CHAPTER TWO

MATERIAL AND METHODS

MATERIAL :

Western Ghats is one of the most important geographical and geological phenomenon in the Indian subcontinent. The hill range influences the climate and annual rainfall of the country to a great extent. The high rainfall areas in the Western Ghats are thickly vegetated catchments of a large number of eastwardly and westwardly flowing rivers and thus have great environmental importance.

In Maharashtra, the Western Ghats, locally called as 'Sahyadri', give rise to a series of north-south hill ranges built of horizontal sheet of lava having volcanic origin. These groups of hills are almost parallel to the west coast. The elevation of the region ranges from 600 meters in the river valleys in the east to 1400 meters at the crest line with an average of 900 meters above mean sea level. The crest line of these hills is broken and marked by a peculiar saddle like formations. The western slopes of the hill range are precipitous and have escarpments, all along with degraded vegetation. Due to the heavy rainfall and steep mountain slopes the soil erosion is extreme which exposes the lateritic soil on the hill tops and redish brown soil on hill slopes. Formation of rocky belts due to the high erosional rate is the characteristic feature of the study area.

The Deccan traps form the entire western banks of the region where these traps are either vesicular or non-vesicular. The vesicular type are soft and break easily. The plateau tops in the study area show capping of 60-80 feet of laterite.

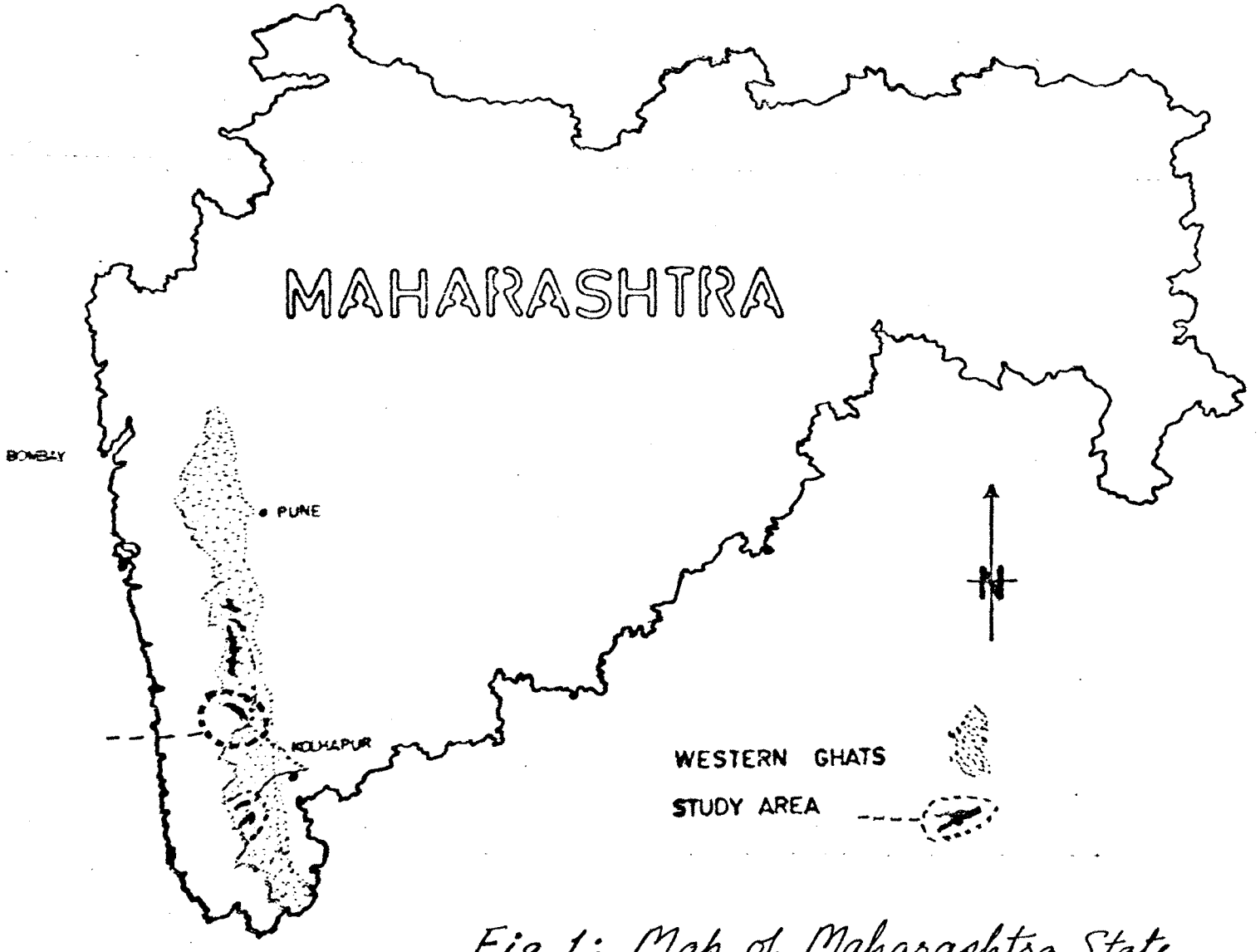

Fig 1: Map of Maharashtra State with the location of Study Area, Chandoli Wildlife Sanctuary.

