CHAPTER-I

INTRODUCTION

GENERAL

The Gir area in Junagadh district is the only large forested area remaining in the seasonally arid thornscrub desert country that constitutes a greater part of the Kathiawar or Saurashtra peninsula of Gujarat state. It is also a major watershed region of the area. Moreover, it is the only abode of the Asiatic Lion (Panthera leo persica).

The Gir, as it is commonly called, was a compact block of forest covering an area of over 5000 sq.km in the past, has now been reduced to an area of about 1412.13 sq.km. Till recent times, the main research interests in this area have been in ecology, zoology and botany, with total negligence of the geological conditions which form the basis of all the natural resources. Since the last two decades, the area in and around Gir is facing a variety of geo-environmental problems viz., drought, cyclone, soil erosion, improper land-use, etc. resulting in the depletion of natural resources. The present study has been taken up with the basic presumption that the earth based resources (soil, water, etc.) are the controlling factors responsible for the sustenance of the associated flora and fauna, including human

beings. Any disturbance of the terrestrial system, generally speaking, would result in the degradation of the environment.

LOCATION AND EXTENT

The geo-environmental study was carried out in the Gir Wildlife Sanctuary, Junagadh district, Gujarat state, India (Fig.1 & 2) (abrevations used in various thematic maps: H - Hasnapur, K - Kankai, C - Chhodaudi, J - Jamwala, S - Sap Nes, and T - Tulsishyam). The area selected for investigation forms a part of Survey of India Topographic Map nos. 41 K/8, 11, 12, 15, 16; 41 L/9 & 10, 13; 41 O/4 and 41 P/1. The Junagadh district forms a part of the south-western border of Gujarat state. The Gir Wildlife Sanctuary comprising an area of about 1412.13 sq.km with a small 258.71 sq.km internal core area (Gir National Park), lies in the south-eastern part of the Junagadh district. The study area lies between $20^{o}55'N$ to $21^{o}20'N$ latitude and $70^{o}25'E$ to $71^{o}15'E$ longitude. It is about 58 km SSE of Junagadh, the district headquarter. The study area is roughly bounded by :

North :- Revenue areas of Visavadar taluka of Junagadh district and Dhari taluka of Amreli district.

South :- Revenue areas of Kodinar taluka of Amreli district.

East :- Revenue areas of Una and Talala talukas of Junagadh district and Khamba taluka of Amreli district.

