparis decidua<br>Calotropis procera | Lasiurus sindicus<br>(other ephemereals) |
| 26 Berisiala | 1988-89 | 450 | signs seen | - | Present | - | -do- | -do- |

TABLE 11

DENSITIES OF SOME MAMMALS AND BIRDS
IN SOME IMPORTANT DNP CLOSURES

(Vehicle counts; density per. sq. km)

RAMDEVRA A & B (Length of transect 13.7 km)

| Indian fox | Chinkara | Tawny Eagle |
|---|---|---|
| 22.37 | 47.65 | 25.68 |

RASLA A & B (Length of transect for Rasla A 7.2 km; Rasla B total count in 100 ha. closure)

| Rasla A Chinkara | Rasla B Chinkara |
|---|---|
| 21.57 | 11 |

SUDASARI A, B & C (Length of transects: A = 9.1 km, B = 4.2 km & C = 7 km)

| Sudasari A Chinkara | Sudasari B Chinkara | Sudasari C Chinkara | Desert Fox |
|---|---|---|---|
| 24.28 | 19.61 | 75.76 | 4.57 |

## A LIST OF VEGETATION SEEN IN THE DESERT NATIONAL PARK

| FAMILY/species | MARWARI NAME |
|---|---|
| **Acanthaceae** | |
| 1) *Blepharis sindica* T. Anders | Bhangri/Bhawari |
| **Aizoaceae** | |
| 2) *Sesuvium sesuvioides* (Fenel.) Verde | Mamuli |
| 3) *Zaleya redimita* (Melville) Bhandari var. flava Bhandari | Satta |
| 4) *Mollugo cerviana* (Linn.) Serr | |
| 5) *Mollugo cerviana* (L.) Serr. | Sareli |
| **Amaranthaceae** | |
| 6) *Aerva persica* (Burm. F.) Merr. | Booi |
| 7) *Aerva tomentosa* Forsk. | Booi |
| 8) *Digera muricata* (Linn.) Mart. | Loleru |
| **Asclepiadaceae** | |
| 9) *Leptadenia pyrotechnica* (Forsk.) Dune | Khimp |
| 10) *Calotropis procera* (Ait.) R. Br. | Aak |
| **Asteracea** | |
| 11) *Dicoma tomentosa* Cass. | Tilganti |
| **Boraginacea** | |
| 12) *Heliotropium* sp. | Kharnia |
| 13) *Heliotropium strigosum* Willd. | Dhawalphuli |
| **Bignoniaceae** | |
| 14) *Tecomella undulata* (Sm.) Seem. | Rohida |
| **Caesalpinoideae** | |
| 15) *Cassia italica* (Mill.) Spreng. | Ghodabhel |
| **Capparaceae** | |
| 16) *Cleome gynandra* L. var. nana (Blatt. & Hallb.) Bhandari | Bagra |
| 17) *Dipterygium glaucum* Decne. | Phel |
| 18) *Cleome viscosa* Linn. | |
| 19) *Capparis decidua* (Forsk.) Edgew. | |
| **Chenopodiaceae** | |
| 20) *Haloxylon salicornicum* (Mog.) Bunge | Lana |

Cucurbitaceae

| | |
|---|---|
| 21) Coccinia grandis (Linn.) J.D. Voigt | holabel/Gholada |

Euphorbiaceae

| | |
|---|---|
| 22) Euphorbia granulata Forsk. var. granulata | Dudheli |
| 23) Euphorbia caducifolia Haines | Thor |

Faboideae

| | |
|---|---|
| 24) Indigofera linifolia (L.F.) Retz. | |
| 25) Tephrosia stigosa (Dalz.) Santapau & Mahesw. | |
| 26) Dalbergia sisoo Roxb. | Sheeshum |
| 27) Crotalaria burhia Roxb. | Sinia/Chug |

Liliaceae

| | |
|---|---|
| 28) Corchorus sp. | Aada Kheth |

Mimosoideae

| | |
|---|---|
| 29) Prosopis cineraria (Linn.) Druce | Khejidi |
| 30) Acacia senegal (Linn.) Willd. | Kumat |
| 31) Prosopis chilensis (Molina) Stuntz | |
| 32) Prosopis juliflora (Swartz) DC. | |
| 33) Acaccia nilotica (Linn.) Del | Babul |
| 34) Acacia totalis | |

Myrtaceae

| | |
|---|---|
| 35) Eucalyptus sp. | |

Nyctaginaceae

| | |
|---|---|
| 36) Boerhania elegans Choisy | |
| 37) Boerhavia diffusa Linn. | Sinaudi |

Poaceae

| | |
|---|---|
| 38) Eragrostis ciliaris (Linn.) R. Br. var. brachystachya Boiss | |
| 39) Panicum antidotale Retz. | Girabana |
| 40) Eragarostis sp. | Oobadi |
| 41) Letipes senegalensis Kunth. | |
| 42) Stipagrostis hirtigluma (Steud. ex Trin & Rupr.) de Winter | Lamp |
| 43) Tragus roxburghii Panigrahi | Kuri |
| 44) Cenchrus pennisetiformis Hochst & Steud | Dhaman |
| 45) Enneapogon schimperanus (Hochst. ex Rich) Renvoize | Mirak |
| 46) Lasiurus hirsutus Boiss. | Sewan |
| 47) Aristida funiculata Trin. & Rupr | Lamp |
| 48) Urochloa panicoides P. Beauv. var. pubescens (Kunth) Bor | Kuri |

| | |
|---|---|
| 49) Cymbopogon jwarancusa (Jones) Schult. | Boorda |
| 50) Dactyloctenium sindicum Boiss | Ubio ghantia |
| 51) Dactyloctenium sp. | Ghantiya |
| 52) Melanocenchrus abyssinica (R. Br.) Hochst. | |
| 53) Cenchrus catharticus Del. | Bhurti ghas |
| 54) Dactyloctenium aegypticum (Linn.) P. Beauv. | Kuri |
| 55) Brachiara ramosa (Linn.) Stapf | Murat |
| Polygonaceae | |
| 56) Calligonum polygonoides Linn. | Phog |
| Rhamnaceae | |
| 57) Zizyphus nummularia (Burm. f.) Wt | Bordi |
| Salvadoraceae | |
| 58) Salvadora persica Linn. | Jal |
| Solanaceae | |
| 59) Lycium barbarum Linn. | Murali |
| Zygophyllaceae | |
| 60) Fagonia schweinfurthii (Hadidi) Hadidi | Dhamiya |
| 61) Seetzenia lanata (Willd.) Bullock | Dhakdi |
| 62) Tribulus rajasthanensis Bhandari et Bhandari | Kanti |
| 63) Tribulus pentandrus Forsk. var. pentandrus | Dhakda |

## CHECKLIST OF THE BIRDS SEEN IN JAISALMER, BARMER & JODHPUR DISTRICTS

| | | |
|---|---|---|
| 1) | Little cormorant | Phalacrocorax niger |
| 2) | Pond heron | Ardeola grayii |
| 3) | Cattle egret | Bubulcus ibis |
| 4) | Little egret | Egretta garzetta |
| 5) | Bittern sp. | Ixobrychus sp. |
| 6) | Pariah kite | Milvus migrans |
| 7) | Buzzard sp. | Buteo sp. |
| 8) | White-eyed buzzard-eagle | Butastur teesa |
| 9) | Tawny eagle | Aquila rapax |
| 10) | King vulture | Sarcogyps calvus |
| 11) | Cinerous vulture | Aegypius monachus |
| 12) | Griffon vulture | Gyps fulvus |
| 13) | Indian whitebacked vulture | Gyps bengalensis |
| 14) | Egyptian vulture | Neophron percnopterus |
| 15) | Montagu's harrier | Circus pygarus |
| 16) | Laggar falcon | Falco biarmicus jugger |
| 17) | Lesser kestrel | Falco naumanni |

| | | |
|---|---|---|
| 18) | Grey partridge | Francolinus pondicerianus |
| 19) | Grey quail | Coturnix coturnix |
| 20) | Common peafowl | Pavo cristatus |
| 21) | Demoiselle crane | Anthropoides virgo |
| 22) | Great Indian bustard | Ardeotis nigriceps |
| 23) | Houbara bustard | Chlamydotis undulata |
| 24) | Blackwinged stilt | Himantopus himantopus |
| 25) | Creamcoloured courser | Cursorius cursor |
| 26) | Indian courser | Cursorius cursor |
| 27) | Redwattled lapwing | Vanellus indicus |
| 28) | Indian sandgrouse | Pterocles exustus |
| 29) | Imperial sandgrouse | Pterocles orientalis |
| 30) | Blue rock pigeon | Columba livia |
| 31) | Indian ring dove | Streptopelia decaocto |
| 32) | Little brown dove | Streptopelia senegalensis |
| 33) | Great horned owl | Bubo bubo |
| 34) | Spotted owlet | Athene brama |
| 35) | Shorteared owl | Asio flammeus |
| 36) | Common kingfisher | Alcedo atthis |
| 37) | Whitebreasted kingfisher | Halcyon smirnensis |
| 38) | Bluecheeked bee-eater | Merops superciliosus |
| 39) | Green bee-eater | Merops orientalis |
| 40) | European roller | Coracias garrulus |
| 41) | Hoopoe | Upupa epops |
| 42) | Ashycrowned finch-lark | Eremopterix grisea |
| 43) | Black crowned finch-lark | Eremopterix nigriceps |
| 44) | Large desert lark | Alaemon alaudipes |
| 45) | Lesser short-toed lark | Calandrella rufescens |
| 46) | Crested lark | Galerida cristata |
| 47) | Grey shrike | Lanius excubitor |
| 48) | Baybacked shrike | Lanius vittatus |
| 49) | Redbacked shrike | Lanius collurio |
| 49) | Brown shrike | Lanius cristatus |
| 50) | Black drongo | Dicrurus adsimilis |
| 51) | Rosy pastor | Sturnus roseus |
| 52) | Common myna | Acridotheres tristis |
| 53) | Bank myna | Acridotheres ginginianus |
| 54) | House crow | Corvus splendens |
| 55) | Raven | Corvus corax |
| 56) | Common wood shrike | Tephrodornis pondicerianus |
| 57) | Whitecheeked bulbul | Pycnonotus leucogenys |
| 58) | Redvented bulbul | Pycnonotus cafer |
| 59) | Common babbler | Turdoides caudatus |
| 60) | Common babbler | Turdoides caudatus |
| 61) | Plain wren-warbler | Prinia subflava |
| 62) | Lesser whitethroat | Sylvia curruca |
| 63) | Desert warbler | Sylvia nana |
| 64) | Rufous chat | Erythropygia galactotes |
| 65) | Bluethroat | Erithacus svecicus |
| 66) | Pied bush chat | Saxicola caprata |
| 67) | Isabelline chat | Oenanthe isabellina |
| 68) | Desert wheatear | Oenanthe deserti |
| 69) | Pied chat | Oenanthe picata |
| 70) | Grey wagtail | Motacilla cinerea |

| | | |
|---|---|---|
| 80) | Purple sunbird | Nectarinia asiatica |
| 81) | House sparrow | Passer domesticus |
| 82) | Yellowthroated sparrow | Petronia xanthocollis |
| 83) | Whitethroated munia | Lonchura malabarica |
| 84) | Blackheaded bunting | Emberiza leucocephalos |
| 85) | Greynecked bunting | Emberiza buchanani |
| 86) | Rock bunting | Emberiza cia |

SOME MAMMALS SEEN IN THE THAR DESERT

| | |
|---|---|
| Desert Cat | Felis libyca omata |
| Small Indian Mongoose | Herpestes auropunctatus |
| Desert Fox | Vulpes vulpes pusilla |
| Indian Fox | Vulpes bengalensis |
| Jackal | Canis areus |
| Chinkara | Gazella bennetti |
| Blackbuck | Antilope cervicapra |
| Nilgai | Bocelaphus tragocamelus |
| Blacknaped Hare | Lepus nigricollis |
| Longeared hedgehog | Hemiechinus auritus |
| Indian Desert Gerbille | Meriones hurrianae |

Reptiles

| | |
|---|---|
| Sawscaled viper | Echis carinata |
| Royal Snake | |
| Desert monitor | Varanus griseus |
| Indian monitor | Varanus bengalensis |
| Spiny tailed lizard ('Sanda') | Euromastix hardwicki |
| Toad agama | Phrynocephalus euptilopus |

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THE THAR DESERT

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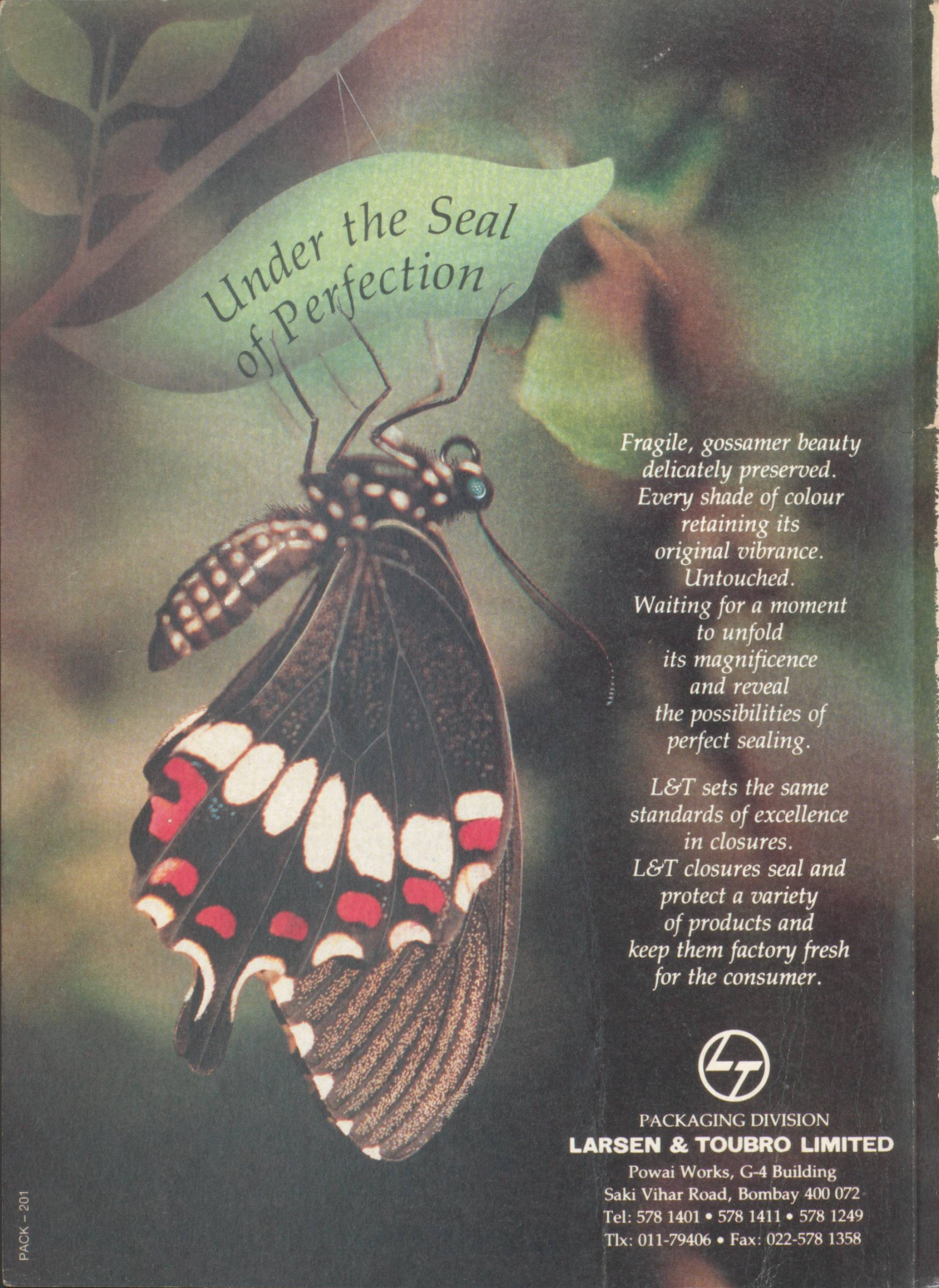


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**Correspondents:** Kailash Sankhala, 21 Dhuleshwar Garden, **Jaipur** 302 001. Tel: 63933.

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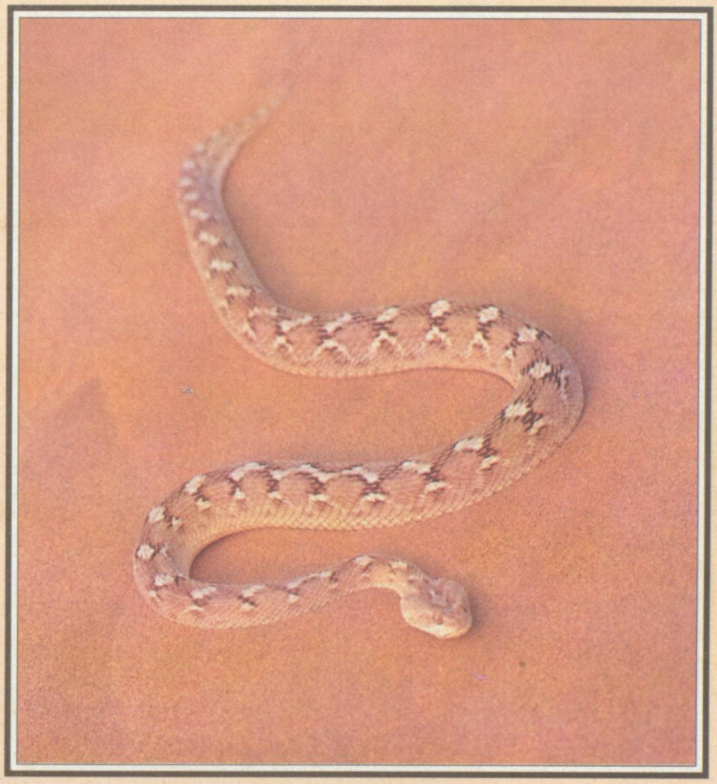
VOL. XII. NO. 2. 1992



## *Commentary*

*Superbly adapted to their Nilgiri haunt, tahr managed somehow to endure the hunting orgies of the past. Today, safe from the gun, their survival — and that of hundreds of other equally vulnerable wild animals — depends on whether or not we can disarm the lethal weapons of commerce which are trashing the very ground under their precariously perched, but agile, feet.*

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They were approached by a delegation of farmers who were worried about the effects of pollution from the plant.

It was cause for concern. Just a few months earlier, when our engineers had toured a neighbouring cement plant, they had emerged grey: coated with dust from head to toe.

Clearly, something had to be done. As a first step, a team of engineers were despatched to Switzerland to study pollution control measures.

They discovered a plant near the Swiss Alps operating at 50-100 mg/per $NM^3$, possibly the world's most pollution-free cement plant.

The engineers returned with a resolve to achieve Swiss levels of pollution control. (As against Indian requirements of 150-250 mg/per $NM^3$.)

They began by setting up expensive filter bag pollution control machines.

Individual responsibilities were given to each engineer to ensure filters were regularly cleaned so that the pollution control system worked at maximum possible efficiency.

To monitor its effectiveness, they set up a rose garden in the middle of the plant to see if it would flourish.

The pollution levels went down to 120 mg/per $NM^3$. There was no visible sign of smoke or dust even 200 yards from the plant.

The farmers were satisfied. The engineers were not. The roses, on close inspection, had a film of dust. So in February 1990, Ambuja installed an 'electrostatic precipitator' on the clinker cooler. The result: a fall in pollution levels to 70-80 mg/per $NM^3$, well below the rigorous Swiss standards.

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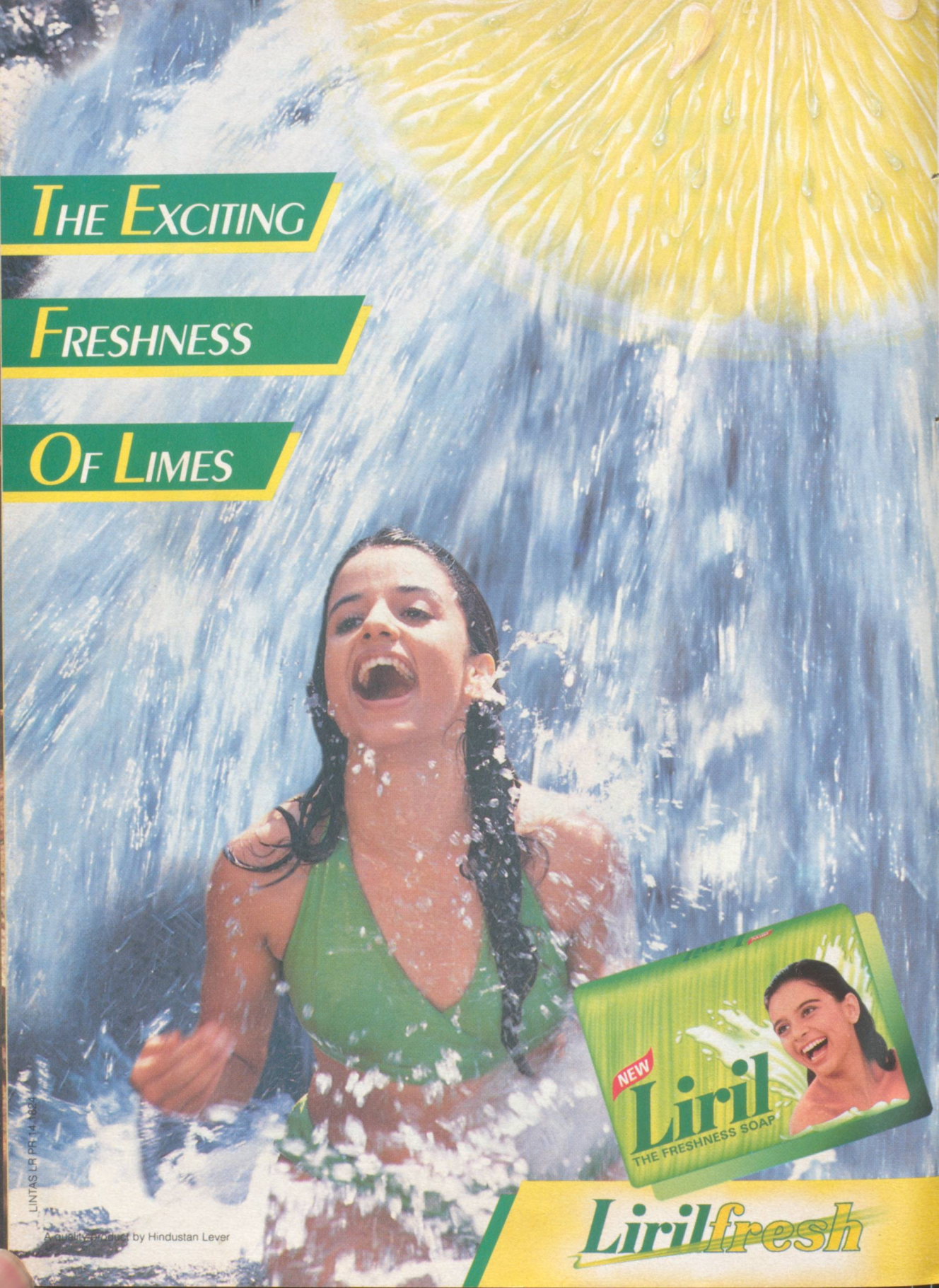
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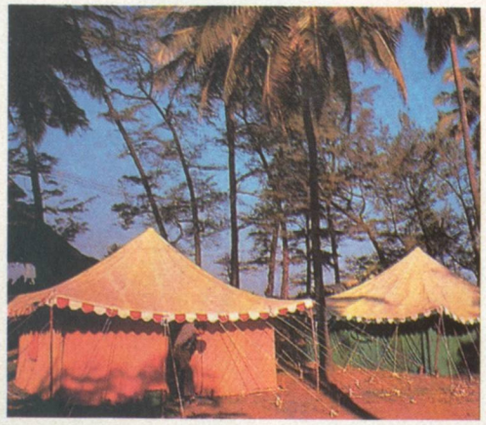