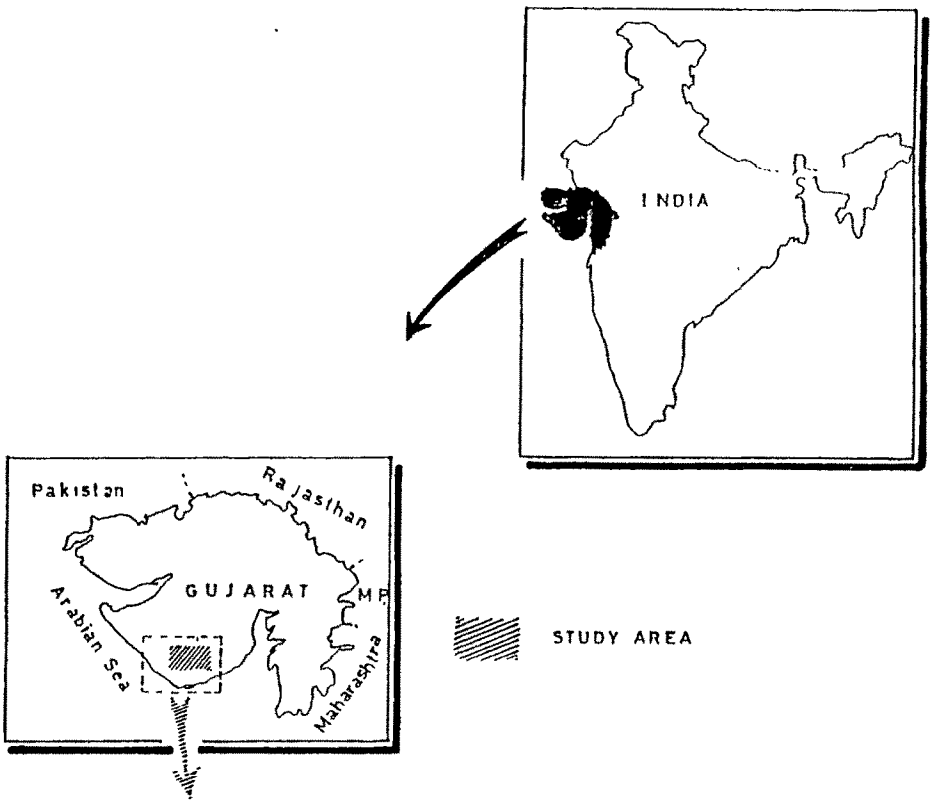

FIG. 1. LOCATION MAP

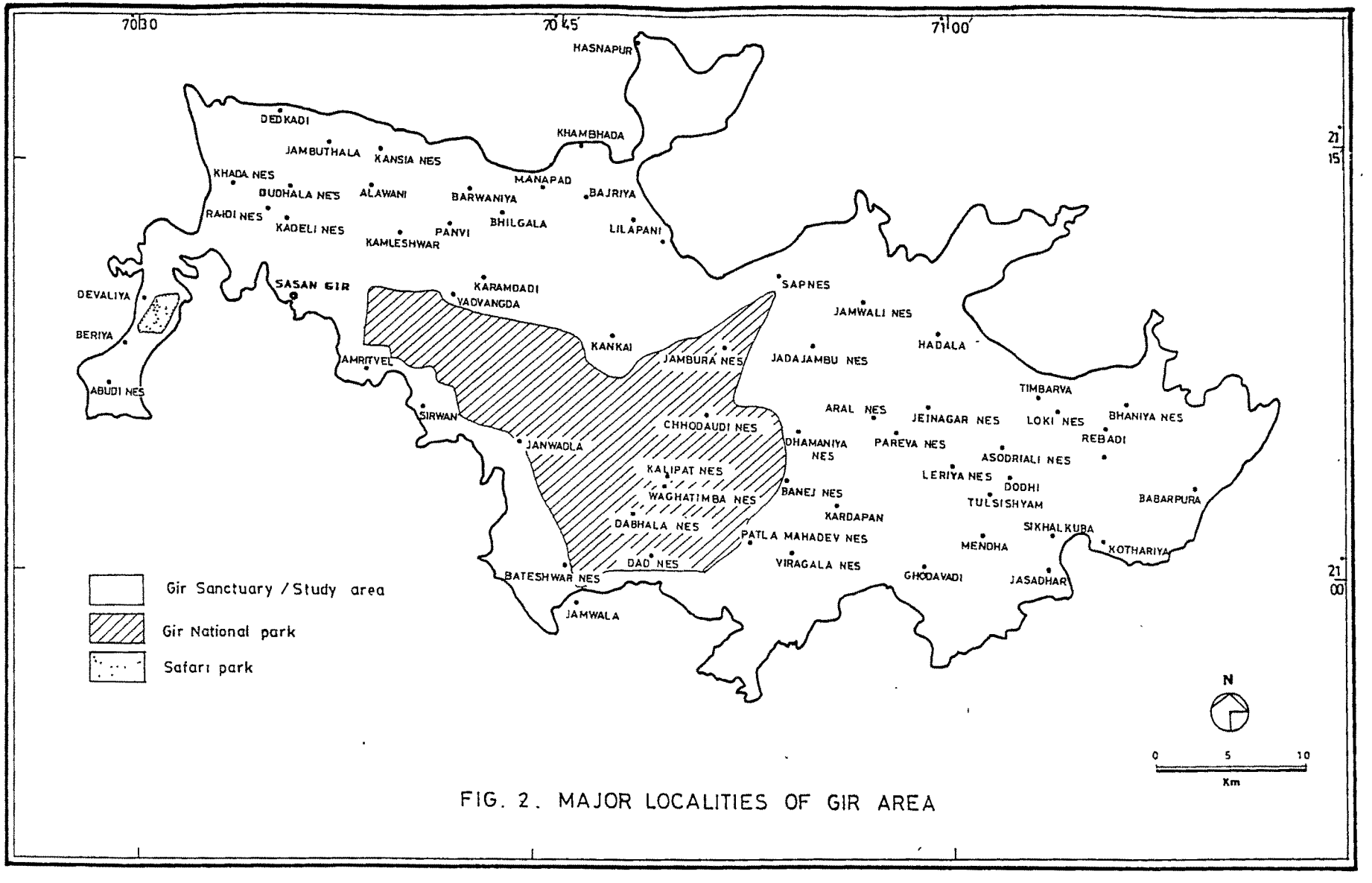

FIG. 2. MAJOR LOCALITIES OF GIR AREA

West :- Revenue areas of Malia and Mendarda talukas of Junagadh district. The Gir forms the only compact block of forest in the southern part of the Saurashtra peninsula, stretching over a length of 70 km from west to east, and 40 km from north to south.

PHYSIOGRAPHY AND DRAINAGE

The physical aspect of the area is rugged, with dense forests and extensive undulating plains, intersected by various rivers and streams. The topography of the area is more or less controlled by the lithology and structure of the geological formations.

The northern and western portions of the study area are rugged and hilly. Gir has the largest and most widely extended hill range in the district, with the highest peak not exceeding 609.60 m. The range occupies a breadth of nearly 48.28 km. Two branches of them, Nandivela and Tulsishyam are noteworthy. The hills are generally low, with the lowest peak being 150.26 m high. Nandivela, the highest hill in the Junagadh Gir to the extreme south east, is 530.65 m above M.S.L. In the Sarasia Gir, Sarkala is the highest peak which is 641.60 m above M.S.L.

There are a few notable plains in the area especially near Panvi, Kamleshwar, Janwadla, Dabhala, Banej, Kardapan, Jasadhar and Hadala.

Slopes are moderate, though here and there, steep inclines are met with. As the general slope of the land is towards the south, most of the rivers flow southwards. The entire area is divided into catchments of the following major rivers, viz. Hiran, Shingoda, Shingavadi, Machhundri, Raval, Malan, Dhantarvadi, Shetrunji and Popatdi. All the rivers are seasonal. On account of uneven topography, lithological and structural variation, the streams in the hilly terrain are flowing in all directions, forming a radial drainage pattern, whereas the drainage pattern of the streams in the low grounds is dendritic, flowing towards the Arabian sea.

CLIMATE

The Gir area has a 'tropical savanna climate' as per Koppen's (1931) classification (Fig. 3) and on the whole is hot, humid and malarious during and after the monsoon. There is a distinct dry period in the winter. During the strong monsoon season, south-westerly winds from the Arabian sea bring rainfall between June to September. While frosts are unknown, dewfall is pretty heavy, particularly during the winter months.

Seasons

The warm monsoon season extends from about June-July to September. October is a transitional period between monsoon and winter. Winter is a cool, dry period extending from

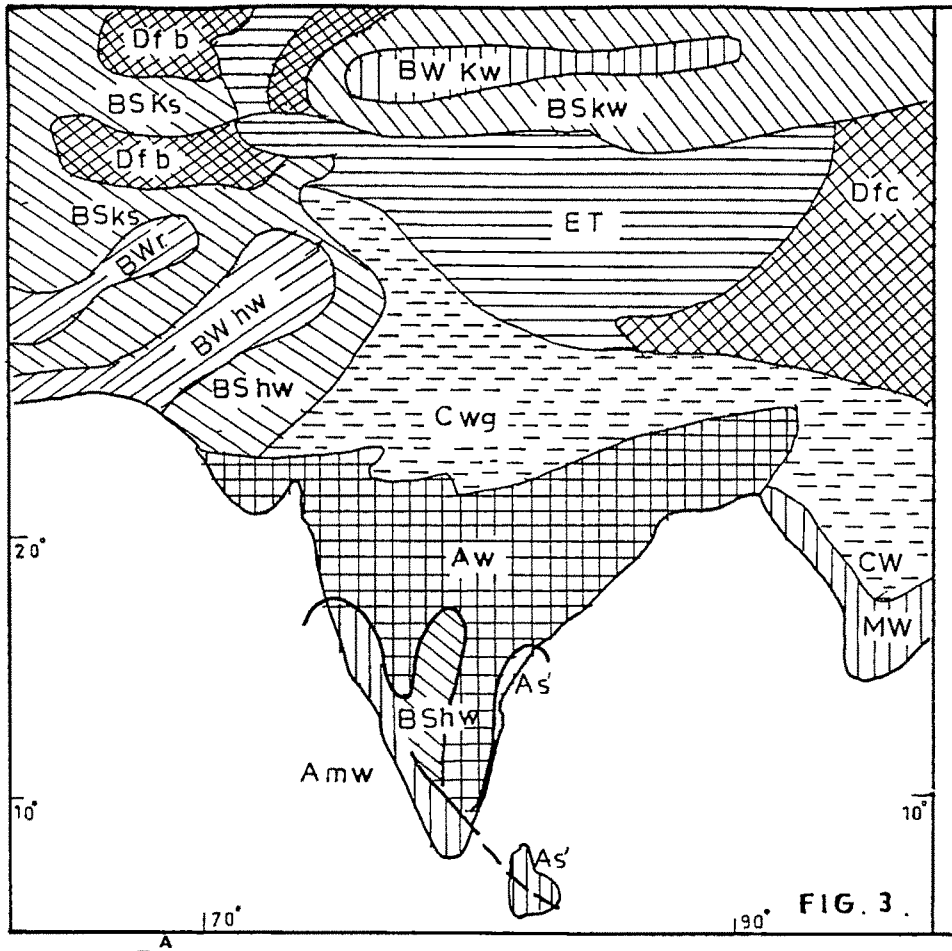

FIG. 3.

The coded symbols of the climates in Fig 4 have the following meanings.

First letter

A, C, D Sufficient heat and precipitation for high-growth trees

A, Tropical climates, as at Singapore, Malaysia

B, Dry climates, as at Aswan, Egypt

C, Humid, mesothermal climates coldest month between 64° and 27° F, Mediterranean type of climate as at Palmero, Italy

D, Humid, microthermal climates warmest month over 50° F coldest month below 27° F, as at Moscow, USSR

Second letter

S, Steppe climate.

W, Desert climate (German Wüste)

f, Sufficient precipitation each month.

m, Forest, tropical climate despite dry period

s, Dry period in summer of respective hemisphere

w, Dry period in winter of respective hemisphere

Third letter

a, Warmest month over 72° F

b, Warmest month below 72° F, at least 4 months over 50°

c, Less than 4 months over 50° F.

d, Less than 4 months over 50° F, coldest month below 36° F

h, Dry-hot, mean annual temperature over 64° F

k, Dry-cold, mean annual temperature below 64° F.

CLIMATIC ZONES OF INDIA

(AFTER KOPPEN, 1931)

A

Tropical Rainy climates

1 Tropical Rainforest Climate (Af, Am)

2 Tropical Savanna climate (Aw)

B

Dry climates

3. Steppe climate (BS)

4 Desert climate (BW)

C

Humid Mesothermal climates

5 Warm climate with Dry Winter (Cw) (Monsoon and Upland Savanna)

6. Warm climate Dry Summer (Cs) (Mediterranean)

7. Humid Temperate climate (Cf)

D

Humid Microthermal climates

8. Cold climate with Moist Winter (Df)

9. Cold climate with Dry Winter (Dw) (Monsoon Type)

E

Polar climates

10 Tundra climate (ET)

11 Climate of perpetual Frost (EF)

November to January-February. Winter is followed by a prolonged summer season with hot and dry dessicating winds, extending from February - March to May - June.

Rainfall

The average annual rainfall is about 800 mm, decreasing from about 1000 mm at Sasan in the southwest, to 650 mm at Jasadhar in the east. Thus, the precipitation steadily decreases as one proceeds from southwest to northeast. However, the annual variations in rainfall are large. About 94% of the rainfall is usually received during the monsoon, with July-August being the period of maximum rain. On an average, there are about 40 rainy days in a year. Long, dry spells during the rainy season are fairly common. Moreover, the area is roughly affected by a 4-year drought cycle.

Temperature

From the beginning of March, the temperature starts rising steadily, and May-June are the hottest months, with the maximum temperature being 44°C. After the monsoon sets in properly in mid-July, the temperature drops a little. In the post-monsoon period of October, the days are hotter than the summer, but nights are cooler. From November onwards, the average temperature gradually decreases until January, which is the coolest month, with a minimum temperature ranging between 4° to 5°C.