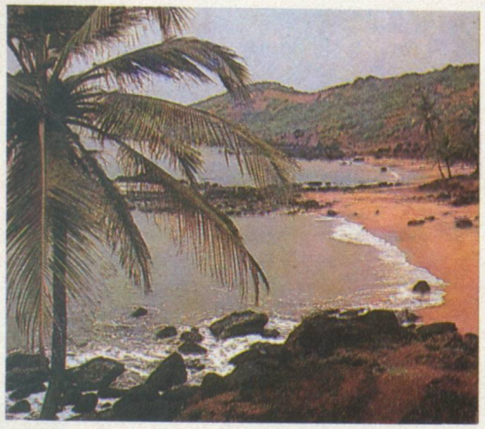

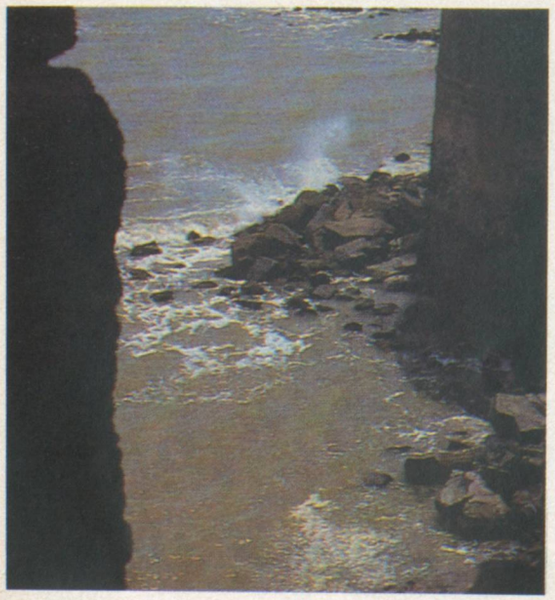

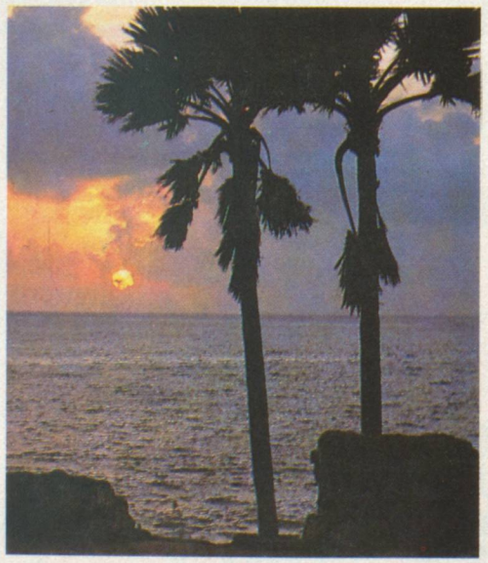

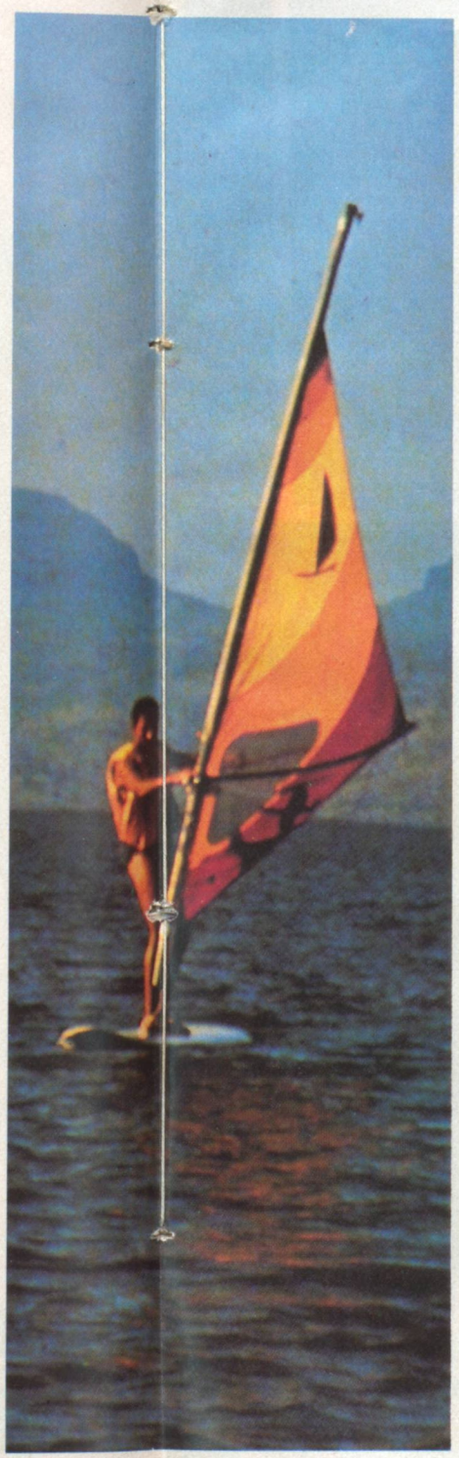

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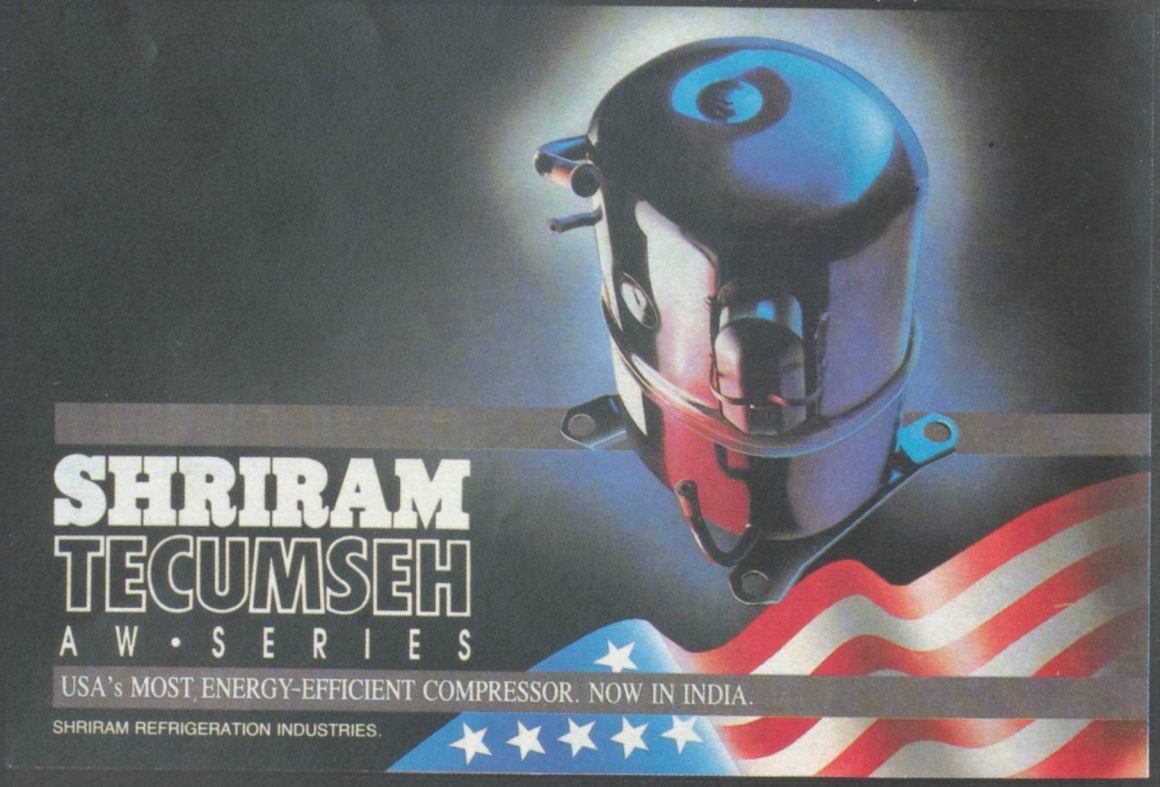

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# Inside the Thar Desert

Text and photographs by Ravi Sankaran

*The saw-scaled viper is the most common venomous snake in the Thar. It moves sideways, often raising its body off the ground to facilitate rapid motion. The toad agama (inset) is a lizard — not an amphibian — and lives, superbly camouflaged, almost exclusively on sand dunes.*

*Field biologists possess more information vital to the survival of our country than almost any other academic group. It is not surprising that they understand the earth better than most, considering as how they are willing to invest vast portions of their lives in remote habitats, in the company of wolves, jackals and other wild animals of all descriptions. As any field biologist will confirm, the more severe the environmental conditions, the more fragile the habitat. This applies particularly well to deserts.* ***Ravi Sankaran*** *from the Bombay Natural History Society (BNHS) recently spent six months in the Thar, the world's most densely populated desert. He shares with us some of the information he gleaned from his trip, as also his love for the austere surrounds and the colourful people of the Thar.*

**THE SUMMER HEAT** baked the earth around me. Riding out of my camp on camel-back in the late afternoon, I headed for the dunes. Once there, I tethered the animal to a convenient tree just before the sand line and started off on foot. The soft sand was hot and shifty underfoot and this made progress slow, but I was in no hurry anyway. The dunes were not very extensive, perhaps spreading to around two sq. km. and in places I could see huge crescents of loose sand that, at points, dropped all the way down to hard earth. From the vantage point of one such ridge, I was able to look all around me and I gazed admiringly at the patterns sculpted in the sand by the wind. The desert is a magnificent experience. My instincts as a biologist, of course, led me to keep a sharp lookout for any signs of life and I observed several insects, reptiles and birds, recording their behaviour where possible. Below me, to where the dune fell to the ground, I saw a dead tree. At first it seemed quite devoid of life, but suddenly, disturbed by my presence, a desert fox bolted from a den cleverly dug at the base of the lifeless trunk. After setting a safe distance between us the exquisite animal paused atop a dune across me, threw me one backward glance and then made off at a gallop across the Thar desert.

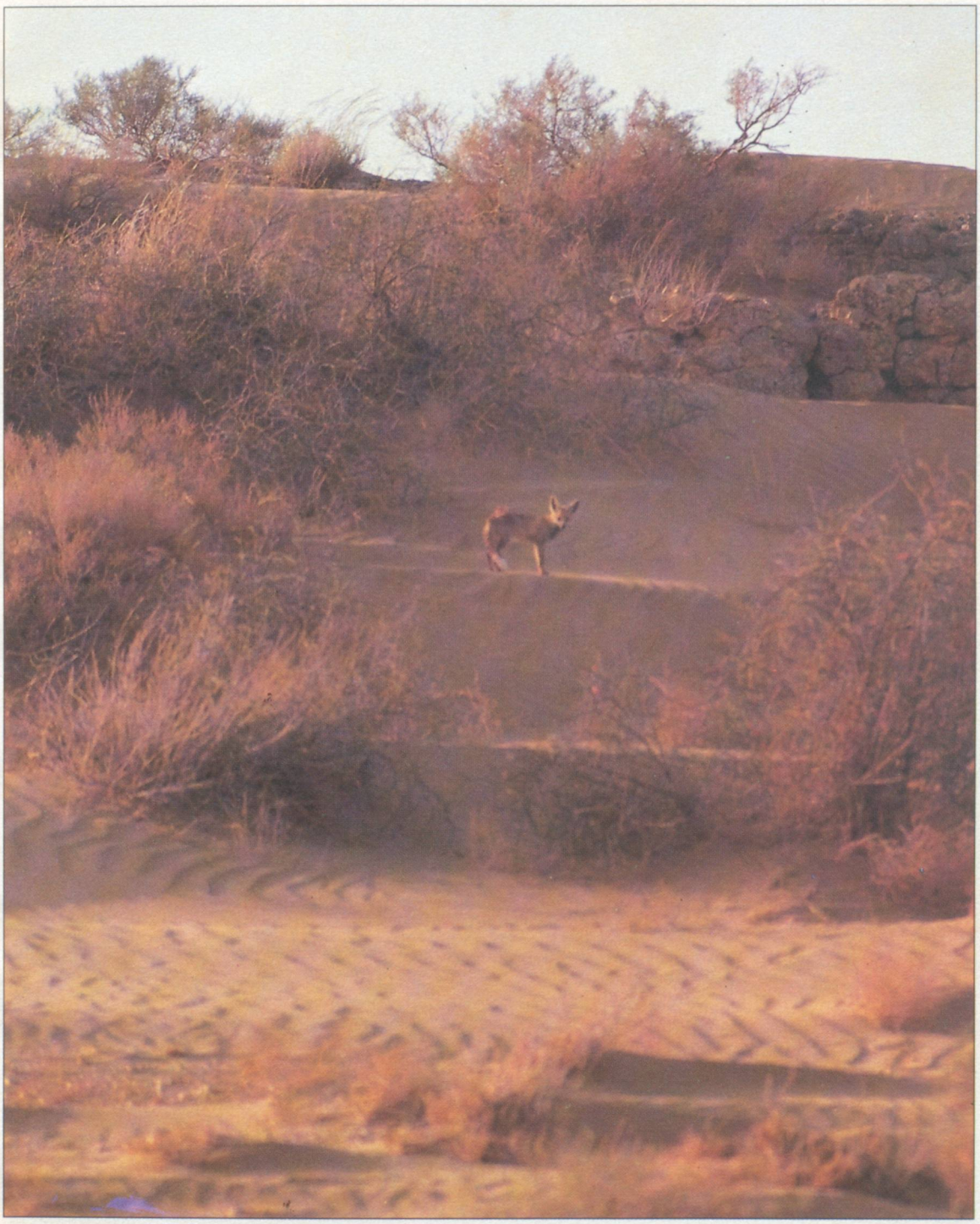
**I WAS IN RAJASTHAN** as a part of the BNHS grassland study project and this was my first long-term experience of the desert. The first few weeks were pure hell. I had walked right into the blistering heat of a desert not yet cooled by rain. Each day as the sun rose the wind would grow rapidly in strength, swirling up a storm of sand. There was no shelter from it. For two full weeks the sandstorm blew daily. The cool of the night offered some respite, but some days the storm blew through the night as well. With every gust of wind, sand filled my hut, blanketing everything. In the early days of my private war against the sand, the dust I collected inside my hut made up a pile almost as high as my knee! Outside, I once measured the surface temperature on a minute sand dune that the wind had blown up opposite my door at $61^0$ C. My condition was made none the easier by the fact that I had come into this harsh and inhospitable terrain after a year of sedentary city living.

Gradually, however, I became used to the storms, to the heat, the glare of the sun reflecting off the sand and the necessity to live on just two buckets of water a day. I would fill my belly with water at every opportunity and drink tea brewed from brackish water. I also began to relish simple wholesome desert meals which consisted of *bajra rotis* and *chaas* (buttermilk). To my utter delight, I also learnt the art of riding camels. Even the most recalcitrant of beasts now held no fear for me.

Naturally, I spent much time on the animal and plant life around me and each day revealed new information. Additionally, from the nomadic existence of the desert people who live so comfortably in the inhospitable terrain, I discovered many simple survival techniques. Eventually, my experiences in the Thar developed into an enduring love for the desert and for the way of life so peculiar to the Thar.

**THE DESERT CAT** is the ruler of the night sands, as surely as the falcon is the master of the desert sky. I have trudged some of the most remote parts of our country and seen some of its rarest wildlife, but my quest for the elusive desert cat was proving to be more difficult than I had anticipated.

# THAR DESERT



*The desert fox* ***(above)*** *is a sub-species of the red fox and can be easily differentiated from the Indian fox by the colour of the tail tip — white in the former, black in the latter. A sanda or spiny tailed lizard* ***(facing page)****, disappearing into its burrow. Sanda live in colonies characterised by numerous burrows. The width of the burrow opening is indicative of the size of its occupant.*

*Great Indian bustards have been hunted for decades and survive in small isolated pockets today. The Thar desert harbours India's largest population of these magnificent birds.*

Frustrated, I had even momentarily contemplated putting out a bait for the cat, but, of course, did nothing of the sort! One morning as I ventured forth on camel-back, my luck changd, sort of. The morning was long and hot and we were still a good 10 km away from camp. Without warning, before our very eyes, a feline form darted out of the sparse shrubbery. I got only the briefest of glimpses and was desperate to make a positive identification. But when I tried goading my camel into hot pursuit to my utter dismay the wretched beast chose to throw a tantrum! By the time I brought the taciturn brute under some semblance of control, the cat had vanished without a trace. On another occasion I was returning home well after dark, when a cat-like creature was picked up briefly in the bright arc cast by the headlight of my vehicle. But the animal vanished too quickly for me to identify it. These then were the only two instances during my sojourn in the Thar desert that could possibly constitute (unconfirmed) sightings of the desert cat.

**AN EARLIER *BNHS* STUDY,** on which I had worked, involving the bustards of India, had highlighted at least one major point — apart from bustards, several animals specific to grassland habitats are currently threatened. It was as a result of these findings that a sequential project commenced, this time to study the grassland ecosystem as a whole, with special reference to its endangered fauna. One of our target areas is the Thar desert, much of which is clothed by arid grasslands. Like many BNHS projects, this too was sponsored by the Ministry of Environment, (Forests and Wildlife) and funded by the US Fish and Wildlife Service. As in the past, the Rajasthan Forest Department supported our study.

My specific task was to study the grasslands and wildlife in the Desert National Park (DNP) and Sam, a tiny village 45 km west of Jaisalmer, was to be my home for a little over five months. It was to be one of the most memorable field trips that I have ever made, when every day exposed me to something new, something exotic; when every day was a day of learning about one of India's last extensive wildernesses.

With semi-arid areas included, nearly one-third of the earth's surface comprises deserts. However, only five per cent of the surface is considered to be *extremely* arid. It is difficult to precisely define a desert. The common concept, as an extremely dry region with little vegetation is, however, fairly accurate. Deserts are arid lands where the annual precipitation is 250 mm or less and several different desert types occupy this environmental niche. Though deserts are thought to be baking waterless lands, these comprise only a part of the arid areas of the world. For example, the polar regions of the Antarctic and Arctic have an annual precipitation of between 125 and 200 mm. These too are deserts — arctic deserts. Then we have what are called edaphic deserts, where precipitation is greater than 250 mm per annum, but because the soil is exceedingly porous, water retention is much too poor to sustain plant life, irrespective of how much rain falls. Such areas include parts of Iceland or the Canaries.

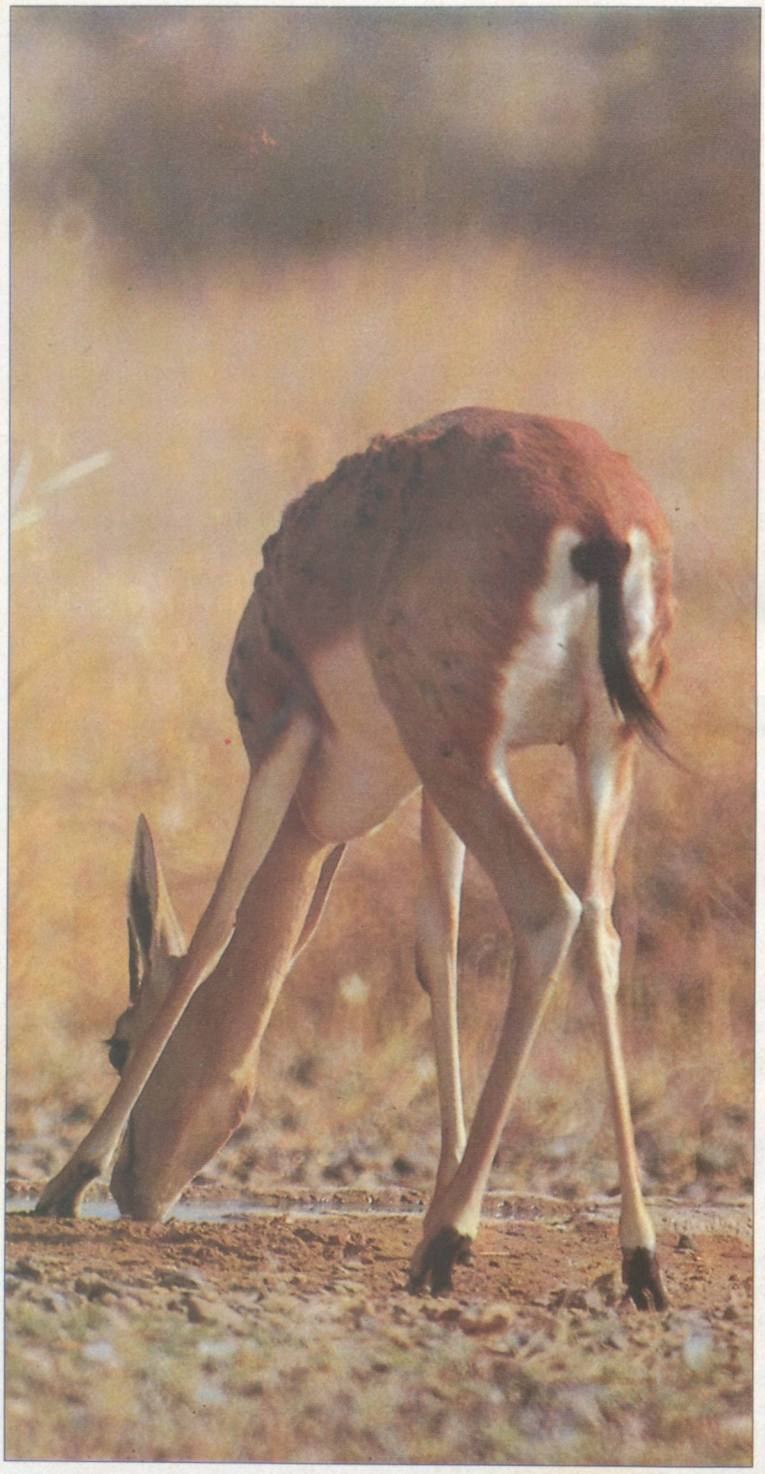
Mankind has played a significant role in accelerating the process of desertification across the globe and also in destroying fragile desert ecosystems. But the primary cause of desertification and the location of hot deserts is in the dynamics of atmospheric circulation. Air that is heated at the equator by solar radiation rises, cools, condenses and releases its moisture in the tropics. It then descends towards the earth's surface near latitudes $30^0$ N and $30^0$ S, thus producing two belts of sub-tropic high pressure. Known as the trade winds, hot and devoid of all moisture, these winds then blow back towards the equator.

**MOST OF THE WORLD'S** large hot deserts are present just below or near these high pressure belts. The hot, dry trade winds blow across the Sahara, the deserts of the Middle East, the Thar and parts of north America. Similar atmospheric conditions are also responsible for the occurrence and location of deserts in the southern hemisphere. Wherever trade winds blow from seas onshore, the moisture they carry precludes the existence of deserts. Several of the world's deserts are, however, what can be called the high latitude types, in that they lie north or south of the arid belt. These are created because of a rain shadow effect; moisture-bearing winds condense and deposit their wetness on barriers, for example on a mountain range.