Humidity

Relative humidity is generally over 80% during the monsoon. In winter and the earlier part of summer, it may be around 30-40% in the afternoon.

Cloudiness

The sky is heavily clouded or overcast on many days in the monsoon. During the rest of the year, the sky is usually clear or only slightly clouded. During a few days in winter, the sky may become cloudy.

Wind

Wind is usually light to moderate, though gusty bouts are prevalent during the monsoon. In the afternoons, the wind blows mainly from the southwest to west, while in the mornings, the wind blows mainly from the northwest to northeast. In the latter part of summer and in the monsoon, the wind is predominantly from the southwest to west. Thunderstorms commonly occur during May and June, and in the monsoon, rain is sometimes accompanied by thunder. Occasionally, the area is swept by cyclonic winds during the post-monsoon period, usually around November.

RESERVOIRS

There are four man-made reservoirs for minor irrigation formed by the damming of the following rivers in the study area :

i) Hiran (Kamleshwar Dam)
ii) Machhundri,
iii) Shingoda, and
iv) Raval

These small dams are designed for irrigating the cropland outside the Gir Wildlife Sanctuary.

VEGETATION

As a result of comparatively favourable climatic and edaphic factors prevailing in the Gir, the area supports comparatively rich vegetation. The density of tree growth in the area generally decreases from west to east coinciding with the rainfall pattern. Thus, while the western half of the area predominantly carries teak and mixed deciduous forest, the eastern half is characterised by thorn forest and open savanna. The study area in general can be described as a mixed deciduous type of forest, in which Teak (Tectona grandis) forms about 70% of the crop. A detailed classification of vegetation as compared with the six forest types is given in Table : 1 and Fig. 4. All technical details and the vegetation map have been presented with the close

Table - 1

Detailed classification of the floristic elements of the study area as compared to the forest types

Forest type	Floristic elements (common names only)
Dry deciduous teak forest	Sag, sadad, timru, kalam, dudhlo, bili, apto, khakhro, hingor, etc.
Dry deciduous mixed forest	Sadad, kakad, modad, bili, saledi, kadayo, simlo, khair, dhraman, rangari, mindhol, kalukdo, dhavdo (in eastern Gir), vad, etc.
Open scrub forest	Baval, harmo, khakhro, bordi, hingor, gengdi, karamdi, dudhlo, etc.
Riverine forest	Kalam, pongaro, sadad, amli, jambudo, umbro, sag, amla, apto, piplo, atedi, nirgundi, etc.
Thorn scrub forest	Baval, khair, harmo, limdo, garmalo, bili, lodri, maditha, hingor, bordi, etc.
Savanna	Baval, bordi, khair, etc. and other grasses.

Scientific names of floristic elements mentioned in Table-1

Amla - Emblica officinalis

Amli - Tamarindus indica

Apto - Bauhinia racemosa

Atedi - Helicteris isora

Baval - Acacia nilotica spp. indica

Bili - Aegle marmelos

Bordi - Zizyphus mauritiana

Dhavdo - Anogeissus latifolia

Dudhlo - Wrightia tinctoria

Dhaman - Grewia tiliaefolia

Garmalo	-	Cassia fistula
Gengdi	-	Xeromphis uliginosa
Harmo	-	Acacia leucophloea
Hingor	-	Balanites aegyptica
Kadayo	-	Sterculia urens
Kakad	-	Garuga pinnata
Kalam	-	Mitragyna parvifolia
Kalukado	-	Holarrhena antidysenterica
Kanta seriu-		Barleria prionitis
Karamdi	-	Carissa congesta
Khair	-	Acacia catechu
Khakhro	-	Butea monosperma
Limdo	-	Azadirachta indica
Maditha	-	Dichrostachys cineria
Mindhol	-	Xeromphis spinosa
Modad	-	Lannea coromandelica
Nirgundi	-	Vitex negundo
Piplo	-	Ficus religiosa
Pongaro	-	Derris indica
Rangari	-	Morinda tinctorea
Sadad	-	Terminalia crenulata
Sag	-	Tectona grandis
Saledi	-	Boswellia serrata
Simlo	-	Bombax ceiba
Timru	-	Diospyros melanoxylon
Umbro	-	Ficus racemosa
Vad	-	Ficus benghalensis