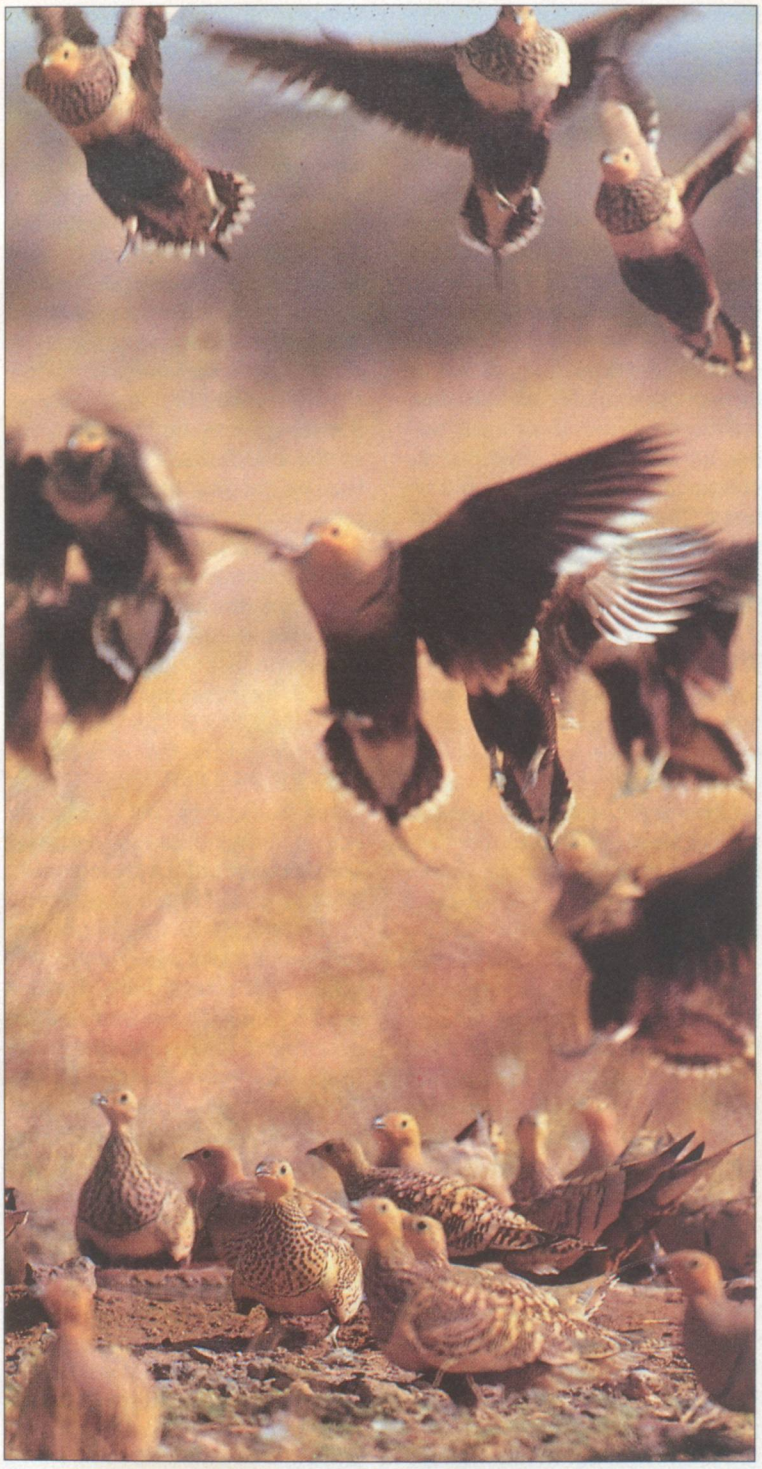
By the time they reach the leeward side they are dry and desertification takes place. Such deserts include the Tibetan plateau, the Patagonian desert of Argentina and much of the north American deserts. Some deserts like the Gobi and the Takla Makan of central Asia exist because their location in the interior of the continent prevents moisture bearing winds from reaching those areas.

The Thar or great Indian desert is the only hot desert in the Indian subcontinent. It covers an area of approximately 200,000 sq km and is bordered by the Indus plains to the west, the Aravallis to the south-east, the Rann of Kutch to the south and the fertile Punjab plain to the north and northeast. Physio-geographically, the Thar is the eastern extension of the vast Saharo-Thar desert. This region is believed to have once been part of the Indian ocean, a fact corroborated by the presence of marine fossils in many areas. The aridity was caused primarily by climatic oscillations after the last phase of glaciation during the Pleistocene. Two river systems pass through, or adjacent to, the Thar — the Indus and the Luni. Other water courses rapidly fill and overflow during the rains but the waters are lost quickly. The Thar and the semi-arid areas associated with it cover many districts of western Rajasthan. Jaisalmer is very arid and Jodhpur, Barmer and Bikaner have increasing levels of aridity as one moves from east to west. While other districts like Pali are predominantly semi-arid areas. The Thar is the most densely populated desert of the world. Here the primary source of livelihood is animal husbandry in the arid areas, while agriculture increasingly replaces it as one moves into semi-arid areas.

**THE NOTION** that deserts are predominantly barren expanses of sand is wrong. In general, sands must be regarded as occupying just a minor portion of the desert. For example, sand occupies not more than 10 per cent of the Sahara, a desert that boasts areas such as the Grand Erg Oriental in Algeria, among the largest 'sand seas' in the world. The presence of such large quantities of sand in deserts



*The chinkara or Indian gazelle is able to get by with very little water, taking what it needs from the moisture content of several favoured plants, including the hardy Calotropis.*



*At a waterhole the air is thick with common Indian sandgrouse. The birds normally gather in large numbers at dawn to drink up for the long, hot and dry day ahead.*

is still not clearly understood, though several explanations have been put forward. Contrary to popular belief wind action is not responsible for the creation of such large quantities of sand. The wind's role has been to move, modify, add and subtract from existing desert sands. Dunes can be classified into two types, fixed or mobile. Fixed dunes are those sufficiently covered by vegetation to prevent their being displaced. Mobile dunes are bare or very sparsely vegetated and occur in different shapes — linear, (oriented by wind direction), S-shaped, star-shaped and the crescent-shaped (Barchans) which are the commonest type in the Thar.

**SAND DUNES APPEAR** to be no more than barren stretches of loose sand, devoid of life, from a distance. On closer examination, of course, a plethora of life forms, including large mammals, can be seen here. Two species of fox are known on the Indian sub-continent — the Indian fox and the red fox. The desert fox, which I mentioned having seen from atop a sand dune, is a sub-species of the red fox and can be easily differentiated from the Indian fox by the colour of the tail tip — white in the former, black in the latter. While the Indian fox is widely distributed through the country, the desert fox inhabits only dry, arid regions. Even here, it is less common than its cousin which, in one enclosure of the DNP, Ramdevra is found in as high numbers as two per running km. In some areas both species occur together and I am curious to know how two predators that apparently occupy the same ecological niche apportion resources between them.

While walking across the same dune upon which I spotted the fox,

I was puzzled by a set of tracks that followed the rim of a ridge top, before disappearing before my very eyes. On examination I could see that the sand had been disturbed at the point where the tracks disappeared. Closer scrutiny revealed a pair of eyes, and a bit of the top of the head of some animal peering up at me. It was my first introduction to the toad agama, a lizard — not an amphibian — that lives, superbly camouflaged, almost exclusively on sand dunes. My interest aroused, I gently eased it out of the sand. On being exposed it scurried away and when it thought I wasn't looking, began wriggling rapidly and sank into the sand once more, with only its eyes showing above the surface.

**THIS UNIQUE BEHAVIOUR** of the toad agama kindled in me an interest in lizards, a group of animals to which I had thus far paid scant attention. My biggest handicap at the time was the lack of a comprehensive field guide. Apart from differentiating most of what I saw into respective groups like skinkidae etc., there was little else I could do. Nevertheless, I watched with fascination as lizards turned blue in spectacular territorial advertisements, or dashed athletically into burrows, or simply made decorative tracks on telltale sands. One day I even watched a female dig out a nest and lay her eggs, carefully covering them up with soil. I also watched lizards raise their bodies and tails off the blistering desert sand, to reduce contact and thus control their body temperature. That other marvellous desert reptile, the sanda, or spiny tailed lizard, was, of course, a familiar sight.

Reptiles thrive in deserts. In the *thalar* regions of the Thar, where the soil is flat and hard, one is very likely to come across *sanda* colonies. These are characterised by numerous burrows, with openings that are flush with the earth, descending to about a metre. The width of the opening is indicative of the size of its occupant and at some point the burrow broadens out sufficiently to allow the resident to turn around, before tapering again. Each individual supposedly has its own burrow, but on being disturbed may dash into the nearest available one. Radiating from the mouth of each burrow are meandering trails that the *sanda* makes as it leaves and returns. The area surrounding a burrow is dotted with black droppings and the grass cropped to a stubble.

The sanda is vegetarian! A 'lazy' lizard it only emerges from its burrow after sunrise. I observed the process one morning when a cautious head emerged to make a preliminary check, then, ever so slowly, the forelegs and upper body followed, pausing at the entrance before finally coming out to catch some sun or forage.

At the slightest hint of danger, the lizards will rush back to the edge of the burrow and either stop there to investigate further, or dive headlong to safety. If the opening is too small the *sanda* laboriously squeezes itself in. Lizards of varying sizes will be found in a colony. Large adults can grow to nearly a foot in length and can get quite plump. Some two hours or so before sunset the sanda gets into its burrow and shuts the opening with a plug of soil that is very hard to break through. I have it on the best authority that not only does this effectively prevent predators from entering, but should it rain heavily, the plug even stops the burrow from getting flooded!

Dangers abound in wild places and the *sanda* would make a tasty morsel for several predatory desert gourmets. One moonlit night wandering through a colony of *sanda,* I came across a sand boa, obviously on the lookout for a meal. Fox and the desert monitor also welcome the chance to hunt sanda, as do raptors. In one colony in the Ramdevra closure of the DNP I counted over 35 tawny eagles. This unusually high density of Indian fox and eagle at Ramdevra was undoubtedly due to the large *sanda* population. But by far the most dangerous predator of the *sanda* is man. Some catch the lizards for food. Others, its medicinal properties. Many itinerant practitioners of folk medicine often keep a few specimens with them, which are immobilised by breaking their backbones!

**THERE IS ONE SPECIES** of snake in the area that needs special mention. I have never ever seen such enormous specimens of the saw-scaled viper as are found in the Thar. It is the commonest venomous snake and one that was killed near where I lived measured 81 cm! The saw-scaled vipers found in desert areas differ from their counterparts in the way they locomote. They move sideways, often raising their bodies off the ground to facilitate rapid motion, leaving behind S-shaped tracks on the sand.

Deserts are not devoid of vegetation. Certainly, large tracts of the Thar desert are barren, particularly where the ground is rocky or stony (locally known as Magra), but large stretches of the desert are well vegetated. I can, in fact, think of several areas in peninsular India which have a far lower tree density than sections of the

Thar. Much of the vegetation in the desert comprises plant species specially adapted to an unpredictable supply of water. Adaptations include specialisations like root systems that descend deep into the soil or spread over very wide areas just below the surface. In some species the biomass of the roots is several times that of the above-ground portion of the plant. A classic example of this is the woody bush called Phoge, *Calligonum polygonoides*. A commonly seen adaptation is the retrogation of the leaf into thorny or hard vestiges; an adapted petiole, or stem, serves the function of leaves as in the kair, *Caparis decidua*. Still others have developed thick cuticles that prevent loss of moisture through transpiration.

**THE DESERT REALLY** comes into its own in the brief, rare time when it rains. The ground is then blanketed by ephemerals that spread rapidly over the surface, grow in bushy clumps, or occur as tiny outcrops of green on the soil. I was amazed at the ability of plants to flourish with so little water. Dry clumps of Sewan, *Lasiurus sindicus*, a kind of grass found almost exclusively in the desert, dot the surface, sometimes forming exclusive stands. With the first rain the dry stalks sprout green shoots. And in a few short days what was once a half-metre high dry clump shoots up into surprisingly green bushes, double that height, with every other stalk ending in a delicate flower. Another example of the typical flora of this region is the *Khumbi*, a puffball mushroom that makes an excellent curry or an absolutely delicious *kadi*! The largest of these mushrooms has a head as big as a fist; they are found mainly on sandy soil and in large numbers in areas where the woody bush Lana, *Haloxylon salicornicum*, forms extensive stands.

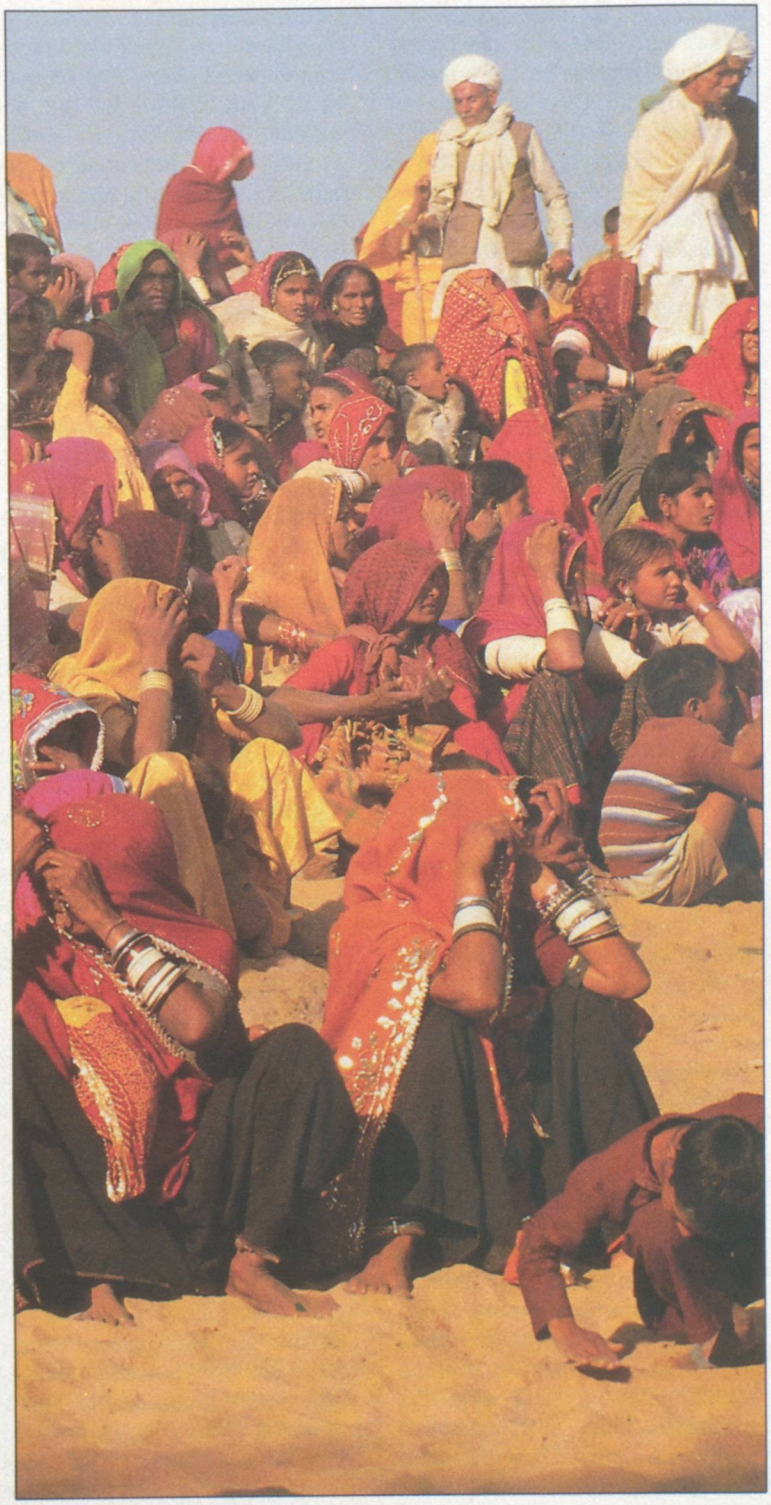
The rainfall pattern in the desert is unique. Unlike wetter areas, where it rains on and off for several days, here barely four or five rain days are experienced during the season, sometimes less. In the Thar the amount of rain is gauged by how deeply the water has penetrated the soil and the depth is measured by the width of ones four fingers *(unglis)* — thus, four *unglis*, eight *unglis* and so on, conveys the quantum of rainfall. Typically during the rains, clouds build up and pass overhead four or five times, accompanied by strong winds that raise a storm of sand. If a given location is lucky, the clouds will burst overhead. If such cloudbursts occur more than three or four times during a season, then that year is one of plenty. But because the rain falls so rarely, enormous variations occur between areas. Sam, where I lived, for instance, was in the grip of drought; Sudasari, 15 km away, had better rainfall, while just beyond Kanoi, about six km from Sam, it was a year of plenty!

**THE DIVERSITY OF BIRDS** in the desert is not high but some species are found exclusively in arid areas as they have evolved special characteristics to survive here. The ashy crowned finch-lark, common in semi-arid and sub-humid areas, is replaced by the black-crowned finch-lark, which is perhaps the commonest of the lark group found in the Thar. Far more uncommon is the hoopoe or bifuscated lark, that gets its name from the long down curved bill resembling that of the hoopoe. Some species of birds are remarkable in the diversity of habitats that they occupy. Species like the ring dove, black drongo or pied bushchat are found right from the wet forests associated with the Himalayas, to the most arid parts of the desert. One afternoon, I was astonished to see a white-breasted kingfisher outside my hut! Raptors too are found in fairly high densities; the tawny eagle and the laggar falcon are commonly seen. The king vulture is also frequently sighted. Less common is the cinereous vulture. The giant of the corvidae, the raven, is another common resident. Wheatears, both pied and desert, are other common winter visitors. The cream coloured courser is yet another winter visitor to the Thar. At almost any time of the day one can hear small parties of sandgrouse flying overhead. While driving or walking I have often inadvertently flushed birds from hiding. Come morning, few species put up as remarkable a show as the sandgrouse. An hour or two after sunrise, hundreds of grouse gather to drink from water points. They first begin gathering near the waterhole in small groups that rapidly build up into large congregations on the ground. Hesitantly, a few brave pairs, summon the courage and fly across to the water to drink; then, as if the flood gates have been opened, the sandgrouse start flying in ones, twos, tens and twenties, till the water hole and the ground around is covered by a moving mass of birds. Still more fly in to take the place of those that leave after quenching their thirst. The sound of converging grouse reaches a crescendo, and the air is thick with arriving and departing birds. Then, almost as abruptly as they arrived, the last of the sandgrouse depart, and silence decends. The water hole is now left to the other denizens of the desert.

*The long-eared hedgehog,* Hemiechinus auritus, *when alarmed, will roll itself into a ball. Nocturnal insectivorous hunters, they are able to cover great distances under cover of the dark.*

Two species of sandgrouse are commonly seen in the Thar. The Indian sandgrouse is resident, but in winter migratory flocks of the imperial sandgrouse greatly increase the number of attendees at this morning ritual. Once, some years ago, I was sitting on the bund of the check dam adjacent to the Khinya temple. Imperial sandgrouse were coming in by the hundreds to drink at the pond before me. From out of the sky a lagger falcon swooped down upon a sandgrouse which swerved, right into the talons of a second falcon. Nature of course takes its toll of the birds, but the real decimation has been conducted by man. The hunter's modus operandi is fairly simple: Allow the first arrivals (the pilots) to drink and the flocks that follow will not stop. Knowing this, hunters have killed grouse by the hundreds at single sessions. One Maharaja is said to have imported a gun specially designed to shoot sandgrouse. The weapon took cartridges the size of a man's palm and sprayed hundreds of pellets with every shot.

The great Indian bustard is, without doubt, the star among the avifauna of the Thar. The region has the largest population of great Indian bustards in the country and in certain places seeing 40 or 50 birds in the course of a long drive is not uncommon. The houbara bustard, a winter visitor, is far more persecuted. It continues to be one of the most popular game birds, and the species is shot, trapped and hunted with falcons. The degree of persecution is reflected in the wariness of the birds that migrate to the desert. I have tried approaching them on numerous occasions but the shy birds would not let me get closer than 50 metres before launching into flight. I can still vividly recall one



*Local villagers add a splash of colour to the monochromatic desert during the annual Pushkar mela.*

morning in Bikaner district, my friend Asad Rahmani and I were looking for great Indian bustards and, stopping at one spot, we used a telescope to scan the surroundings. We saw typical bustard shapes in the distance, on closer approach we found a group of about 10 houbara. It was my first sighting of the houbara and it was an exciting moment. We continued on our way to scan new areas, but while returning it so happened that we used the same path. We saw a Jeep moving along slowly with two twelve bore guns pointing out, one from the front seat and the other from the back. Barely 10 metres away, moving in that typical gait implying urgency, was a disturbed houbara. We revved up and rushed the vehicle in defence of the bird and this caused the poachers to make off at top speed. Our arrival was propitious to that particular bird and probably to others within the group. But having some idea of the extent of hunting pressures on the species one cannot but look upon their future with pessimism.

**IN NO OTHER PART** of India, in my view, can wild ungulates be as commonly seen from highways as the Thar. The chinkara or Indian gazelle is seen throughout the region. Large herds of blackbuck are found in semi-arid areas while the nilgai is found in smaller numbers in both arid and semi-arid areas. The chinkara, inspite of its abundance and wide distribution in the Indian subcontinent has not been studied in any detail. Like many gazelle species, males form territories that show some clustering in their distribution over suitable habitat. Such territories are easily identified by the presence of dung piles or middens. Chinkara are able to get by with very little water, taking what they need from the moisture content of their hard diet. Even *Calotropis*, a plant which very few animals feed on is eaten. In fact, the presence of chinkara in several areas is often indicated by the stems of *Calotropis* plants stripped bare of leaves a couple of feet above the ground. Some areas of the Thar have very high densities of chinkara, for instance at Sudasari in the Desert National Park one can easily see 80 or 90 chinkara, while in other areas during a similar drive one sees barely four or five.

The chinkara is unfortunately much hunted by the large meat eating population in the Thar. I was under the impression that only guns were used to hunt them, but a young boy described in vivid detail how they trapped chinkara in the hot summer months when the animals are unable to run far and are quickly exhausted. Groups of youngsters then easily run the gazelles to the ground. The drought that many parts of the Thar has been experiencing for several consecutive years has resulted in a reduction in animal populations everywhere.

One automatically associates blackbuck in the Thar with the Bishnois, a people whose strong religious sentiments have resulted in the areas around their villages being turned into sanctuaries. While the blackbuck is considered holy by the Bishnois, the killing of all life forms is abhorred and some of the highest densities of blackbuck and chinkara are seen in Bishnoi areas. It has been estimated that as many as ten thousand blackbuck are found in the Bishnoi areas of the Luni river basin. Blackbuck are more dependent on water than the chinkara and are hence, found in the less arid regions of the Thar

I have always been fascinated by people, their customs and way of life and have rarely lost an opportunity to interact with the local inhabitants, to observe the effects of modernisation and progress on their lives. I have yet to meet a a race of people as fascinating as those that inhabit the Thar. Their physical grace and beauty is a reflection of their uncomplicated, healthy way of life. The quiet dignity of these simple people is so refreshing to one's jaded city mind. The bright intelligent eyes of village children follow one everywhere. It is a land where age old customs and traditions still play an important role in the lives of the people. A land of legends and folklore, where incidents of valour and courage in everyday life are still common. Paradoxically, this inhospitable land is home to some of the most generous, and hospitable people on the Indian subcontinent.

Once, after an unexpected sandstorm, my Jeep got mired in a sand dune that I had to cross to reach home. I walked across to the nearest village. Only a few men were left, the majority had taken their livestock to graze in areas that had better rainfall. One among the few to extend a helping hand was a venerable old man by the name of Ladoo Khan.

**TIMES HAD CHANGED,** I discovered, while talking to him. Over a cup of tea in his hut, he spoke with the typical disdain that the elderly have for the changed lifestyle of the youth and commented wryly on the piped water that is now available in most villages. The water, he said, was brackish and was drawn from the new tube wells sunk deep into the earth at a few locations. Locals now prefer to drink and use this brackish water,

rather than traditional water sources. In some areas, where underground water sources lie closer to the surface, a series of *baeris,* very narrow stone lined wells, have been in use for generations. *Baeris,* however, are usually a little away from the villages and with the introduction of piped water, these traditional wells have been left unused for some time now and without periodic maintenance have filled up with sand. Some areas have extremely deep wells and the ropes required to draw water out with draught animals had to be specially made. The advent of piped water resulted in these wells being neglected and the required paraphernalia was not maintained. Take the case of one village where the piped water became unavailable because of the breakdown of the pump at the tube well. Water that might have been drawn from the *baeri* was unavailable, since the ropes had long since decayed. The villagers had to undergo severe hardship before water supplies were resumed. As long as a regular supply of piped water is guaranteed, all will be well, but if for any reason the tube wells run dry, the local populations will be ill-equipped to deal with the situation, having lost touch with the tried and tested methods of water management handed down over the centuries.

**NOMADISM, TOGETHER** with a near total dependence on animal husbandry and high population densities, has resulted in the overall degradation of the desert ecosystem, primarily by overgrazing. Traditionally, livestock could remain in the desert areas only so long as surface water was available. Thus for much of the year grazing pressure was at a minimum, water being the chief limiting factor. The availability of water dictated the number of animals that could be grazed and also the duration of time during which grazing was possible. The supply of piped water to villages prolongs the presence of livestock, long after surface water has been exhausted. The availability of fodder is now the primary limiting factor. The result is that the desert is hopelessly overgrazed before the animals are herded out to less arid lands. Thus, the increase in water availability has been disastrous for the regeneration of vegetation and greatly threatens the wildlife of the desert.

That the people of the Thar know how to utilize their environment was never better exemplified than by the effective method of birth control used on livestock to restrict the size of herds. I was sitting drinking tea at a *gol* — a temporary camp people make when they are some distance from their village, grazing livestock when surface water and fodder is abundant. It had rained twice so far and the land was lush; just one more shower was needed for the people to remain in their villages that year. The lack of it would result in their moving out with their livestock. It was evening and the sheep were being rounded into a tight herd, a woman moving about them with a pot, milking the ewes. I then noticed that the rams would mount ewes but were unable to mate and would dismount immediately. Curious, I walked to one and saw that the end of its penal sheath had been tied up with string, loose enough for it to urinate, but too tight to allow an erect penis to emerge. As a result, the rams were temporarily sterilised! The logic was simple, the flock was large and if it did not rain one more time it would be a drought year. If so, then the difficulty of finding fodder, in transporting the livestock etc., would be greatly magnified if the flock was too large. Tying of the penal sheath ensured manageable numbers and allowed the shepherd to bring his flock through the drought with minimal losses. If however it rained again, the strings would be untied and the flock would multiply. I thought it was brilliant; I also felt humbled as I had been expounding in detail on range land management, to a people who obviously understood their land well.

But is such knowledge now being 'wasted' as a result of an increase in the population of humans? With increased human numbers, particularly when grown sons leave to start families of their own, the flocks of sheep and goats also increase. These in turn increase the pressure on the land making it impossible for it to regenerate. In this vicious cycle the desert is the only victim.

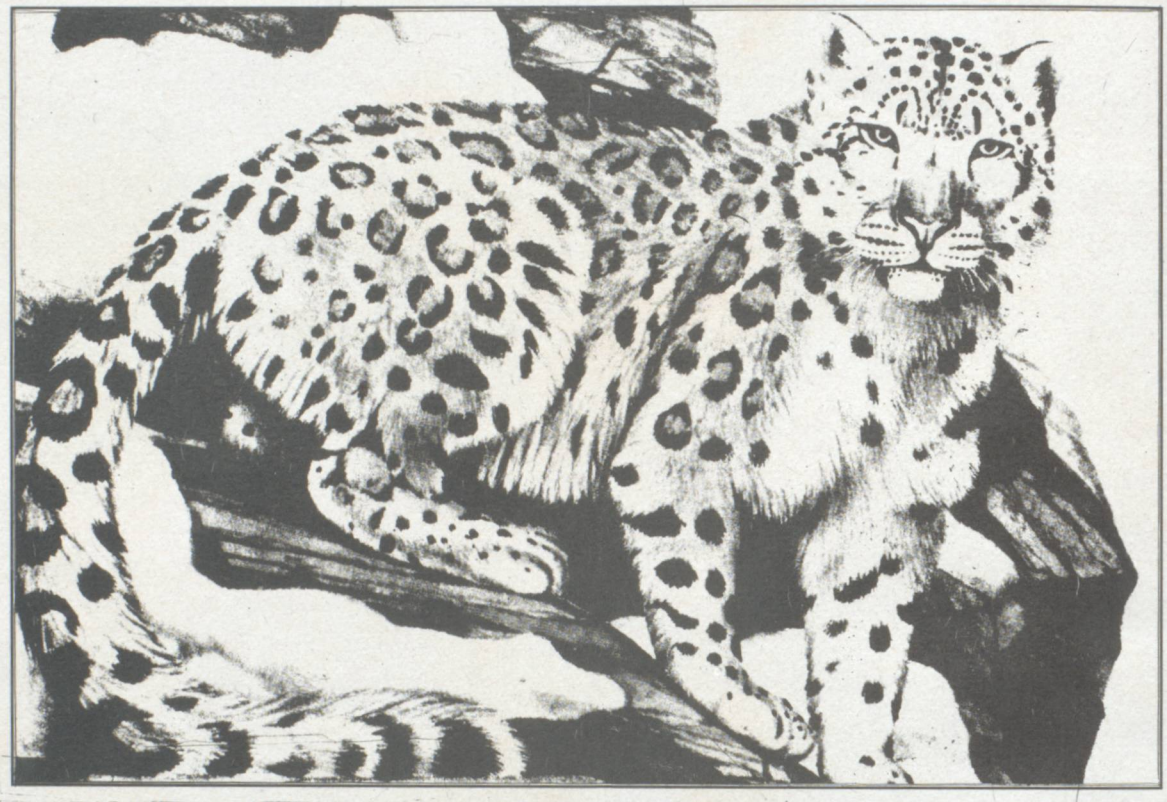
**IT WAS WINTER NOW.** I had watched the changes in the desert from the end of summer, through the brief beauty of the rains and now the land was dry once more. The little grazing that the rains had provided was over and many of the nomads whom I had got to know so well had left with their livestock. Those that had not were making preparations to do so. It was time for me to move on too, not without a pang of regret. My departure from the Thar was made easier by the knowledge that I would one day return. The walled city of Jaisalmer rising out of the desert behind me receded swiftly as the Jeep carried me across the desert. Soon it was gone, its magic but a memory as civilization reclaimed me. □

# NANDA DEVI

## An overview

Text and photographs by Dr. Girish Kumar

# NANDA DEVI



*In its brief history of 110 years, the Nanda Devi Biosphere Reserve has passed through three stages: exploration, exploitation and now conservation. It is presently one of only three declared biosphere reserves in the country and an area of inestimable wealth. Between 1981 and 1984, the author, together with Dr. P.C. Tak, worked on a project entitled* "Status Survey of Endangered and Threatened Species of Mammals and Birds at Nanda Devi National Park". *The author, who has also often trekked for pleasure to the fabled valley, offers us a bird's eye view of this Himalayan wonderland through brief sketches of its history, beauty and natural history.*

**BARELY FIFTY YEARS AGO,** no one had set foot into Nanda Devi's pristine, glacial confines. The local population, mostly Garhwali and Bhutia tribals, had long worshipped the mountain from afar. To these superstitious folk, the entire region is 'Dev Bhoomi', the home of Lord Shiva and his consort Parvati, and therefore inaccessible to man. In tribal mythology, individual mountains have specific functions. The Trisul peak is the abode of Lord Shiva, while Nanda Devi is the home of the Goddess Parvati. Devangan (the courtyard of the Gods), Devsthan (the seat of the Gods), Nanda Ghunti, Nanda Khat — each peak fulfils a special role in the abode of the Gods.

Year after year simple and hard-working tribal people, held *poojas* (prayers) and *yatras* (pilgrimages) to honor their Gods. And for centuries, their religious beliefs ensured that Nanda Devi remained undisturbed by human interference. The region's inaccessibility also ensured its isolation. A high enclosing mountain range, with icefalls and landslides, defied even the most intrepid adventurer. In 1883, W. Graham attempted an exploration of the region. He reached only as far as 'Trisul nallah' — the 'first door to the Lord's house'. Over the next fifty years, a number of expeditions tried to explore the area. Many lives were lost in attempting to open this region to 'civilisation'.

**THE YEAR 1934** is a landmark in the history of Nanda Devi. In this year, two brave Kenyans, Eric Shipton and Bill Tilman, came to India to explore what they called the 'Valley of the Lost Horizon'. By discovering a path along the Rishi Ganga river to the heart of Nanda Devi, they became the first to set foot in this most sacred of lands. The discovery of the passage, and the fascinating tales of

the Kenyan expedition, threw open the floodgates to Nanda Devi. Scores of mountaineers arrived from all over the world to test their skill and mettle on the scores of peaks in the area. Immediately after 1934, as many as 31 expeditions attempted to scale Nanda Devi alone! Trekkers converged on Nanda Devi to attempt the 'world's toughest trek'. Hordes of naturalists, wildlife enthusiasts, botanists and geologists also descended upon the area. Predictably, the increase in human traffic brought with it a host of problems. A fragile ecosystem, which had lain undisturbed for millions of years, was suddenly faced with an onslaught of humanity.

Mountaineering expeditions often include upto a hundred porters and many times that number of pack animals. Porters hack away at trees and brush for firewood while their goats place severe grazing pressure on the alpine meadows. Even a seemingly insignificant activity, such as climbers placing their feet on tree roots for support, has grave implications in this region. Pressure dislodges the soil and accentuates the effects of soil erosion — leading to landslides and avalanches. In spite of warnings, expeditions also leave behind tin cans and plastic wrappers, the indelible signs of human 'civilisation'.

Scientists were quick to realise the threat caused by the increased human presence in Nanda Devi. In 1939, the area was awarded the status of a sanctuary and controls on human movement applied. It was, however, almost another 50 years (1982) before the sanctuary was elevated to the status of a national park so that more rigid strictures could be enforced. Nevertheless, in 1982 alone, 22 expeditions — with 209 mountaineers, 1,050 porters and 2,500 pack animals — were recorded to have been in the park for months at a stretch! Two flocks, consisting of 4,000 goats and sheep also came from Himachal Pradesh for summer grazing in the pastures of Nanda Devi.

**IN NOVEMBER 1982,** the Government of India closed the park to all human activity save for research and administration for a period of five years. And today the area has been designated as a biosphere reserve, to allow for still more rigid monitoring and surveillance. If the Nanda Devi Biosphere Reserve is to be preserved for future generations, such moves will need to be supported and bolstered.

Located in the Garhwal Hima-

# NANDA DEVI

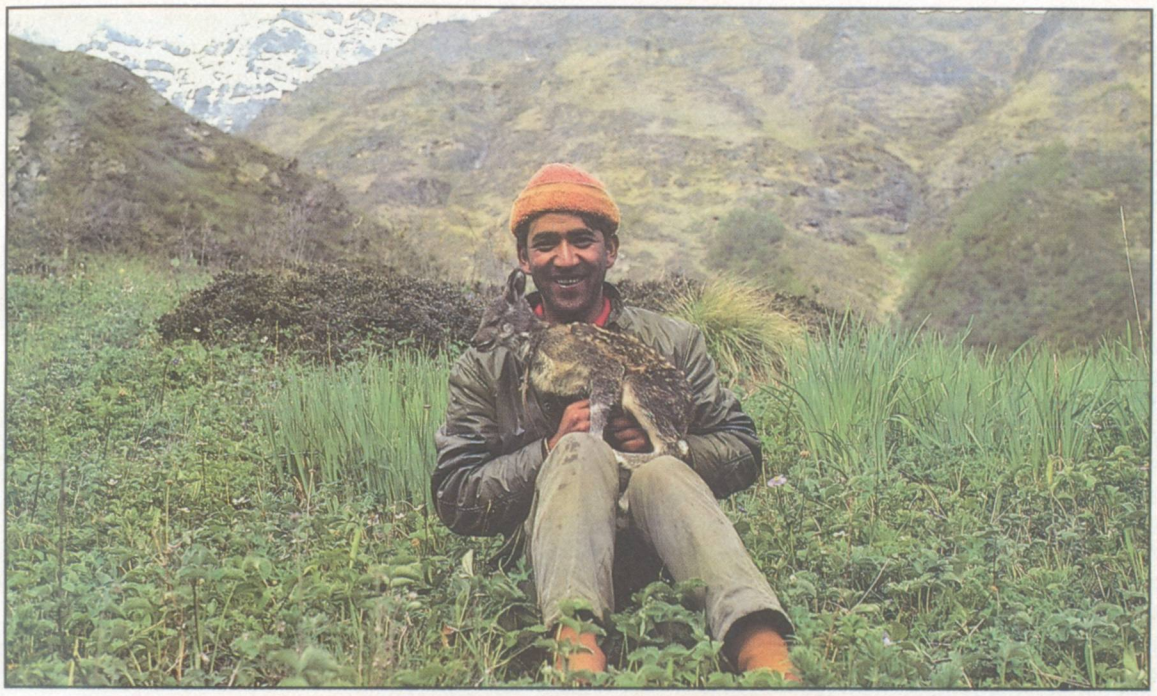
*Hanuman Peak as seen from Ranikholi. Until barely fifty years ago, no man had set foot into Nanda Devi's pristine, glacial confines. The local population have long worshipped the mountains from afar and their religious beliefs ensured that Nanda Devi remained undisturbed by human interference.*

laya, the Nanda Devi Biosphere Reserve lies in the upper watershed of the Alaknanda, the eastern arm of the Rishi Ganga. The original sanctuary area was 630 sq. km. In 1982, when it was upgraded to a National Park, it was expanded to 800 sq. km., with an inner core zone and an outer 'recreation zone'. When it was upgraded to a biosphere reserve, the area was increased to 2000 sq. km. The biosphere reserve lies between the coordinates of $30^0$ 17' and $30^0$ 41' N and $79^0$ 04' and $80^0$ 05' E. Altitudinal variations within the Biosphere Reserve range from 1500 m to 7817 m.

The boundary of the biosphere reserve passes through the Chamoli, Pithoragarh and Almora districts of the Garhwal-Kumaon Himalaya (see map). From the village of Reni, it runs northeast along the Dhauli Ganga to Malari. It then follows a tributary of the Girthi Ganga southeast to Unta Dhar and further southeast along a tributary of the Pindar to Mortoli. From Mortoli, the boundary stretches southwest along the Pindar, through the villages of Purkhia and Dwali, upto Khati. It then extends north along the Sunderdhunga Gad to Sunderdhunga from where it dips southwest to Sounder. From Sounder, it moves northwest to Rounti touching the villages of Dhak, Mulkhet, Baratoli Tribhuj, and Nanda Ghunti along the way. It then stretches northwest to Reni. Thus, while there is no human habitation inside the Nanda Devi National Park, 16 villages fall inside the biosphere reserve.

**TO GET TO NANDA DEVI,** we travel 530 km. from Delhi on the Niti National Highway. We pass Rishikesh, Joshimath and Tapovan before approaching Lata, the last outpost. The park itself is a cup-shaped valley surrounded by 70 lofty peaks. From the outside, we see only icy walls and corniced ridges. Lata and Reni are the final frontiers along our route. From either of these, it is a 10-day trek to the inner sanctuary.

There are two entry points into the core area. They are accessible only for four months of the year, from June to September, as they are snow-bound for the rest of the year. The older entry point, near Reni, is at the confluence of the Rishi Ganga and the Dhauli Ganga. This is the easier route, since it passes through lower altitudes. However, the swift Rishi Ganga and falling stones make it a risky trek. The newer entry point, near



*This musk deer fawn found near Dibrughata, was sent by the Forest Department to the breeding farm at Khechuli Kharak in the Kedarnath Sanctuary. In the wild, animals like the musk deer are highly threatened and will, therefore, benefit greatly from habitat protection.*

Lata, is a tougher trek, passing at higher altitudes. Eventually, both routes converge at Dibrugheta.

A high ridge with snowbound peaks forms a natural boundary between the core and the recreation zones. Devisthan I, II, III (6,678, 6,529, 5,977 m respectively), Rishikot (6,240 m), Kalanka (6,931 m), and Changabang (6,864 m) are some of the peaks in this ridge. The Rishi Ganga flows through the centre of the park. Within the core zone lie Maiktoli (6,805 m), Nanda Khat (6,568 m), Lata Dhura (6,392 m), Sangram (6,568 m), Nanda Devi East (7,434 m) and, of course, Nanda Devi West which, at 7,817 m, is the highest peak in the Garhwal-Kumaon Himalaya and the third highest in India.

The core area remains under a thick carpet of snow for six to eight months of the year. One needs tremendous physical strength and endurance to reach the inner sanctuary. Falling rocks, overhanging ledges, raging torrents and bottomless crevasses pose grave dangers even to experienced climbers. This is one of those regions of the world where, after successful climbs, mountaineers often invite death by carelessness and overconfidence on the way *back* to the road-head. I too have had a number of narrow escapes at Nanda Devi.

**A GLACIER SYSTEM** dominates the entire Nanda Devi region. In the north it comprises of the Ramani, Changabang and North Rishi glaciers. In the south, it includes the Nanda Ghunti, Roti, Betartoli, Trisul, south Rishi and Nanda Devi glaciers. This glacier system is the perennial source of the Rishi Ganga. The north Rishi and the south Rishi rivulets flow from their respective glaciers along Nanda Devi's precipitous cliffs. A short distance below their confluence, the Rishi Ganga flows into a stupendous upper gorge, cutting at right angles across the Devistan-Rishikot ridge. On clearing the upper gorge, it receives the Ramani stream. Further down, the Trisul torrent joins the Rishi Ganga from the south, draining the extensive basins of Trisul and Bethartoli glaciers. After receiving a number of torrents from both sides, the Rishi Ganga finally enters the lower gorge guarded by overhanging cliffs, to merge with the Dhauliganga near the village of Reni.

The Rishi Ganga itself, through the Dhauli Ganga, and major rivers like the Pindar, Nandakini and

Birahi Ganga, forms an important part of the Alaknanda watershed. Ultimately, it joins the Bhagirathi to form the Ganga, the waters of which govern the destinies of millions of Indians living in the Indo-Gangetic plain.

**THE CLIMATE** of the Nanda Devi basin is unique as it is situated at a point where the Himalayan chain deflects from its south-eastern direction, to head due east. Its alignment with other mountains causes updrafts of warm, moisture-laden air to release relatively high precipitation. Inflow of warm air from gorges results in the formation of dense mists over the higher meadows and heavy clouds often blanket the numerous ridges and peaks. Clouds accumulate in the valley every night creating the impression of a river of clouds in the morning.

Nanda Devi's exceptional configuration has, in fact, resulted in the creation of a sub-climate all its own. The snow is thicker and stays longer on slopes that face away from the direct rays of the sun. Thus the southern part of the basin takes longer to thaw than the northern region.

The flora and fauna of the reserve requires considerable more study. Harsh environments allow only very limited life forms to survive. However, once they find a niche, the lack of competition enables plants, insects, birds, reptiles and mammals to exist in a state of equilibrium almost indefinitely. Till fairly recently, the web of life of Nanda Devi's basin had remained virtually unaltered for millions of years. Even now, each summer brings new life to the mountains as plants and insects thrive, in turn sustaining the larger life forms. The region today is possibly the last remnant of the extensive Himalayan pastures that had existed before the advent of man.

Information compiled from the Forest Department of Uttar Pradesh, the Botanical Survey of India and expedition reports, reveal that 341 species of trees, 552 species of herbs and shrubs, and 18 species of grasses can be found in the reserve. More than 200 species of plants, eight species of Pteridophytes, five species of Gymnosperms and 188 species of Angiosperms grow in the core area of the Reserve. Of these, about 15 species are rare and endangered. One, a *Sisoria* species known as 'Brahm Kamal', has special religious value. It is offered in temples and as 'Maha Prasad' to pilgrims at the Kedarnath and Badrinath temples. The area also abounds in medicinal plants and edible mushrooms. Villagers collect the mushrooms, called *Gucchis* in local parlance, to supplement their incomes. *Gucchis* sell for about Rs. 600 per kg. as they are considered a delicacy in Europe.

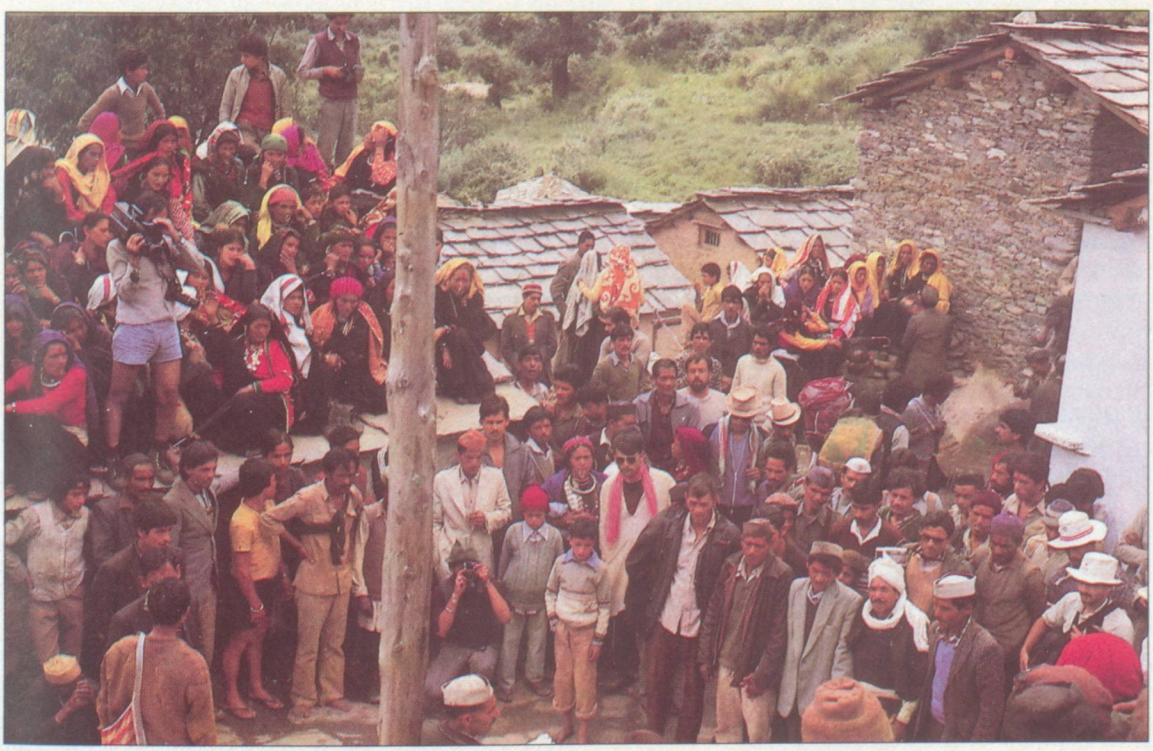
Pine, deodar, fir, bhojpatra, oak and rhododendron are dominant species at lower altitudes. In the core area of the Biosphere Reserve, oak and pine stands near the village of Lata rapidly give way to deodar and fir. At higher altitudes, near base camps, we commonly find rhododendron and fir. The ground species of fir yield very good firewood and are frequently used by porters, shepherds and mountaineers to light camp fires.

The faunal life of Nanda Devi, bird and animal, is rich. Approximately 86 species of mammals, 534 birds and 45 species of reptiles and amphibians have been recorded in the Reserve which also teems with insect life. These life forms exhibit adaptations to high altitude, cold, aridity, isolation, radiation and snow. Their bodies are usually covered with either fur or feathers and are coloured to protect them from the intense radiation found at higher altitudes.