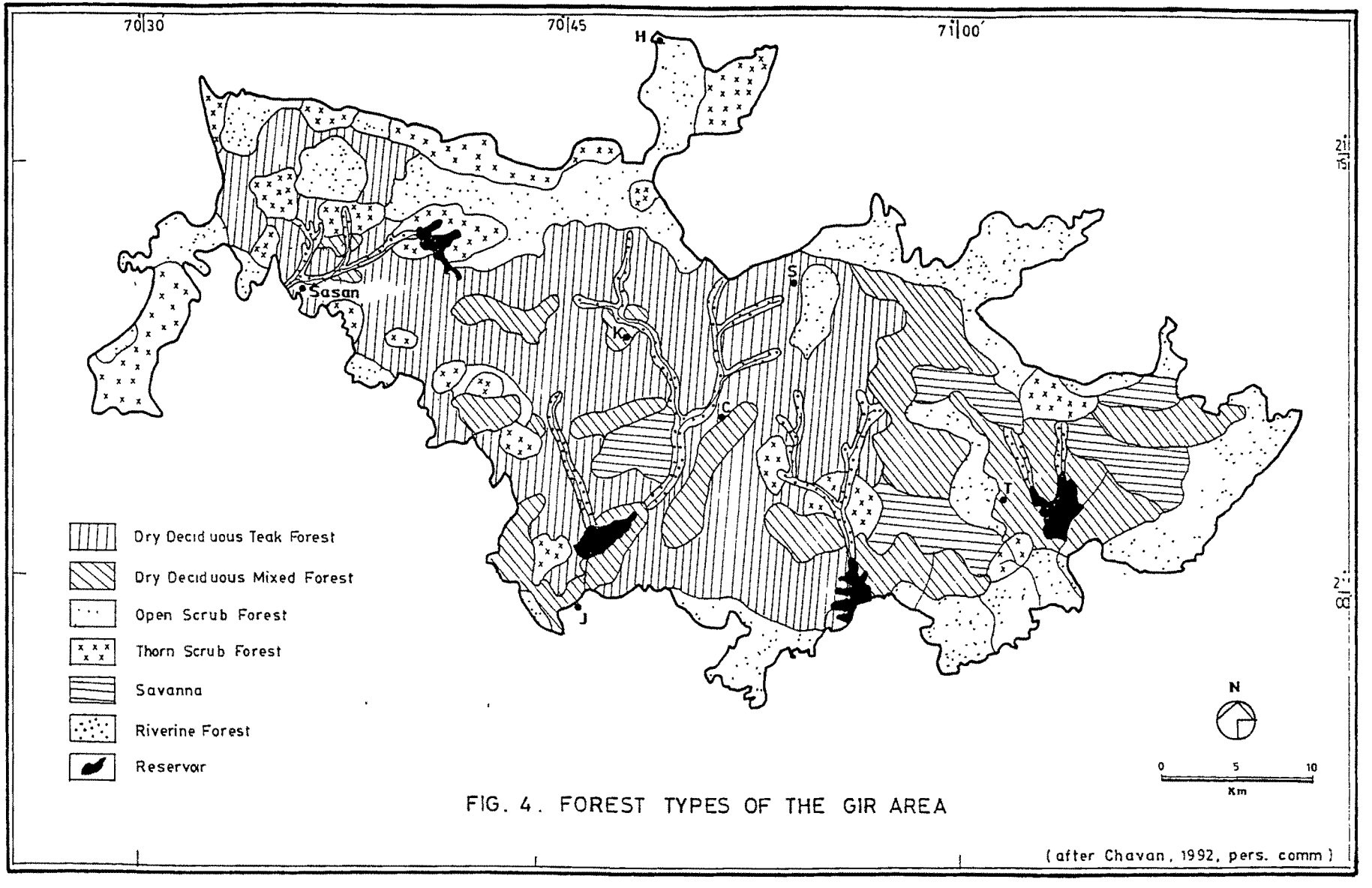

FIG. 4. FOREST TYPES OF THE GIR AREA

(after Chavan, 1992, pers. comm.)