During our study period in the early eighties, we organized six expeditions totalling 171 days. We observed fifteen species of mammals of which eight were on the endangered list. We also recorded 80 species of birds, six of which were on the endangered list. As yet, there is no published record of the invertebrate fauna, fish, amphibians or reptiles of the region.

**MAMMALIAN LIFE**, however, is comparatively better studied. Bharal, *Pseudois nayaur*, or the Himalayan blue sheep, are the most conspicuous large mammals in the inner sanctuary. They inhabit areas between the tree and the snow lines. It is common to see bharal in the upper Rishi gorge and at the Tala and Trisul base camps. Bharal subsist on grass and tend to browse less than goats. The herd size usually consists of 30 to 60 animals. Bharal have an amazing capacity to traverse near-impossible terrain. Occasionally, the Nanda Devi herds move out to mingle with bharal that live outside the mountain barrier. Bharal are an endangered species due to large scale hunting for their hide and meat. Himalayan tahr, *Hemitragus jemlahicus*, sometimes graze alongside the bharal. Tahr have distinctive horns and sport shaggy hair all over their bodies. On the back and shoulders this hair grows in a mane that sometimes hangs down to the knees. Tahr inhabit rocky, inaccessible terrain, preferring altitudes between 3,000 and 4,000 metres.

*Shepherds and their flocks: increased human presence in the reserve threatens a fragile ecosystem, which had lain undisturbed for millions of years.*



*The Nanda Devi Raj-Jat mela in progress at Van village: the buffer zone of the reserve is famous for its pilgrimages which are characterised by prayers, music and dance.*

Males generally graze after sundown, though females may sometimes be seen in clearings during the day. Males indulge in violent combat over females. Bodies of tahr are sometimes seen at the bottoms of cliffs where both 'gladiators' have fallen to their deaths. Stones dislodged by tahr can sometimes pose a hazard to climbers and trekkers on lower slopes. The Goral, *Nemorhaedus goral*, is a goat antelope, stockily built, with coarse hair forming a small crest on the neck. Goral mix freely with the larger sheep, though they are more skittish than the latter. They browse off the dwarf rhododendron. When alarmed, goral make a hissing sound, an alarm that is quickly picked up and repeated by other members of the herd. All three, bharal, tahr and the goral are particularly affected by the presence of domesticated goat and sheep within the Reserve, since they compete directly for the alpine pastureland. Musk deer, *Moschus moschiferus*, are shy, diminutive creatures that prefer to stay in the birch forests above the pine zones. They are prized for their musk, secreted by a gland found under the abdominal skin of the males. Poaching has driven the musk deer to the very brink of extinction. The absence of horns on musk deer seems to be compensated for by the unique development of their canine teeth, particularly in males. The long pointed central hooves and large lateral hooves of the deer allow them a strong foothold on snowy and icy slopes. Their diet comprises mainly of grass, lichens, leaves and flowers. We observed female musk deer with fawns near Dibrugheta, Deodi and Ramani. Our porters once captured a fawn near Dibrugheta. The Forest Department required the fawn for its breeding farm at Khechuli Kharak in the Kedarnath Sanctuary.

**THE SNOW LEOPARD,** *Panthera uncia*, is the dominant carnivore in Nanda Devi. Though its droppings are often seen, the leopard itself is difficult to spot because of its nocturnal habits and its preference for inaccessible terrain. A glimpse of the cat is therefore a rare privilege. Indirect observations, such as pugmarks and droppings indicate its presence in a given area. Brown bears, *Ursus arctos*, are sometimes found in open areas above the tree line. Soon after their winter hibernation they can be seen following the melting snow line. The bear is endangered as it has been indiscriminately hunted for its fur. Himalayan black bear, *Selenarctos thibetanus*, can be observed in the outer sanctuary or the recreation zone. We saw plenty of indirect evidence of their presence, including droppings, pugmarks and diggings, between the Lata and the Deodi camp sites. Besides these threatened species, the Himalayan mouse hare and the yellowbellied weasel are common near camp sites.

The birds of Nanda Devi have been little studied on location, but fairly thorough bird counts have been conducted over the years. Pheasants, among the most spectacular of all life forms, are shy and difficult to spot but one often hears the call of the koklas pheasant, *Ceriornis macrolophus*, in the reserve. We flushed out Koklas pheasants near the Betla Khark area and the forested valleys of the Park. These medium-tailed pheasants sport metallic green tufts on their heads which, together with their white cheek patches, make them fairly easy to identify in the field. The Himalayan Monal pheasant or Impeyan, *Lophophorus impejanus*, is a common bird of the higher Himalayas, frequenting altitudes between 2,600 and 4,000 metres. It is the state bird of Himachal Pradesh and arguably the most beautiful of all Indian birds. We saw flocks of upto 14 birds in the core and the buffer zones. The Impeyan is a prized target for hunters because of its delicious meat and the beautiful crest of the male bird which can fetch upto Rs. 90/- in the open

## THE FLORA OF NANDA DEVI

The vegetation of the core area can be broadly classified into three categories: I. **Sub Alpine Forests:** which comprise three canopies — upper, middle and lower. The upper canopy is formed of *Abies pindrow, A. spectabilis, Pinus* sp., rhododendron, *betula*, oak, and deodar. The middle canopy consists of smaller trees and shrubs like wild rose, *Viburnum* and *Jasmium*. The lower canopy or ground cover is composed of a tangle of herbs and grasses. We noticed this type of vegetation in the lower Rishi gorge upto an altitude of 3,000 m.

II. **Moist Alpine Scrub Forests:** consist of pure stands of betula and rhododendron.

III. **Alpine Meadows:** are composed of numerous shrubs including rhododendron anthopogon, juniper, Salix species, medicinal herbs and grasses.

market. The Western tragopan (Tragopan melanocephalus) is another beautiful pheasant seriously threatened because of excessive hunting. It is confined to the lower limits of the Dharansi area. We, however, never had an opportunity to see or hear the bird. The Himalayan golden eagle, *Aquila chrysaetos*, is found throughout the park, at altitudes between 1,850 and 5,500 metres. It soars over the mountains, preying on smaller mammals and reptiles. We observed it twice, near Lata Kharak and Dharansi. The lammergeir or Himalayan bearded vulture, *Gypaetus barbatus,* is common all through the Himalayas. It prefers altitudes between 385 and 7500 m and is common throughout the park. The Himalayan snowcock, *Tetraogallus himalayensis*, frequent altitudes between 3,800 and 5,000 m. We observed flocks of six to 22 birds near the Ramani Bhujgara and Patalkhan areas of the core zone. Their presence can be noticed by their peculiar cackling sound. This species is also threatened due to large scale hunting for its meat.

**TOURISM IN NANDA DEVI** offers multifold opportunities, but can pose serious problems if not properly controlled. Mountaineers thrive on the challenges posed by the seventy peaks, some of them as yet unnamed. The steep slopes are ideal for skiing down after a gruelling climb. Permission for Nanda Devi expeditions is much sought after by climbing teams, who have to 'book' the mountain years in advance. The Reserve also attracts trekkers from all over the world, who come here to the challenge of what is said to be the world's most difficult trek. Botanists, geologists, zoologists and all lovers of nature are also attracted to the reserve, spellbound by the beauty of its alpine meadows and high altitude lakes.

A unique attraction is the mysterious lake at Roop Kund, where hundreds of human skeletons can be seen below the frozen lake surface. Carbon dating shows these skeletons to be more than 600 years old. Theories on their origins differ. Some claim that they belong to Jorawar Singh's army, trapped in an attempt to cross over from Tibet. Others say that they belong to pilgrims making the Raj-Jat yatra. Tourists come from all over the world to observe the spectacle. Pilgrimage tourism is also very popular. The buffer zone of the Reserve is famous for its *yatras*. Late summer brings the Nanda Devi Raj Yatra which begins at Karur and ends at Badini Bugyal. Every 18 years, there is also the Nanda Devi Raj-Jat Yatra, which starts from Nauti village in the Chamoli district, and culminates at Home Kund, near the base of the Nanda Ghunti peak. This *yatra,* along the mythological route taken by the Goddess Nanda from her mother's home to that of her husband, is famous for its religious significance and peculiar customs.

The last Raj-Jat yatra was held in August 1986. I was fortunate to be in the area at the time, working with a team of scientists on a Natural Resource Data Management System (NRDMS) project, under the able guidance of Dr. D. Pal. The *yatra* began at Nauti on the August 18, however, joined it at Dewal eight days later. The yatra was led by four horned sheep, called *khadu,* who are said to represent the Goddess. The *khadu,* gaily decorated with bangles, ribbons and jewellery, wound their way through rugged terrain stopping at a number of villages on the way. Thousands of pilgrims, many of them barefoot, followed the *khadu*. At every village, the locals organized a *mela* with prayers, music and dance. We passed through Loha Jank, Van, Badini Bugyal, Patal Nachauni, Roop Kund, Jorawar Gali and Shila Samundar before arriving at Home Kund. Here a final *pooja* was performed, before the *khadu* were released.

**PROBLEMS BESET** the Nanda Devi Biosphere Reserve due to inadequate management. Forest Department personnel are no match for determined and well-equipped poachers. And the rugged terrain and insufficient data only compound the problem of poaching. The reserve desperately needs a well-trained security force. Preference should be given to local people, Army personnel, and committed members of the Indo-Tibetan Police. Recruits should be well — paid to diminish the temptation of colluding with poachers.

Regular scientific studies must be carried out to guide the administrative staff and to increase our knowledge of the area. For this purpose, the Forest Department of Uttar Pradesh requires its own scientific staff and infrastructure. The current laws governing the Reserve are often inadequate or ill enforced. Rules must be modified to serve changing needs. Once suitable rules are in place, they must be strictly enforced, with physical and monetary punishment for violation.

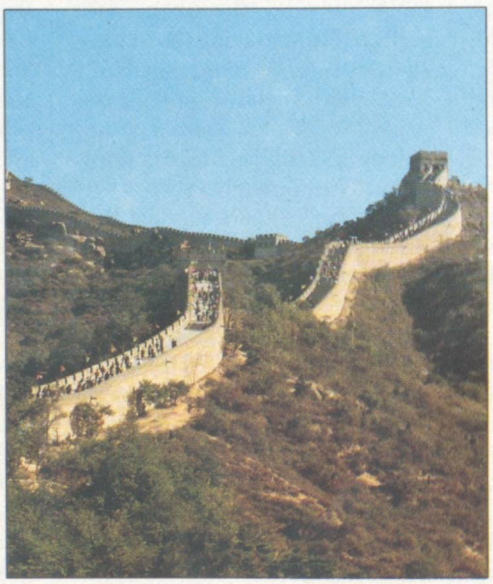
It is my firm belief that these steps will restore the Nanda Devi Biosphere Reserve to its pristine glory and preserve it for posterity.

# CHINA

## Land of the threatened dragon

**Text and photographs by Ramya Sarma**

*Referred to in Mandarin as* ***Chung Hua Jen Min Kung Ho Kuo*** *(central glorious people's united country i.e People's Republic) China's ancient culture places this exalted land in the firmament of great nations.* ***Ramya Sarma*** *travelled to China — named after the Ch'in dynasty which ruled from 221 to 207 B.C — and took a close look at its people, culture and land. What emerged was an environmental assessment which has great bearing on India. In both countries, for instance, ancient wisdom has been abandoned in favour of a more aggressive 'dominate nature' syndrome. And both nations now suffer the consequences of such folly — floods, droughts, pollution and rampant disease. Yet, in the cradle of both civilisations lie time-tested solutions to self-inflicted environmental traumas. What remains to be seen, however, is whether the light of history will deliver their people from the darkness of environmental doom in time. Read on to discover a face of China that few travel brochures are ever likely to highlight.*



*The Great Wall was built to protect the Chinese from marauders.*

**CHINA. MORE THAN A COUNTRY** — a culture, a civilization, a way of life, evolved over five thousand years of recorded history. Long before that, *Sinanthropus pekingensis*, a protohuman, lived in the mists of prehistory in the rugged caves of Choukoutien, near what we now known as Beijing. Modern man made his appearance much later, in the deserts of China's Ordos region, about 20,000 years ago. China, however, is probably best known the world over for its 2,400 km long Great Wall, built to protect its inhabitants from northern 'barbarians'. China has always fascinated the world. The Ming dynasty, the legendary wisdom of Confucius, the ancient cult of Taoism and the famous giant panda are all household words in New York, Bombay, or Moscow. Some archaeologists even suggest that ancient Chinese civilisations show a marked resemblance to those of Mesopotamia! Interestingly, India has played a vital role in the evolution of Chinese culture by freely exporting its advances in medicine, mathematics, astronomy, architecture and even Buddhism to China.

Since the 2nd millennium B.C., nevertheless, China has enjoyed a unique and virtually uniform culture which has withstood all manner of invasions and revolutions to become what it is today, one of the world's most ancient, least understood, civilisations. As with all great civilisations, China too was built on the bedrock of abundant natural wealth.

**VAST, WITH A 3,800,000 SQ MILE LANDMASS,** larger than the United States and a quarter as huge again, as Australia, this gigantic nation is home to over a billion people. Unevenly distributed, the Chinese have colonised the rich flatlands in the east and along the southern coasts; sprawled across the great valleys of the Huanghe (Yellow), Changiang (Yangtse) and Pearl Rivers; settled by the millions in huge industrial cities and converged — one hundred million souls — in the rice-bowl basin of inner Sichuan. Elsewhere they are scattered lightly.

The Steppes of Mongolia and Xinjiang are thinly peopled by Kazakh, Uigur and Turkic tribesmen and the decendants of Ghengiz Khan. The ice plateau of Tibet, a land of soaring peaks, precipitous caverns and frigid highland plains has fewer than two million people. In the jumbled mountains of the southwest, a chaos of races live in steep river valleys, each largely unconcerned with the press of life outside their own austere habitat.

**THROUGH ITS LONG AND TURBULENT** history, China's fabled wealth, most of it created by the endless toil of its peasants, has been a magnet for plunderers, adventurers and invaders of all descriptions. Nature, likewise, while gifting the Chinese people with the plenty of its larder, has frequently taken a savage toll — with droughts and floods, earthquakes landslides, tidal waves and typhoons, conspiring to decimate carefully nurtured crops, herds and homes. As in so many parts of the world, in China too forests have been felled in pursuit of elusive 'development'. With little to protect slopes, or staunch the rain, once benign rivers turned into raging torrents. To make matters worse, attracted by the silt deposited by floods, people chose to settle in the flood plains. Not for nothing, therefore, has Huanghe River come to be known as "China's Sorrow". In the past its floods have beggared whole provinces, destroyed crops over enormous areas and sentenced untold millions to death by famine. Today, of course, the growth of China's huge population has put still greater strain on tried and tested, ancient agricultural practices. Which is why intensive farming practices have become the norm. Other changes too have overtaken China. Economic and intellectual reorganisation of communist attitudes in recent years, for instance, has seen the government encouraging China's 800 million peasants to grow and sell their own crops, privately, after meeting state quotas. The Yangtse Delta has thus become a showcase for China's new 'responsibility system' of agriculture, which has made a good portion of the country's peasants amongst the most highly paid members of the economy. (A radical modification of the communistic system of the 1950's, the new scheme encourages individual initiative by linking remuneration with output. While individual households are responsible for managing their tiny contracted plots, the state still owns the land.)

**THE SYSTEM SEEMS TO HAVE WORKED.** That over a billion people in China enjoy a healthy satisfying, substantial diet, with no rationing of basic foodstuff, is widely regarded as the single most vital achievement of the government in Beijing. This is in direct contrast with China's neighbour to the north, where even before the breakup of the USSR acute food shortages and serpentine queues were a common sight on most city streets.


*The giant panda, which once roamed the whole of southern China has become an international symbol for conservation.*

This is not to say that all is well in Communist China today. Centuries of cultivation along fertile river valleys and corresponding degradation of the natural forest cover have led to serious degradation of natural habitats. This is without doubt a major cause of the devastating floods that ravage China with depressing regularity today. Ironically, the Chinese began designing complicated irrigation schemes by harnessing the might of their rivers over two thousand years ago! The systems worked admirably in the early days, when the technology to denude the land was missing. With passing centuries increasing human interference caused the disappearance of forest lands. And with the forests went the reliability of the hydrological systems

which had long powered Chinese agriculture. Many Chinese ecologists now realise that the spread of marginal cultivation, in the proximity of natural habitats, is the single most consequential factor contributing to the genesis of new deserts both north and south of the Great Wall. Belatedly, therefore, after first destroying their rich earth, in the north the Chinese are engaged in a massive tree-planting programme. A *Great Green Wall* which extends *4,000 miles* from east to west, is one brave attempt at checking the relentless onslaught of the sands of the Gobi desert.

**IF ONLY SUCH SOLUTIONS COULD** restore China to the position it once enjoyed in the lap of natural plenty. Ecological problems, however, have and continue to be compounded by the unsupportable demands of modern industry and farming practices. Unchecked pollution of its waterways, soils and atmosphere now threaten to turn China into an environmental Hades.

It's a familiar story. The peasant or small farmer demands little of his environment. He takes from it only just what he needs. Instead of depleting his store of natural resources beyond recuperative levels he, in fact, renews them, utilising age old methods of crop-rotation and organic cultivation. The downslide begins when the demands of industry and the headlong rush towards modern farming take precedence over priorities which balance lifestyles and environments.

Industries, for instance, need fuel. In areas where wood is abundant, it is now the first choice for factories. Trees are cut, first perhaps carefully then, as demands accelerate, arbitrarily. The mountains lose their protective flak-jacket of foliage. Soil, no longer anchored by roots and exposed to the elements, is swept away by sharp winds and dragged downhill by rainwater or streams. One obvious example is visible along the course of the Yangtze (Changjiang) River, particularly in the Three Gorges section. Here the land slopes steeply, sometimes even vertically into the mud-brown water. The region is prone to crippling floods, as was experienced by the Chinese people during the monsoons of 1991. A permanent high-water mark lines the gorges of the Daning River, a tributary of the Yangtze. In search of fragile sustenance, a smattering of villages and towns are scattered across precipitous hillsides, some in places that have no evident access. Fields terraced in high, narrow steps, climbing upwards over seemingly impossible slopes. Occasionally a farmer can be seen, carefully tending his tiny plot high above the river. Lush green masks the rocks in late summer, covering scars of landslides or erosion gullies with a layer of paler vegetation.

That man has orchestrated his own scenario of destruction in the region is obvious. Around the more extensively industrial towns — Wuhan and Yichang, for example — the gentle hills have bald tops, their tree cover stripped for wood. Further up the river's course, particularly near small towns like Shuanglong, the lower slopes have been denuded, the upper reaches presumably being too steep and too high to be easily reached. Up north in the Shanxi Province, severe erosion has carved the Loess Plateau into bizarre dunes. Several million tons of yellow soil wash into the Huanghe (Yellow) River, giving it its name and causing serious flooding and siltation. Each year an average of 1.6 *billion* tonnes of top-soil is carried down into the water and three quarters of this filters into the Yellow Sea. The remainder accumulates on the river bed causing it to rise continuously — between three and 15 metres above the surrounding flatlands. The river is contained by dykes built higher each year. These dykes are breached with devastating regularity, causing ruinous floods with every heavy monsoon.

**APART FROM THE FORESTS,** the land itself has purposefully been torn apart by mining operations. Coal dust deltas slip down dirty black hillsides and shale and rock debris crush the fresh green luxuriance of the hills. Not far from the city of Yichang — which seemed to prosper greatly after the Yangtze dam (Gezhouba Project) was built, factories now belch smoke into the atmosphere and spew effluents into the already turbid waters of the once pure river. Following the dictates of political ambition and power Chinese leaders are on the verge of constructing yet another gigantic series of dams in the Three Gorges stretch of the river, near Yichang. These will displace over 1.4 million people and submerge an area of great cultural and historical importance. Even ancient Chinese paintings have immortalised the Three Gorges, which are currently a tourist attraction of international repute. Environmentalists and social activists, both in China and around the world, are understandably vociferous in their opposition to this ill-fated project; however, like the Indian government and the Narmada Project, the Chinese too show little sign of being deterred from their luckless path.

The cost of such projects are difficult to quantify in economic terms. Apart from the human misery, for instance, the Gezhouba dam resulted in at least one

catastrophe which has been extensively publicised. With the damming of the Yangtze River, the Chinese sturgeon, which (like salmon) goes upstream to spawn, disappeared. After extensive exploration a few specimens were caught alive and transported to a research institute at Yichang. The fish are now the focus of an intensive captive breeding program involving artificially induced fertilization techniques in growth-enhancing conditions. Young fish at various stages of development have since been released in the river but there are no fish gates, allowing the fish access to the spawning grounds upstream. Still, official reports suggest that the project is a success. Meanwhile, these are, at best, hit or miss measures for very severe problems created by gross habitat distortions.

**CLEARLY THE TOLL IS GOING TO MOUNT.** In the late 1980s, avalanches of rock were frequent and sides of entire hillsides began to collapse as heavy rains beat down on exposed land. These wiped out a great many villages along the upper Yangtze. Today, with the irrepressible resilience so typical of the Chinese, the people have rebuilt towns, re-started factories and re-dug mines. But all this renewed activity is merely metres away from the gashes and scrapes gouged by nature only very recently. The thin layer of new plants which have covered the tell tale signs of disaster belie the possibility of yet another catastrophe waiting in the wings.

Through the length and breadth of China, the signs of environmental neglect, and its handmaiden, human misery, abound. A traveller who hop-steps from city to Chinese city would be confronted with the depressing effects of people wilting under the brunt of dirt and disease. Wuhan, a city about the size of Bangalore located on the Yangtze in the province of Hubei, for instance, is steeped in Chinese history and culture. The Wuhan Iron and Steel Complex sited here began operations in 1958 and has been expanding steadily since with foreign collaboration. Close by is the Daye Iron Mine, which extracts ore from the surrounding hills. As a result of the mining activity a light fog permanently blankets the areas around the factories and industrial units. Past evidence of civilization is grossly overshadowed now by chimneys, ugly factory blocks and smog. Predictably, respiratory problems have spread through the three smaller cities of Hankow, Hanyang and Wuchang that make up Wunan.

Elsewhere too, the environment continues to be assaulted. In Shanxi province to the northwest, in the city of Xi'an, pollution is the order of the day. Here history has become a victim of misguided development. Ancient monuments — like the terracotta army of the first Qin emperor and the Qin dynasty royal tombs — are being badly corroded, their frescoes eaten away by chemicals in the humid air. Once clean narrow streets are now perilous passageways thanks to the irrational disposal of wastes, both human and animal.

**IT WOULD BE WRONG TO SAY,** however, that environmental awareness is not making its mark in China. Under the glare of international publicity, Beijing, for instance now enjoys a much more strictly controlled and enforced environmental protection system than most other cities. Protection starts with rigid zoning laws that keep the centre of the sprawling city green and esthetically harmonious. No high buildings can be seen here as localities present a practical, modern version of the traditional *feng-shui* which had an strong underlying respect for the environment. Industry is regulated and kept at a distance outside the main ring roads. Factories must conform to strictly controlled emission standards. Another example is the ever-expanding city of Shanghai, made famous by stories of its beautiful women, ganglords and opium dens. Shanghai is China's largest industrial metropolis. To the east lies Pudong, notified as the 15th Economic Development Zone, a region that is expected to ease the city's population problem. Environment-consciousness has partially permeated its development and planners suggest that the future Pudong will actually be an integrated economic zone with financial, commercial, real estate, cultural, port, telecommunications and airport facilities. While culture works hard to keep ancient traditions alive through museums, art and painting, a major clean-up of Shanghai's older industries is in progress. This jas sstarted with stringent new regulations for factory construction, operations and emissions and will cover both existing and planned units.

Guangzhou (or Canton) has recently discovered the hazards of noise pollution. The main reason for this problem is the high proportion of vehicles to roads — the district sports only 900 kms. of road and over 200,000 motor vehicles. Innumerable buses, taxis and motorcycles add to the din. The fact that two million bicycles are still the prime means of transportation, however, has probably done more to preserve the city's environment than any government clean-up measures. Old, narrow streets unsuited to so much traffic lead to snarls, despite the construction of 40 or so newish bridges and underpasses.