guidance of Shri Sanat Chavan, Conservator of Forests, Gujarat Government. The other main floristic associates are Behda (Terminalia bellirica), Karanj (Derris indica), Baval (Acacia nilotica), Babar khair (Acacia ferruginea), Haldarvo (Adina cordifolia), Ron (Soymida febrifuga), Rayan (Manilkara hexandra), etc. Bamboo (Dendrocalamus strictus) also occurs in pathces. The common species of shrubs in the undergrowth are Indrajav (Holarrhena antidysenterica), Antedi (Helicteres isora), Karamdi (Carissa conjesta), Akdo (Calotropis gigantiea), Zil (Indigofera oblongifolia), etc. The common climbers are Khairvel (Acacia pinnata), Amarvel (Cuscuta reflexa), Chanothi (Abrus precatorius), Ekal kand (Dioscorea bulbifera) and Bhoin kand (Dioscorea hispida).

The good quality fodder grasses in the area are Shaniyar (Sehima nervosum), Zinzvo (Dichanthium annulatum), Moshti (Iseilema asthephoroides), Dharafdo (Chrysopogon montanus), and Bhangoru (Apluda mutica). Other grasses not of good fodder value are Gandharu (Cymbopogon jwaraneusa), Kagado (Hetropogon controtus) and Lapdu (Aristida adscensionis).

FAUNA

The study area has a very representative faunal population, though many of the species, particularly the larger ones, are today threatened. Gir is the only refuge of about 284 Asiatic Lions (Panthera leo persica) outside the African continent. The other large predator in the area apart from the lion is

the Leopard (Panthera pardus). Other carnivores include the Striped Hyaena (Hyaena hyaena), Jackal (Canis aureus), Jungle Cat (Felis chaus) and Civet Cat (Viverricula indica).

The primary consumers include Chital (Axis axis), Sambar (Cervus unicolor), Nilgai or Blue-Bull (Boselaphus tragocamelus), Four-horned Antelope or Chausingha (Tetraceros quadricornis), Chinkara (Gazella gazella), Wild Boar (Sus scrofa) and Hanuman Langur (Presbytis entellus). Other smaller mammals include Ratel (Mellivora capensis), Pangolin (Manis crassicaudata), Mongoose (Herpestes edwardsi), Black-naped Hare (Lepus nigricollis) and Porcupine (Hystrix indica). Plates of some representative fauna are given in Appendix - I.

Kamleshwar Dam (Hiran river) in the study area has India's largest concentration of Marsh Crocodile (Crocodilus palustris) in the natural environment.

Among reptiles occurring in the area that need to be mentioned are, Rock Python (Python molurus), Cobra (Naja naja), Monitor Lizard (Varanus monitor), etc.

The area has a rich and varied avifauna. The total number of observed species exceeds 250. These include a number of water birds, raptors, pheasants, doves, woodpecker, flycatchers, warblers, wagtails, flowerpeckers, mynas, orioles, etc.

COMMUNICATION AND TRANSPORT

The study area is served mostly by a network of fair-weather roads which are not negotiable during the rains. In addition, there are four state highways passing through the sanctuary. These roads connect (1) Veraval with Junagadh via Sasan, (2) Sasan with Visavadar, (3) Jamwala with Dhari, and (4) Una and Tulsishyam with Dhari. The most important motorable (asphalted) road passes through the area in the south from Jasadhar, and extends right across to Dhari to the north.

Sasan Gir, which is the research base, is well connected by road, rail and air (Fig. 5). Sasan Gir is connected by state transport bus service and local transport services. Sasan Gir railway station is situated on the meter gauge line of Western Railway connecting Ahmedabad with Veraval on the west coast. The nearest airport is about 90 km away at Keshod, which is connected with Bombay by a daily air service during the fair season.

Sasan Gir, being the headquarter of the Gir Wildlife Sanctuary, is facilitated by wire-less and telephone links.