*The Yangtse (Changjiang) River is also known as 'China's Sorrow' because of its propensity to burst its banks, thus causing floods that ravage the countryside.*

**NOISE LEVELS ARE UNBEARABLE.** The city's Baiyun Airport, the busiest in China, exacerbates the problem with approximately 150 planes taking off and landing each day. In addition to the noise, citizens are plagued with a high density of population, frequent power cuts due to overloading and the discharge of 400 million tonnes of waste into waterways every year. Measures are now being taken to solve the problem. In consultation with municipal leaders, new subways, freeways, gas lines and apartments are being constructed, while waste management and recycling projects are being planned.

Environment awareness is also being worked on at the more academic level, a major indication of the fact that China does acknowledge its pollution problems even though they are not highly publicised. Most reports of studies done, published in the *Chinese Journal of Environmental Science*, have emerged over the past two years. Subjects like acid rain, garbage leaching, liquor, biotoxicity, noise, insecticide residues, traffic emissions, thermal balance, the greenhouse effect and chemical effluents promise to become matters of grave concern in modern China. Though not much talked about, radiation pollution is

## THE GIANT PANDA, *Ailuropoda melanoleuca.*

A magnificent animal and the object of worldwide affection and admiration, the giant panda is known in China as *bei-shung,* or white bear. (Some also call it Pere David's bear, or the bamboo bear.) The animal once roamed the whole of southern China, but can only be found today in the mountains of western Szechwan, the east Tibetan plateau and eastern Sinkiang. No one can positively confirm how many giant pandas are left alive today, but scientists estimate that the figure cannot be more than a few hundred. This despite the fact that the Chinese government had extended protection to the panda as far back as 1939, declaring its forests as a nature reserve.

Records from ancient China confirm the giant panda's presence in art and history for at least 4,000 years, but the Western world only discovered its presence in 1869 when the French Jesuit naturalist, Pere David described the plantigrade mammal — so called because it walks on the soles of its feet like other bears — from two skins in the possession of hunters on the Mu-ping mountain. It was a full 47 years later that J.H. Edgar, a missionary, saw a live giant panda asleep under an oak tree in the upper reaches of the Yangtse valley. Moving easily between altitudes of 2,500 and 4,000 metres

The giant panda's survival is intimately linked with that of its chosen bamboo forests. Unlike most bears, it does not hibernate in winter, having adapted itself to the extreme cold and having found ways to obtain food, sometimes by climbing tall trees, despite the thick snow cover. The pandas is essentially solitary. It will hole up in a cave or hollow in the ground beneath a rocky overhang after carefully lining it with bamboo leaves and stalks.

A female will give birth to one, very rarely, two cubs. Young ones are born tiny, a mere 450 gms., after a gestation period of five months, but grow to a massive bulk of 135 kgs and to an adult height of around 1.8 metres. Despite this bulk, however, the adult giant panda is extremely agile and will successfully hunt birds, rodents and fish. Its preferred food, of course, remains the fibrous bamboo shoots which grow profusely in the jungle. Equipped with the long morals, commonly found in carnivores, the panda also sports small pads under each forepaw which act as thumbs to help the animal grasp bamboo shoots while it chews them to a pulp.

No one can accurately predict whether or not pandas are making a recovery in the wild today. It is clear, however, that their natural enemies, wild dogs and leopards, are unlikely to wipe them out. The real danger comes from pressure on the fringes of its jungle habitat. If future generations of Chinese are unable to extend the strictest protection to this breathtakingly beautiful beast, it may well join the dodo and several hundred other equally magnificent animals into extinction.

# NATURAL CHINA -- an overview

China boasts of 2,091 species, 714 genera, 156 families of wildlife. More than 100 of these species are exclusive to China. Prime among these are the red-crowned crane, eared pheasant, takin, giant panda, whitelipped deer and Chinese alligator. Mink, marten, sable and fox are commercially sought after by the fur trade, and are to be found in the north and northeast. Rodents, birds and fish are prolific. In the geographical heartland of China is the huge natural bowl of Sichuan. The highlands to the west are shrouded in the diffuse light of cloud and mist. This ancient habitat, ranging from sub-tropical valleys to alpine upper meadows, is the home of the giant panda, (see page ...) and the golden snub-nosed monkey, *Pygathrix rhinopithicus roxellanae*. It is the lower slopes of these mountains that are covered with the magnificent towering forests of bamboo which are the mainstay of the giant panda. The large black and white animals are well loved, totally protected and the local residents of Sichuan often go to their aid when their delicate staple diet is threatened. The lesser panda, *Ailurus fulgens*, a mild mannered, nocturnal creature with characteristic raccoon-like features, is also found in the high altitude bamboo forests of western China.

Several species of pheasants are found in the mountain forests and meadows of the Sichuan region. The koklass, *Pucasia macrolopha*, a medium sized pheasant found on steep wooded slopes, ranges throughout the Himalayas from Afghanistan to Central China. The monal, *Lophophorus ihuisy*, now rare, is limited to mountains meadows in the Sichuan where it roosts in scrub rhododendrons. The tragopan *T. temmincki*, is an arboreal pheasant found only in west China. The Lady Amherst's pheasant, *Chrysolpphus Amherstiae*, a gorgeously plumed and ruffled species is now more common in captivity than in the wild.

The four seas flanking mainland China , (the Bohai Sea, the Yellow Sea, the East and West China Seas) are home to five species of sea turtles, the Ridley, green, hawksbill, loggerhead and leathery turtles have their breeding grounds on the islands near Hongkong and in the Xhi Sha islands in the South China Sea. Other nesting areas lie along the beaches of the southern Guandong province. All along the long coastline, thousands of sea turtles are slaughtered each year for their meat and shells which are turned into inane artifacts. *(See Sanctuary Vol VIII No.3. 1988.)*

As a result of an agrarian tradition developed over thousands of years, many wild plants have been adapted for cultivation — of over 32,000 species of plants in China, more than 2,000 are edible and a great number of herbs and roots are essential in traditional medicine. Cash crops include cotton, soya bean, rapeseed, sugar beet and cane, tungoil and tea. Many tropical plants like rubber, pepper, sisal and coffee are also cultivated.

also a matter of concern, the country's nuclear facilities being constructed in accordance with international standards and regulations.

**WITH ALL THE MEASURES CHINA** has implemented and planned for, how effective are methods to protect the environment? What do the people feel about the problem and its possible solutions? Speaking to students and academicians in various parts of China elicits a general, somewhat sanitised response: "In big cities all this can work, particularly where the western influence is strong, as in Beijing, Guangzhou or Shanghai. But much of China is still rural, uneducated, incapable of understanding the drawbacks of modernisation." This is possibly true. In Beijing, state power is close enough to the people to enforce effective control, but the further away you go from the capital the less the government's influence is felt. In more inaccessible areas like Xi'an, a bigger chimney spewing more dirty smoke still indicates `better' progress!

**CHINA IS SLOWLY CLEANING UP ITS ACT.** With the opening of the bamboo curtain to the world and the growing recognition that tourism can be a prime revenue earner, This is best evidenced by the restoration of its scenic countryside. Reforestation work is also in progress in parts of the Yangtze's course. Nevertheless, the contradictions and anomalies persist in the country's pursuit of mega-projects, a phenomenally expensive nuclear programme and an agenda which seeks to hurtle the country towards still greater industrialisation. We have precious little access to the mind of rural China, however, and it is here that the environmental renewal of any country must take root. Unless this happens, one must regretfully conclude that the fabled dragon of China is likely to succumb to its self-inflicted environmental crises.

# Tahr Tales

Text and photographs by J. Mangalaraj Johnson

*In 34 years the Rajamalai hills near Munnar have seen little change. The grasslands, scrub jungles, sombre sholas, brilliant skies, racing silver clouds and the hospitality of the planters, all remain the same.*

*The author was once in charge of Tamilnadu's famous Mudumulai forest and now teaches wildlife biology at the famous AVC College at Mayavarum. His knowledge of nature has always been tinged by love and respect for the animals under his charge, as can be seen from the following account of the enchanting Nilgiri tahr.*

**BETWEEN MAY 1958** and today I have visited the home of the Nilgiri tahr, in the Rajamalai hills near Munnar, Kerala, some 32 times! Whether the tahr were seen or not, the visits, ranging from between an hour and a week on each occasion, were invariably delectable. The unique landscapes, unforgettable, soul-satisfying experiences and the sheer joy of the outdoors have remained magnetic draws. In the 34 years that have gone by, Rajamalai has seen little change. The grasslands, scrub jungles, sombre sholas, brilliant skies, racing silver clouds and the hospitality of the planters, all remain the same.

In July 1981, while convalescing after a nasty attack of jaundice, I had the good fortune to interact with some of the most famous denizens of the magnificent Rajamalai hills — the Nilgiri tahr. In time I even came to know some of them intimately: Bindu and Gomu, the sentinels, Chocki, the herd leader, Munna, Kurmi's day-old son, Yoyoh the head shaker, Karkee and Cliff, the saddleback are the most memorable of my upland acquaintances. Of course, there are others, who are interesting in many ways. It was the saddleback, which I noticed first on arrival on the first day around 3.00 P.M., moving up the ridge near the horizon. To get a closer look at him I started walking towards the ridge as fast as I could. Almost instantly I discovered just how "breathtaking", the hills could be. Literally. I weigh around 80 kg and I was carrying my own camp kit, plus a non-functioning knee! There were no paths to speak of amid the tangle of roots and boulders and I had to stop frequently to catch a breath. What a picture I must have made, with cloud screens of condensed air hovering over me! At every step I hummed Cardinal Newman's line: "One step enough for me. Lead kindly light, amid the encircling gloom." At such times, when my breath was restored, the calmness and tranquillity of the eternal hills swept over me like a balm and revived me. In the hills, thoughts, physical and metaphysical put rhythm into one's step, as any trekker will confirm! On one such halt I had the distinct impression that I was being watched. On looking around, I discovered Bindu and Gomu, two gentle ladies of the hills, perched atop some nearby rocks, surveying their domain. As tahr are wont to do, these animals were acting as the eyes of the herd. Nothing in the area could move, without being observed carefully by the two sentinels. On the first signs of danger, they would communicate an instant warning to the other members of their family grazing elsewhere in the valley, on the other side of the ridge. In tahr fashion, the herd would group together on picking up a danger signal to work out their strategy — how urgent is the danger and which direction should they move to effect their escape. Only after the herd reached a position of relative safety would Bindu and Gomu leave their outpost, all the while keeping track of the threat. Thus were they trained by their mothers for the altruistic responsibility of guarding the community.

Quite obviously the herd would have been alerted to my presence by Bindu and Gomu, who themselves soon left their watch to vanish into the blue mountains. It was 6.00 P.M. and it was getting dark rapidly. I decided to set up camp for the night and erected the tents. The night was measured by mugfuls of tea, drizzling rain and a barter of stories, unbelievable ones, which the narrator did not expect you to believe. The saddleback which was the most sought after by poachers for years, has survived because of supernatural powers.

Though he is seen frequently he cannot be shot; before the trigger can be squeezed, the saddleback would call for the dense clouds and move into them or else would send some clouds to blind the hunters.

**THE NEXT MORNING** we started perambulating in search of the saddleback. The clouds moved off to show the hill country, montane wet temperate forests, jungles of shrub and rolling grassland. These forests hug sleeping rivers, sheltered slopes and deep valleys. The ancient trees were rugged, stout short boled with long curved branches and ornamented with mosses, ferns and epiphytes and woody climbers. Besides the dark green of the foliage of the canopy, all shades of red strike the eye. The scrubs were the main roaming grounds, tall enough to hide the tahrs whose droppings and footprints are found on the edges of the sholas, grassland and in the jungles of shrubs.

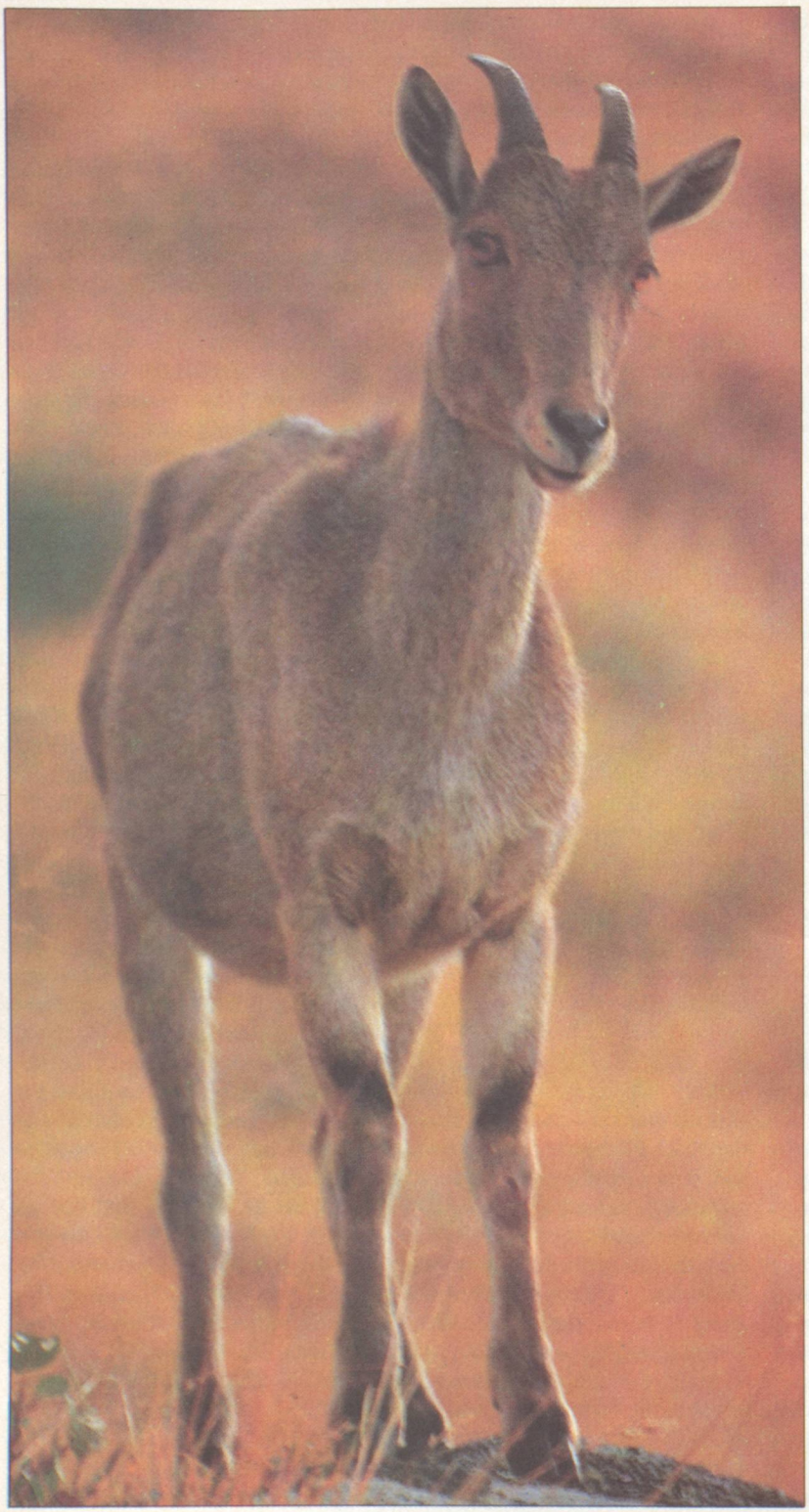
Looking down from the ridge I saw a herd of about ten female tahr grazing against the direction of the wind. They raised their heads, appeared agitated and all eyes moved in one direction. Two jumpy jackals with bared teeth were approaching the herd and moving towards a calf. I expected the herd to run away in panic to the safety of the rocky heights, as I had read in books on them. But all the females as if obeying a command formed a loose semi-circle and faced the jackals, bending their heads low and keeping their sharp horntips pointing up towards the jackals. When the two jackals attempted to attack the calf, with surprising alacrity the female tahrs surrounded the jackals in a tightening circle. When the jackals lunged forward to attack, smashing blows were given on their hindquarters — I could see their rears rise uncomfortably after each attack. After receiving several blows, one jackal escaped howling, piercing the circle, with its tail held between its legs. The other was still learning its lesson. Now the circle was tighter, the attacks were quicker and more power-laden. Whichever direction it turned the attacks were unfailing from behind. The series of attacks kept the jackal whirling around. The battered beast stood bewildered howling in panic. Suddenly it jumped clear over the deadly circle ran for its life and disappeared over the ridge still squealing. I turned to look at the victors but they were grazing as if nothing had happened — a picture of pastoral peace.

All eyes of grazing tahr turned in the direction from where suppressed coughs "Yoyoh" "Yoyoh" were heard. A lean hungry looking male, shaking his head and crying "Yoyoh" was approaching. It was rather an unusual way of making one's presence felt for a mature male. When it approached Karkee, Yoyoh suddenly pushed the head and shoulders of Karkee, who resisted and pushed back. Now they took positions in reverse parallel orientation — the fight was on and consisted of jabbing the sides of the other with head and horns. Both were bleeding profusely. The fight seemed unnecessary, I thought. But then they have to settle the dominance hierarchy. The fight lasted for about an hour. Karkee withdrew abruptly as if he was in no mood to fight. Yoyoh moved away towards the cliff.

As it started raining I returned to the shelter of the tents. When the sun warmed the wet grass on the slopes, a giggling group of black bulbuls came out of the forests. One black and orange flycatcher flew out of its large nest and sat on the forest floor. It might have sighted an insect.

When I saw the tahr family, Karkee, the stumpy male was standing near Chocki. Chocki descended from her podium and moved towards Karkee. I was after the saddleback and walked over the ridge. I would have walked searching for about three hours when a saddleback, the most majestic of all tahrs showed up, ahead of me, at the turn of the trail, surrounded by hundred thousand eternally fragrant grassblades and ageless brown boulders. He was followed by Karkee and Chocki. I named him Cliff. He did not run away, but walked gently towards me, in confidence and stood, looking up with blades of grass in his mouth. This was a gracious symbol of forgiveness for all the misdeeds of hunters and persecutors of all descriptions. I was close enough to take a portrait and could see his expression. There was no heroism, valour or manliness in the demeanour of the saddleback. He looked the kindliest of all living creatures. Cliff lived aloof from the herd yet was one among them. During times of drought his experience enabled him to guide the herd to faraway pastures and hidden waterholes. He is part of the hills. Some argue that Cliff and his ilk are old and cannot breed. Anyway they will die in a few years. Some scientists suggest shooting saddlebacks for better perambulation and conservation of the habitat. The suggestion is a sad reflection of protection.

One aspect of tahr behaviour, that bewilders naturalists is the manner in which they are able to scale vertical rock faces. I was fortunate enough to witness one such



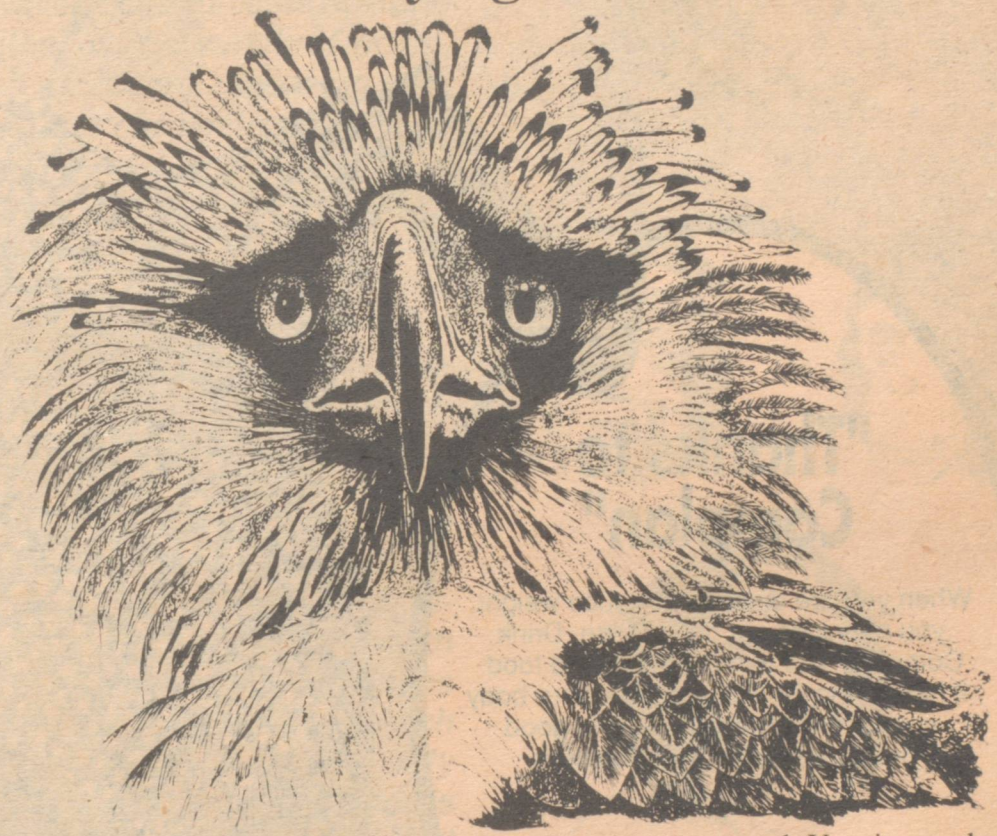
*The springy hoofs of tahr and their immense ability to leap are known. But till one sees it with one's own eyes, the true magnificence of the move cannot be appreciated.*

leap the day Cliff stood before me near the rock face. Traversing a narrow path I came face to face with the herd. Would they turn back, or I should give way? While I was considering what to do, Cliff turned and looked up at the rock face, as if taking its measure as a potential stairway to the top. What followed was one blur of thought, converted to action. He stood for a moment, brought his legs close and then leapt vertically five feet, landing on the protrusions on the rockface. From here he leapt again, repeating the movements till he was right on top of the rock.

**IT TOOK ME** some time to comprehend the whole process of the scaling. When Karkee and Chocki followed their leader, scaling the face in an identical manner, the strategy became clear to me. The springy hoofs of tahr and their immense ability to leap are known. But till one sees it with one's own eyes, the true magnificence of the move cannot be appreciated. Fortunately, I was given the opportunity to have a 'ring side view' as I was situated in a position from where I could see the gap between the leaping tahrs and the rock face. They did not even look up, or at the landing rock ledges, when they began each leap. The series of vaults were sure, steadfast and so quickly performed that it appears as if it was one fluid movement. I returned that day with a feeling that I had touched the fringes of the inner secrets of tahr lives, and with the satisfaction of knowing that there is a place for them on this planet. ▭

# THE SANCTUARY PAPERS

## Monkeying around



No kidding. This bird means business where monkeys are concerned. Yes, it eats dogs or even domestic livestock but without a doubt monkeys are its favourite food. A particularly fierce looking bird it was first discovered in the Philippines in 1894. Initially naturalists called it the Old World Harpy, since it looked so strikingly similar to the Harpy of Central and South America, but eventually it came to be known as the monkey-eating eagle *Pithecophaga jefferyi*, the only representative of its genus. One might imagine that a tough, predatory bird such as this would be doing quite well for itself. Quite the contrary. There are fewer than 100 of these eagles left. Paradoxically, one of the causes for their decline today is the fact that their scarcity makes them prized possessions for zoos and collectors. The I.U. C.N., on whose Red Data Book the eagle features, has put out special worldwide appeals not to place indents for the birds, as their extinction in the wild is imminent. The eagle can today be seen in its natural habitat only on two Philippine islands --Mindanao and Luzon.

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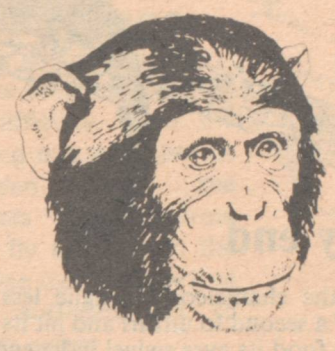
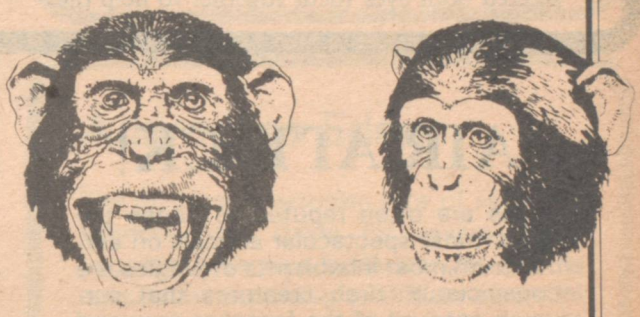
# EXPRESSIONS

*Language, as we humans know it, generally finds expression through the mechanism of speech and script. Animals, however, communicate with one another using a variety of means such as scents, visual signals, vocal communication and echo location. Chimpanzees, like man, seem to rely heavily on facial expressions to signal moods and intentions. Here the five illustrations, in sequential order, indicate: 1. A pensive, relaxed state. 2. An excited possibly fearful state. 3. A happy, playful state. 4. An angry, threat display and, 5. A welcoming pout. Of course chimps, living as they do in dense jungle, often need to communicate with each other over long distances when they cannot even see each other. At such times they rely on their powerful vocal chords to relay noisy messages that cause the jungle stillness to be shattered. Studies conducted by naturalists have revealed that a sophisticated repertoire of postures, gestures and facial expressions allow chimps to convey a considerable deal of factual information and even fine shades of feeling.*





## Sticky end

It takes the chameleon s tongue less than 1/25th of a second to unfurl and hit its prey. To locate food its eyes swivel independently, but the moment the unfortunate victim is sighted both eyes focus together to help the reptile to gauge the precise distance and direction in which its attack should follow. A major hunting aid is its amazing ability to change its body colour to merge with its surroundings. With careful slow movements, the chameleon then creeps to within striking distance to bring its prey to a sticky end.

# AIR ATTACK!

Jungles are often reputed to house the largest, most spectacular animals on earth. In truth,most inhabitants of jungles are inconspicuous drab creatures that survive on account of the fact that prey and predator species cannot detect them because of their camouflage capabilities.

Some birds of prey in jungles, however, more than justify their fearsome reputation as they frequently attain really startling appearances. The African long-tailed hawk (*Urotriorchus macrourus*) for instance, is an awesome predator whose chestnut and black plumage manages to blend fairly well with the dappled foliage of the Congo's forest canopy. The bird's long tail speeds its flight and its short broad wings enable it to manoeuvre in dense undergrowth in order to pounce on its unsuspecting prey which it strangles to death with its powerful talons.



## Did you know?

A spider crab found in Japanese waters has legs that stretch *12 feet* from claw to claw!

When it is born,an American catfish swims normally. Later,it starts to swim on its back and continues to do so *for the rest of its life!*

If you take a sea sponge apart,each separate portion will regenerate into a new,complete sea sponge.

## Tough tiny-tot

A small marine animal, called a water bear, has a normal life span of around a year. Some strange survival technique, however, enables the sea bear to live in a state of suspended animation for as long as one hundred years. In this state it can withstand radiation levels of over thousand times the dose that would be lethal for humans and can also tolerate temperature variations from 300°F to almost absolute zero.

## Lifting experience

If she sees her fledgling in difficulty while the young one attempts its maiden flight, the female housesparrow will fly underneath the novice flier to allow it to get sufficient lift to reach safety.

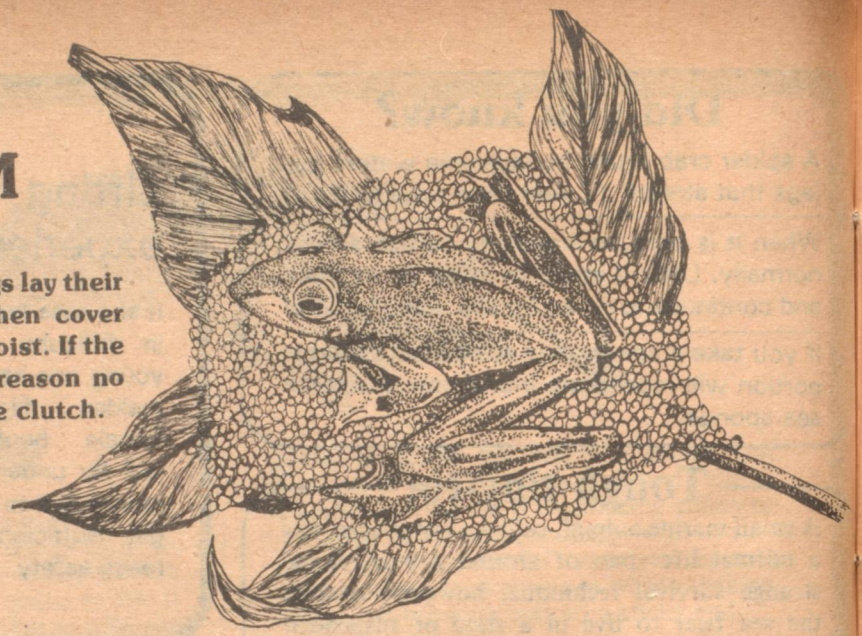
## Adam-less Edens

The mythical Amazonian race of all-female warriors have made for several mind-boggling adventure fantasies through the ages. Now, according to William Moore,an evolutionary biologist from Wayne State University, in Detroit, several precedents of *all-female* species in the animal kingdom have actually been confirmed.

Over 50 vertebrate species, it seems, give birth by reproducing female clones. Some concieve without the help of males while others engage in sex with males of *near related* species, the coupling triggering pregnancy. In any event, the male genes do not fuse with the female genes as would happen in the case of a normal pregnancy. Genetically, therefore, the sex act may as well as not have taken place. Today a variety of scientific techniques permit man to create virgin births in laboratories, even with heterosexual creatures. Such success with cloning leads one to believe that the time is not far when women's libbers may organise themselves so as to make males much more redundant than anyone could possibly imagine!

# FROG FOAM

**To prevent predation, tree frogs lay their eggs high up in trees and then cover them in foam to keep them moist. If the eggs were to dry up for any reason no young would be born from the clutch.**

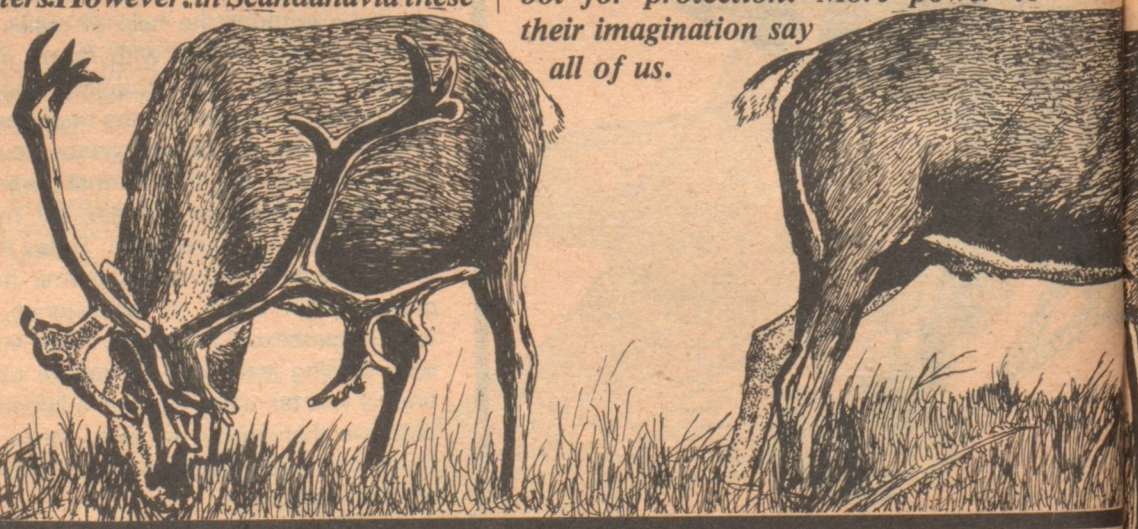


# JINGLE BELLS

*This must be one of the world's most famous deer species—the reindeer of Santa Claus and Christmas fame. The animals are found in the extreme north of Europe and Asia. (In America a similar species is called the Caribou.)*

*Males and females both sport handsome horns which are prized by hunters. However, in Scandanavia these deer have actually been domesticated and play the same role for locals as cattle do in India!*

*In bygone days, the deer used to roam in herds of thousands but their numbers have dropped considerably now on account of over-hunting. Some conservationists have suggested that one way to prevent further exploitation of reindeer would be to use 'Rudolph', Santa's lead deer as a symbol for protection. More power to their imagination say all of us.*





## Heartless encounter

A Russian scientist, Dr. Gennady Sergeyev, has astounded the world with the results of a laboratory experiment in which, he claims, *disembodied frog hearts communicated with each other.*

He removed two frog hearts and, after placing each in a separate dish, injected one with a toxic substance called gitalin (a drug akin to digitalis); the other heart was left untouched. As expected, the injected heart soon lost its rhythm and slowed down considerably. What amazed him, however, was that the second undrugged heart also responded in a similar fashion.

The hearts stayed synchronised about half the time when air or quartz glass separated them, but when a black card was used as a 'fence' between them, the beats differed. This has led him to believe that the organs communicated by weak beams of ultraviolet rays and not sound as he had originally presumed.


## Form IV

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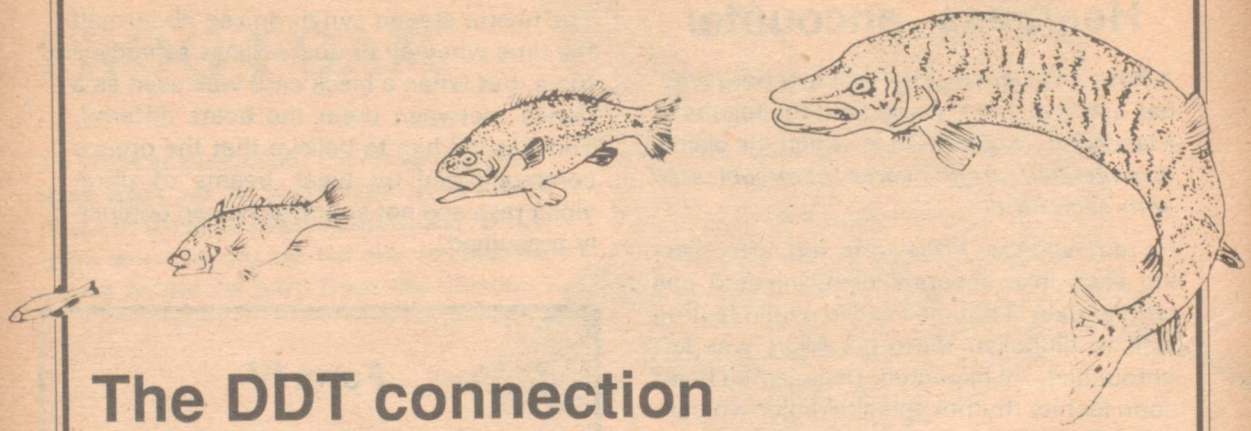

# The DDT connection

Dichlorodiphenyltrichlorethane (DDT) is a particularly stable compound which remains active in the environment for a considerable period of time. Despite its widespread use, we still do not know precisely how DDT kills insects but we do know for sure that it has some pretty unwanted side-effects. DDT's general mode action is through the nervous system and it is not readily eliminated from the body. As a result, as one moves up the food chain from producer to consumer to secondary consumer and so on, the amount of DDT in the tissue of the consumer increases. What now happens is that a small fish with, say, one part DDT is consumed by a larger fish in whose body DDT concentration increases to 10 parts because the larger predator gets and maintains a certain dose from every small fish he eats. The process continues with biological magnification: frightening thought if you stop to consider the high dosage consumed by man every time he fillets a large fish for his table.

# Where are you ?

How does a parent cliff swallow, *Petrochelidon pyrrhonota*, recognise its nestling from among nearly 2,000 others living in a communal nesting site? It's not as easy as one might imagine (as mothers scanning a sea of uniformed school children, while looking for their own child, will confirm). According to Stoddard and Beecher, two ornithologists from the University of Washington, the cliff swallows tune in on their chicks' chirps. Though their sounds seem uniform to the human ear, recordings of particular infants, when played back near vacant nest holes, invariably attracted the parents whose young ones' voices had been taped. This capacity to recognise chirps is considered to be an evolutionary advantage, developed on account of the birds' habit of nesting in large colonies. Barn swallows that construct solitary nests have no such audio ac Just for precaution's sake, nature appears to have provided cliff swallows with a secondary back-up system. To prevent hard-earned food from being thrust into the wrong mouth the parents recognise their offsprings' black and white facial markings which they possibly study before feeding their young.

# War, Environment and the Law

**by Arthur H. Westing**

*The subject of environment pervades all aspects of existence. The author, who is a consultant editor for* ***Environmental Awareness*** *— a journal edited by Dr. G.M. Oza and published from Baroda — brings home this point graphically through the following article.*

## Introduction

I wish to discuss one of the more sombre aspects of world affairs, namely war. More specifically, I wish to connect the issue of war with two other, seemingly disparate, topics: with environment and with the law. In the process, I hope to be able to demonstrate the ever more worrisome connection between war and environment; and then the necessity for forging a stronger connection between those two and the law. I first discuss each of these three topics briefly on its own merits, and then go on to discuss the linkages among them, both existing and needed. It hardly needs stating that the Gulf War of 1991 emphasizes the necessity for greater awareness and attention to this area.

Beginning with the topic of war, we must remind ourselves how much military activities really are part and parcel of human activities in general. Thus, archeological and historical evidence informs us that wars have continued to occur without respite for at least the past nine thousand years, that is, at least since the Neolithic age. In the vivid words of Arthur Koestler: 'The most persistent sound which reverberates through man's history is the beating of war drums. Tribal wars, religious wars, civil wars, dynastic wars, national wars, revolutionary wars, colonial wars, wars of conquest and of liberation, wars to prevent and to end all wars, follow each other in a chain of compulsive repetitiveness as far as (we) can remember (our) past, and there is every reason to believe that the chain will extend into the future.'

Today, some 145 of the 174 sovereign nations of the world maintain armed forces. And merely since World War II, the armed forces of about 100 of those 145 militarized nations have intruded one or more times upon the territory of some other sovereign nation for hostile purposes — once every Seven or Eight weeks, on average. Moreover, it is important to point out that the foreign military adventures are outnumbered by the even more frequent domestic military adventures, that is, by the use of armed forces for domestic repression with deadly intent.

## Armed force

All told, it is clear that we have been a bellicose species. And as in the past, a considerable majority of the nations of the world continue to resolve their disputes, both external and internal, with the help of their armed forces — armed force with which they either threaten or actually use deadly violence. Indeed, at this very moment, in one place or another throughout the world there are more than a dozen wars in progress — sad to say, the normal state of global

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affairs on any given day, not only since World War II, but for as far back as we can determine.

**Environment**

Turning next to the topic of environment, we live within a biosphere of finite size, a biosphere upon which all of us depend for our well-being and very survival. We live in an uneasy state of co-existence with the other living creatures on earth. In fact, in an important sense, we humans are in direct competition with the plants and animals of the world for such key environmental necessities as land and water. And, of course, to some very considerable extent we directly exploit plants and animals, both domesticated and wild, for food and fibre.

We humans have to date taken over some 11 per cent of the world's land area for agriculture (plus another 2 per cent for our homes and other artifacts), in the process, of course, eliminating the flora and fauna that had been flourishing there; and instead harvesting for our own needs the photosynthetic product of the crops (wheat, rice, corn, etc., etc.) that we have established there. In addition, we humans depend massively on the sustainable exploitation of several major natural renewable resources. The grasslands of the world now feed much of our livestock (cattle, sheep, etc.). Indeed, all told, we have replaced some 20 per cent of the world's terrestrial wildlife with our entourage of domesticated animals. The forests of the world supply us with fuel, construction materials, and pulp; in doing so we utilize some 35 per cent of their annual photosynthesis. And the oceans of the world annually supply us with huge amounts of fish — overall, essentially 100 per cent of the sustainable yield. Although less widely appreciated, we humans also depend massively on the renewable exploitation of the major components of the environment — the lithosphere (land), hydrosphere (ocean and other waters), and atmosphere — as sites for the disposal of our huge and growing quantities of solid, liquid and gaseous wastes.

***"If managed sensibly, the renewable natural resources of the world could provide for the sustainable yield of crops, livestock, wood and fish — and for the sustainable disposal of solid, liquid and gaseous wastes — into the indefinite future."***

If managed sensibly, the renewable natural resources of the world could provide for the sustainable yield of crops, livestock, wood and fish — and for the sustainable disposal of solid, liquid and gaseous wastes — into the indefinite future. On the other hand, if we continue as we have been, the renewable resources will be exploited beyond their capacity to renew themselves. Indeed, we are already beginning to overburden all of these major natural-resource systems in many, if not most, parts of the world. Moreover, human numbers are

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continuing to grow at exponential rates (as are also — to exacerbate matters — our material aspirations). The human population, at the moment numbering some 5.4 billion people, keeps increasing at the incredible rate of 1/4 million people per day, which leads to a doubling of the total number about every 40 years.

Finally, it is important to point out that environmental problems — both those regarding resource utilization and waste disposal rarely respect international boundaries. This trans-boundary dimension of so many of our environmental problems, of course, usually makes it desirable, if not necessary, to deal with them on a multilateral basis, often by a regional group of nations and sometimes by nations throughout the world.

**The Law**

Turning next to the topic of the law in our present context, specifically to the topic of international law — I must begin by explaining that despite a plethora of relevant international laws (that is, multilateral treaties, including the Charter of the United Nations), in a fundamental sense the sovereign nations of the world continue to interact within a system of near anarchy. The many multilateral treaties notwithstanding, there is really no ultimate authority to which a nation can appeal for the resolution of its inter-state conflicts, whether political or non-political, that inevitably arise from time to time. Few countries have given over any of their sovereignty to the authority of the United Nations and its International Court of Justice (the so-called World Court). More specifically, only about 19 of the 174 countries in the world have to date submitted to the necessary compulsory unconditional jurisdiction of the World Court.

***"Despite a plethora of relevant international laws (that is, multilateral treaties, including the Charter of the United Nations), in a fundamental sense the sovereign nations of the world continue to interact within a system of near anarchy."***

Nonetheless, a considerable number of important multilateral treaties exists that deal with war in its various details, together comprising the so-called law of war. However, these treaties are (with one exception) not meant to abolish war, but rather to provide a set of rules for its pursuit — in effect, to make its pursuit somewhat less brutal. Thus, the relevant treaties deal especially with such matters as the treatment of prisoners, the protection of non-combatants, and the prohibition of certain weapons considered to be especially odious (although not including nuclear weapons).

There also exists a considerable number of important multilateral treaties that deal with the environment in various of its details. However, these treaties do not address problems of the global biosphere or any of its major components — lithosphere, hydro-

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sphere, atmosphere — in any comprehensive manner. Rather, they deal with a variety of details or, in a very few instances, more comprehensively but in relation to some particular region. To offer several representative examples, various environmental treaties are meant to protect fauna and flora that are in danger of extinction, to conserve wetlands important to migratory waterfowl, to prevent trans-boundary dissemination of radioactive contaminants, and to control air pollution within Europe.

It is important to reiterate that for most multilateral treaties there really does not exist a useful international mechanism for monitoring compliance, or — in the event that infractions become known — for enforcement. To a very large extent, compliance with a treaty is a function of two factors: 1. a perception of self-interest, that is, the extent to which the advantages to a country of compliance seem to outweigh the drawbacks; and 2) the pervasiveness of the cultural norms that underpin its provisions.

***"During World War II, the United Kingdom bombed two major dams in the Ruhr Valley of Germany, killing large numbers of people, and causing high levels of environmental disruption."***

**War and Environment**

I now turn to the connection between war and environment. There is, of course, no escaping the destructiveness of war. Wars are by their very nature violent, deadly and destructive. Therefore, I need not dwell upon this obvious relationship except to point out that the ability to wreak havoc upon the environment in time of war has been increasing in recent decades — and with that ability, the actuality.

The ever-growing technical and logistical abilities of armed forces to devastate large areas can be readily demonstrated by comparing the intensities (per day and per unit area) of US bombing during the Korean War of 1950-1953 was three times as intense as it had been during World War II; US bombing during the Second Indo-China War of 1961-1975 was four times as intense as it had been during World War II; and US bombing during the Gulf War of 1991 was five to six times as intense as it had been during World War II.

It must also be noted that the environment can be devastated in warfare either as a side-effect (as a so-called collateral effect) of attacking enemy soldiers, fortifications, industrial areas, etc. or as an intended direct effect. Three examples of international environmental disruption will suffice. During World War II, the United Kingdom bombed two major dams in the Ruhr Valley of Germany, with the resulting flood waters killing large numbers of people, doing immense amounts of industrial damage, and causing

high levels of environmental disruption. During the Second Indo-China War, the bombing and poisoning of Indo-Chinese forests and agricultural areas by the USA had been central to its ultimately unsuccessful attempt to prevail by denying concealment and sustenance to an elusive enemy. And, of course, during the recent Gulf War, Iraq contaminated the Persian Gulf with large amounts of oil, and also caused the release into the Kuwaiti atmosphere of vast amounts of oil smoke —neither action, however, providing any obvious military advantage. If anything, those acts emphasize the growing wartime threats to the environment posed by an increasingly industrialized world, with its many nuclear, chemical and other facilities containing pent-up dangerous forces.