PURPOSE AND SCOPE OF INVESTIGATION

This study includes a systematic geological, geomorphological, pedological and hydrological study of the Gir Forest area with an aim to make an assessment of the

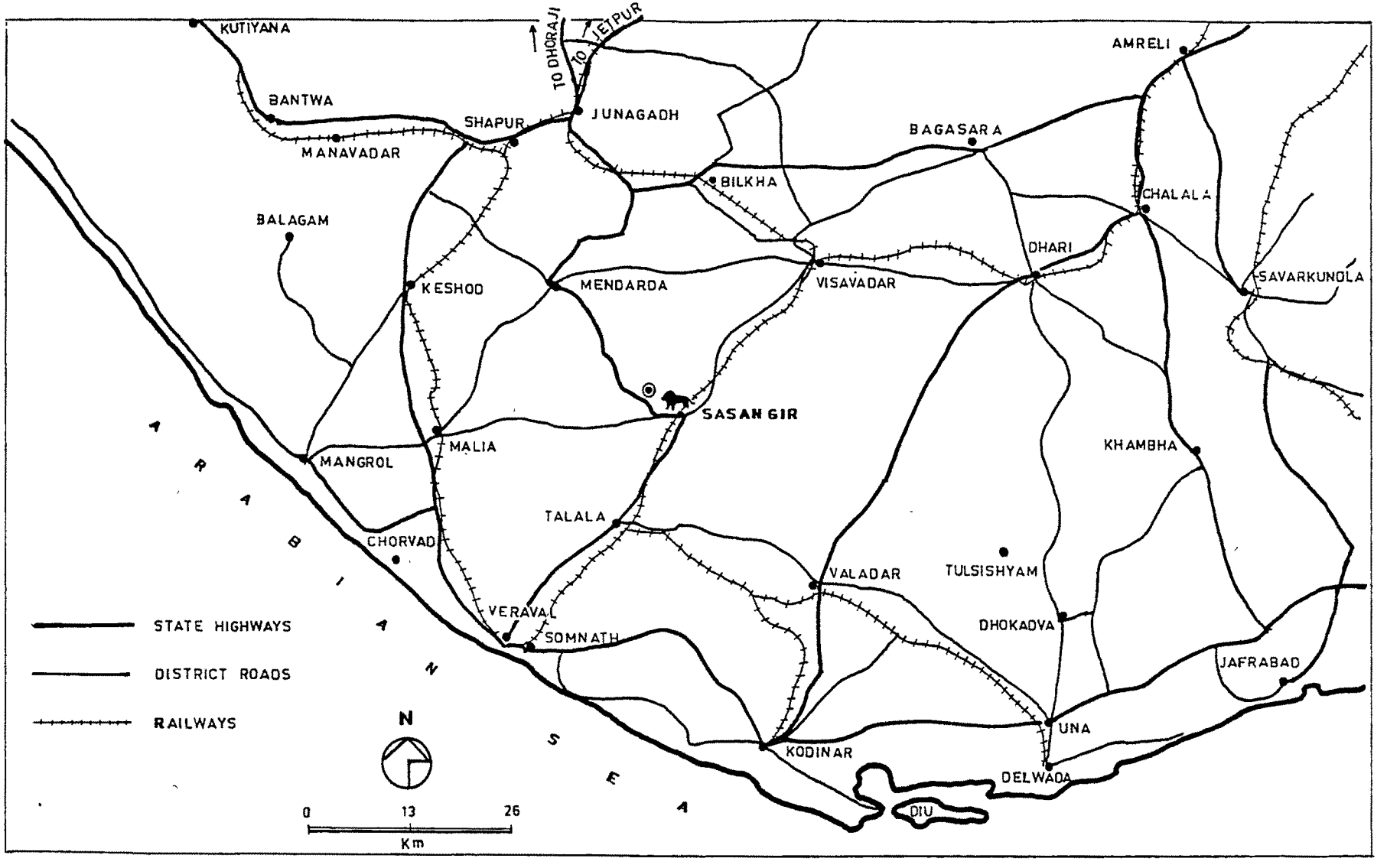

FIG. 5. COMMUNICATION AND TRANSPORT

impact of all the above four parameters on the overall geo-environment of this sole compact forest zone, in an otherwise semi-arid to arid region.

Detailed discussions with eminent naturalists, wildlife experts and relevant forest officials concerned with the preservation and conservation of this fragile forested zone, revealed that there were several glaring problems facing them. An attempt has been made to address these problems specifically, so as to make this study application - oriented instead of it being only an academic one.