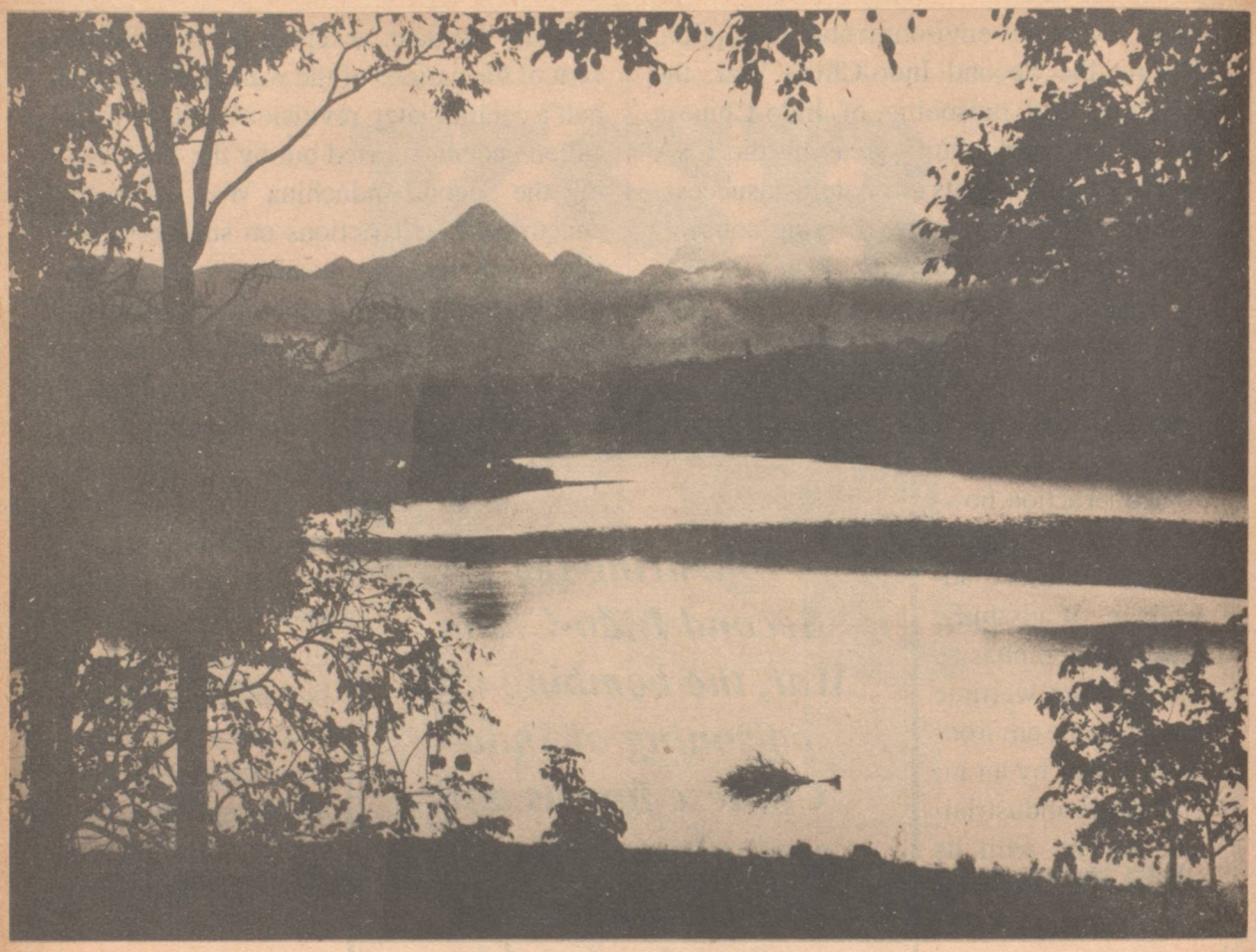
***"During the Second Indo-China War, the bombing and poisoning of Indo-Chinese forests and agricultural areas by the USA had been central to its ultimately unsuccessful strategy"***

**War, environment and the law**

I now turn to the relationship between wartime disruption of the environment and international law. A small body of relevant law does, in fact, exist, much of it quite recent. I begin with a tangentially relevant treaty that grew out of World War I. Revulsion against the use of chemical anti-personnel weapons during World War I led to the enactment of a widely accepted prohibition of their use against other parties, via the Geneva Protocol of 1925 on Chemical and Bacteriological Warfare (to date, accepted by over 70 per cent of the nations of the world). Similarly, half a century later, revulsion against the so-called ecocide carried out by the USA during the Second Indochina War led to the enactment of restrictions on such ecocidal actions, these more recent restrictions taking the form of two separate treaties: the Environmental Modification Convention of 1977; and Protocol I of 1977 on the Protection of Victims of International Armed conflicts.

By becoming a party to the first of those two treaties — the Environmental Modification Convention— a country agrees not to deliberately disrupt the lithosphere, hydrosphere, atmosphere or biota of another party in any substantial way for hostile purposes. To date, only 30 per cent or so of the nations of the world have joined this treaty. By becoming a party to the second of those two treaties — Protocol I — a country agrees (among many other things) not to use methods of warfare that may be expected to cause substantial damage to the natural environment of another party. To date, almost 60 per cent of the nations of the world have joined this latter treaty.

The modest level of acceptance of the Environmental Modification Convention can be attributed in large measure to its debilitating



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provisos. Not only must a certain (essentially undefined) level of severity be exceeded for the prohibition to become applicable, but it must as well be possible to establish that the disruption had been carried out with hostile intent. For the prohibition of Protocol I to become applicable, it is not necessary to establish hostile intent. Protocol I is also more attractive to many nations than is the Environmental Modification for various of its other provisions, among them restrictions on destroying sources of water and food for civilians, and also restrictions on attacking dams and nuclear generating stations.

**Conclusions**

Where does all this leave us? First and foremost, we must learn to recognize that the global environment, and the resources we find necessary to derive from it, are being placed under increasingly damaging pressure. Long-term environmental sustainability is clearly becoming an ever-more elusive goal. Thus it becomes ever-more necessary to protect our fragile environment from becoming further debilitated — that is to say, we must protect and nurture the goose that lays our golden eggs.

It is largely owing to the emergence of environmental problems that we are at last being forced into achieving a truly new world order. As part of such a new world order we must re-orient our thinking towards the development of a more comprehensive form of human security, one that rests perforce on the twin pillars of social and environmental sanity.

To begin with, we must now reject warfare as an acceptable human activity. Such rejection must derive not only from the traditional grounds of morality or ethics, but now also because it is one of our few environmentally disruptive activities that can be avoided without compromising some other component of comprehensive human security, such as health or education. Indeed, the huge amounts of resources — material, financial and intellectual — now being devoted by the nations of the world to preparations for war, and to war itself, are the only ones readily available to shift to such socially and otherwise valuable purposes as environmental protection.

So my concluding message is that we must educate ourselves in three directions — three directions that must soon converge into a single direction. For one thing, we must recognize the urgent necessity for conserving the human environment and for developing its natural resources on a strictly sustainable basis. For another, we must recognize the increasing environmental disruptiveness of war (at the same time recognizing the potential source of resources for environmental improvement to the extent that the military sector of society atrophies). And finally, we must recognize the importance of developing a comprehensive body of multilateral treaties so that the pro-environmental and anti-militaristic cultural norms that become strengthened or developed will be translated, for their just and orderly expression, into appropriate international legal norms.

*Readers who wish to may write to the author:*

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# READER'S FORUM

This is in response to Mr. Nadkarny's comments on Bittu Sahgal's views on nuclear power *(Goodfellas: Vol. XI. No. 6.)*. While extoll the virtues of nuclear power Nadkarny says, for instance, that the Tarapur Atomic Power Station has "in the last 22 years" provided "the hinterland of Bombay .... with over 40,000 million units of electricity, at the tariff rate cheapest next to hydel power." But, are those who enjoy using this electricity aware of the future problem of the radioactive waste that is accumulating? What about the fact that nuclear power stations have a life-span for only 40 years? No power station is meant to last for eternity! What about the sky-rocketing losses that are entailed in constructing and dismantling nuclear power plants and the costs that are incurred for the disposal nuclear waste. This brings us to the gravest point of the debate. How does one propose to do away with this, as-good-as imperishable waste? Reprocessing — for how long? Burial — when? Where?

According to the World Watch Paper 106 (Dec'91), the date for a high level nuclear waste-burial in the U.S.A. was planned in 1985 — a date that has been shifted from 1985 to 1989 to 1998 to 2003 to 2010. What is the U.S.A, so afraid of! The reality is that aware communities oppose siting of toxic material next to their homes and everyone is concerned about the escalating cost of burying irradiated fuel which has risen by 80 per cent since 1983. The disposal cost for a single site holding 96,000 tons of irradiated fuel and high-level waste, is now projected at 36 billion dollars. In a country like India where — 49 per cent of our people live below the poverty line, 60 per cent of women are illiterate, 45 per cent have no safe drinking water, 90 per cent live without proper sanitation facilities — can we afford such high-cost burials of nuclear waste? India purports to reprocess her nuclear wastes, store them for 20 years and bury them in a yet-to-be identified granite spot in 2010 A.D. My question is, where are we going to bury it anyway with our present population growth rate at 2.2 per cent annum?

Mr. Nadkarny, you object to Mr. Sahgal's "talk of Tehri and Sardar Sarovar Dams and Tarapur and Dahanu Power Stations" to children instead of "topics closer to children's world". What is the use of talking about things like cleaner roads, healthy homes, etc. when we are only pushing them into an uncertain world full of hazardous nuclear waste? Isn't it better to prepare them for the realities of nuclear contamination. Lastly, since I do have the chance to work with young children. I can assure you, Mr. Nadkarny these children are more intelligent and conscious than we ever were. And what about the time-tested adage — "Catch them young" — at least teach them now so that they can grow into tomorrow's citizens and decision-makers who are more partial to the environment!

Uttara Gangopadhyay
Calcutta.

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It was really superb to hear about 1,250 children crusading for the cause of the environment *(Goodfellas: Vol. XI. No. 6.)*. However, you could utilise their help in a more effective way, by writing to the Union Minister for Information & Broad Casting Sri Ajit Panja, with the following suggestion: End every major news bulletin both on AIR and Doordarshan with a small item on an issue concerning environment, nature or wildlife conservation. This would help make us aware of environmental issues of the day and could prevent future projects like TAPS, Tehri and Sardar Sarovar dam from coming up.

C.T. Vairavan
Madras.

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As a bird watcher, I am constantly on the lookout for unique observations and was rewarded by sightings of partially-albino red-tailed lapwings, *Vanellus indicus*, and redvented bulbuls, *Pycnonotus cafer*, at Kota. In the case of the lapwing, the upper plumage was white instead of bronze-brown. The black on the throat and breast was there as usual, the legs were yellow and the eyes were brownish red. I saw two specimens frequently on the road between Kota and Bundi. Their territories were about five kms. from each other and they fed near the drains and in adjoining irrigated farms. One of them paired up with a normal coloured male bird and laid four eggs in a ploughed field. The eggs were also of normal colour with dark brown blotches. Both parents shared the responsibility of incubation and care of the chicks when they hatched. Sadly, I could not keep track of them over an extended period of time and cannot confirm if any of them had white upper plumage on maturity. I also saw an almost fully white redvented bulbul at Kota in the palace premises. There was slight greyish

hue on head. It had a red vent, reddish eyes and greyish legs. Its call was normal.

R.G. Soni
Conservator of Forests,
Bikaner.

---

On an ornithological trip to a tribal village near Dhubri, Assam, Mr. Soumyadeep Datta and I saw what we thought were common langurs. On closer inspection, however, they appeared to be golden langurs, *Presbytes geei*. Till now there has been no record of golden langurs in western Assam. If these are indeed golden langurs, we would be grateful to have the new sighting recorded in the name of Soumyadeep Dutta and the undersigned.

Sanjoy Ganguly
Calcutta.

*We are forwarding a copy of your observation to the Bombay Natural History Society and to the Ministry of Environment for their record and comment. Do also get in touch with them directly to establish further details. Ed.*

---

The issue on wildlife and tourism in Maharashtra (Vol XI No. 5, 1991) was a useful collection of neatly drafted and balanced articles especially the one by Dr. Erach Bharucha. Heta Pandit's short and sweet article, 'Mahabaleshwar: a threatened paradise' was also very readable. I would like to seek a clarification on the blue mormon which a photo-caption suggests is the largest swallowtail butterfly of Maharashtra. According to my information this is not true. The common birdwing is the largest of not only the swallowtails but of all the butterflies in India. This species occurs in southern parts of Maharashtra's Western ghats in the Kolhapur and Sindhudurg districts which have a wetter ecology as compared to rest of Maharashtra. I had also sighted a specimen on May 15, 1991 near the MTDC campus at Dajipur. I reported this to Dr. Makrand Dabak, a butterfly expert who supported the view that many butterflies which are not supposed be found north of Karwar or Goa are indeed present in a number of places in Southern Maharashtra where tall, luxuriant forests still exist.

Utkarsh Ghate
Pune.

---

You have published a letter from Romulus Whitaker (Vol. XI No. 6, 1991) wherein he asks for volunteers for conservation action in the Andamans. Let me share my experience with you. About a year back I had written to Mr. Whitaker stating my willingness to work with ANET. Instead of discussing or rejecting my application, he referred me to the Conservation Corps Network of WWF-I, in which I was not interested. So, regarding his invitation to 'visit (ANET) and 'pitch in', I feel somewhat skeptical. It is better if one gets a clarification from him to prevent disappointment.

Uttara Ganguly
Calcutta.

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As a third time visitor to India, I find it as stimulating as ever, full of lively interest and colour. Recently I went to the Sunday afternoon Tourist Plaza at Kala Ghoda which was packed with families enjoying the music, entertainment and snacks. However, But I was increasingly saddened to see the number animals forced to perform tricks at a sharp command, the poke of a stick or jerk of a rope. How much more beautiful monkeys are leaping gracefully in the trees than dressed up and ordered into a series of somersaults on a city street. I was told that such entertainment with all manner of creatures, has been part of Indian life for centuries. So indeed it has been and still is elsewhere. But there is a growing awareness within enlightened communities that such exploitation of other species is demeaning and unacceptable. In Canada now, we have a fantastically successful 'Circus of the Sun' which plays to packed and appreciative audiences wherever it goes. There are no animal acts at all, yet child and adult alike thrill to the beauty, skills and fun of the human entertainers.

I suspect many thinking Indians share my concern, but in the face of tradition and the pressures of a busy life, they are set aside. At the 'Festival of Charities', I was delighted to find there are active and potent animal protection groups in India. If *Sanctuary* readers share such concerns, they should seek out such groups as *Beauty Without Cruelty*, or the SPCA. As Mahatma Gandhi said "A nation can be judged by the way it treats its animals."

Mrs. Maureen Balcombe
Bombay.

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The TRAFFIC network has initiated a project to examine the illegal trade in tropical timber. As members of the network, we have been asked to contribute data and the information we collect falls into the following four categories: 1. Published information relating to illegal or fraudulent activities associated with the tropical timber trade. 2. Anecdotal information relating to illegal tropical timber trade. In an attempt to facilitate collection of this information we have prepared a short questionnaire.

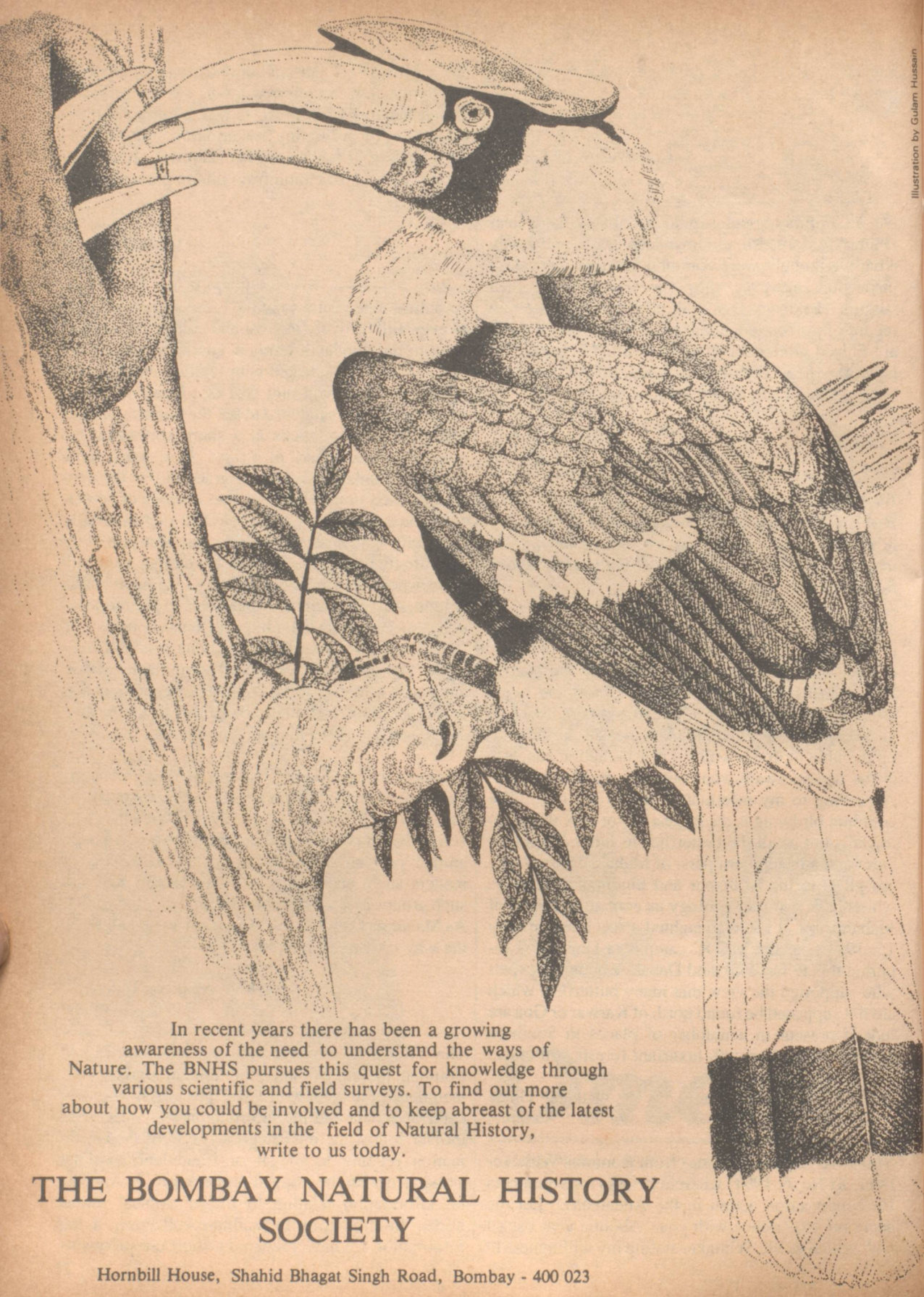

Illustration by Gulam Hussain

In recent years there has been a growing awareness of the need to understand the ways of Nature. The BNHS pursues this quest for knowledge through various scientific and field surveys. To find out more about how you could be involved and to keep abreast of the latest developments in the field of Natural History, write to us today.

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This is attached. Please do not limit your response to the queries on the questionnaire; we welcome your comments on any aspect of the illegal tropical timber trade that you care to bring to our attention. The source of any anecdotal material will be kept strictly confidential. 3. Information on bans, quotas, tariffs and other trade restrictions on the tropical timber trade in consumer and, especially, producer countries. It should be stressed that we do not want information on the entire legislative controls over a given country's timber trade, only details of any trade restrictions. 4. Names of individuals or organisations who may be useful additional sources of information. We would welcome the help and involvement of *Sanctuary* readers.

Ashok Kumar
Adviser-Conservation,
New Delhi.

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A pair of spotted doves, *S. chinensis suratensis*, which visited our garden in search of food, decided to build their nest on our wooden verandah beam. Between March and May, they made two nests and laid a total of eight eggs. Each clutch consisted of two eggs. When two chicks died after 20 days, the pair began incubating another clutch. I was able to make detailed notes and if anyone wishes to know more about the breeding biology of the spotted dove, I would be happy to oblige.

Aroop Chaudhury
C-1, Bagha Jatin, Raja S.C. Mullick Rd.,
P.O. Regent Estate, Calcutta 700092.

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The Proposed Upper Bhadra Irrigation Project was shelved by the Karnataka Government some years ago due to a paucity of funds. I am now told that the Government is thinking of resurrecting it once again. I think this project should never be allowed to take off as, besides submerging a lot of good land, it will also submerge a considerable part of the Bhadra Wildlife Sanctuary. I am an Honorary Wildlife Warden here and fear for the senseless carnage the project will inflict. These days there are far too many impractical and destructive projects — mainly meant to enrich some engineers and politicians and I feel we must do all we can to put a stop to them.

K.R. Sethna
Chikmagalur District,
Karnataka.

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The North Karanpura Valley was opened up for a $200 million project without environmental clearance. On January 20, 1990, an Australian Company, White Industries Pvt. Ltd., began "exploration" at a rate of 0.6 to 1.6 m.t. a year in the Central coal fields. Concurrent to this massive destruction of the best forest in South Hazaribagh, was the displacement of five villages. The raised coal was for Jamunanagar (U.P.) and Dadri (Haryana) Thermal Power Stations. This will feed distant New Delhi's electricity needs. Further, the National Thermal Power Corporation (NTPC) projected damming of the Damodar river and setting up of a 1,000 megawatt Super thermal power project (STPP) in nearby Tandwa, to be fed coal by a "merry-go-round" conveyor system from the Pipaiwar open cast project. On INTACH's formal objection to this project, an enquiry was ordered by the Ministry of Environment and Forests. Subsequently the entire Tandwa STPP project at Tandwa was rejected. The question of damming the Damodar was reverted to Ministry of Water Resources. Meanwhile, INTACH's campaign has prompted full-scale human rights investigations by the Australian Broadcasting Corporation, a team from the Australian government itself and the Rainforest Information Centre. INTACH has now lodged a formal protest to senator G. Evans of Australia's Department of Foreign Affairs and Trade, as well as to Prime Minister Hawke. Despite all this, full-scale mining continues. The same valley has recently yielded rare archaeological deposits, middle stone age tools, Chalcolithic period rock paintings, rock cut temples, and early pebble tools believed to be of the earliest humans. Fine microliths of Mesolithic period have also been discovered. All these finds have been confirmed by the Archaeological Survey of India, including hillocks of iron slag believed to be the remains of the casting of emperor Ashoka's Iron pillars. Today, near this endangered site, a fresh attempt is being made by NTPC (with pressure from the World Bank) to set up yet another 1,000 mw STPP. INTACH has now asked the Ministry of Environment and Forests to make archaeological permission mandatory before permission is given for mining and industry in the North Karanpura Valley and the request is being considered. The devastation does not end here. To the north of these jungles in Potmo, the forest department is itself cutting down vast tracts of sal jungles. No tree escapes their attention, including fruit trees such as barli, kend, bhelwa, pipal, mohua, etc.

If the very governments we elect are going to become destroyers of our natural and cultural heritage, how will we be able to answer to future generations? Has the time come for us to invoke a spirit of revolutionary resistance?

Bulu Imam
INTACH,
Hazaribagh.

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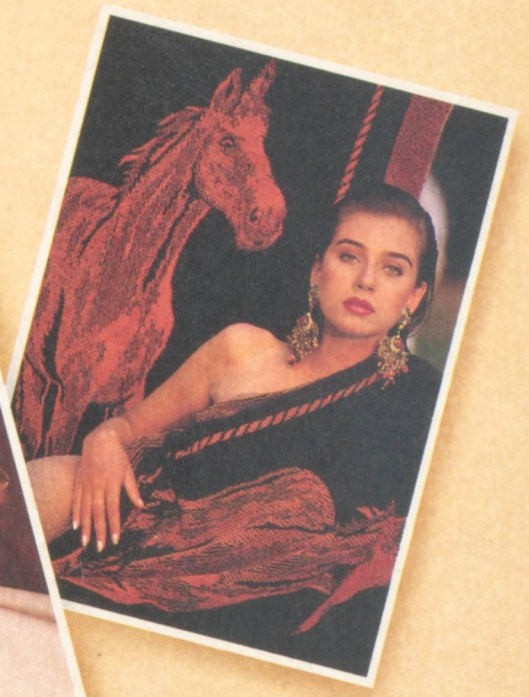

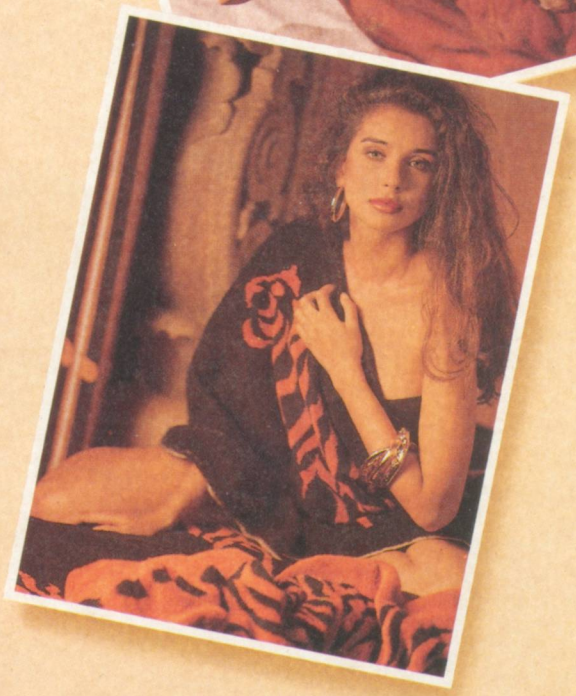

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