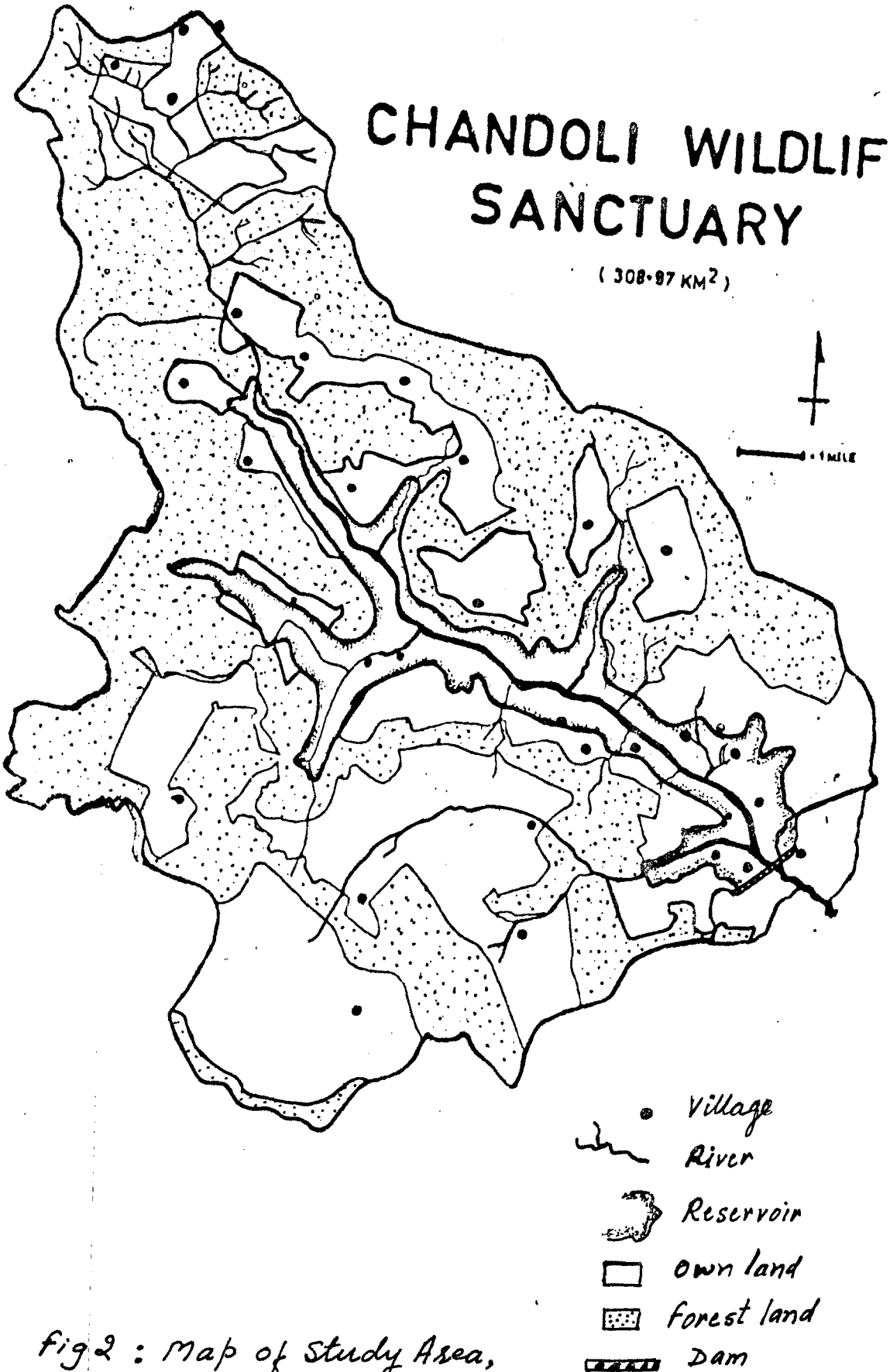

fig 2 : Map of Study Area, Chandoli Wildlife Sanctuary and Warna Dam Catchment.

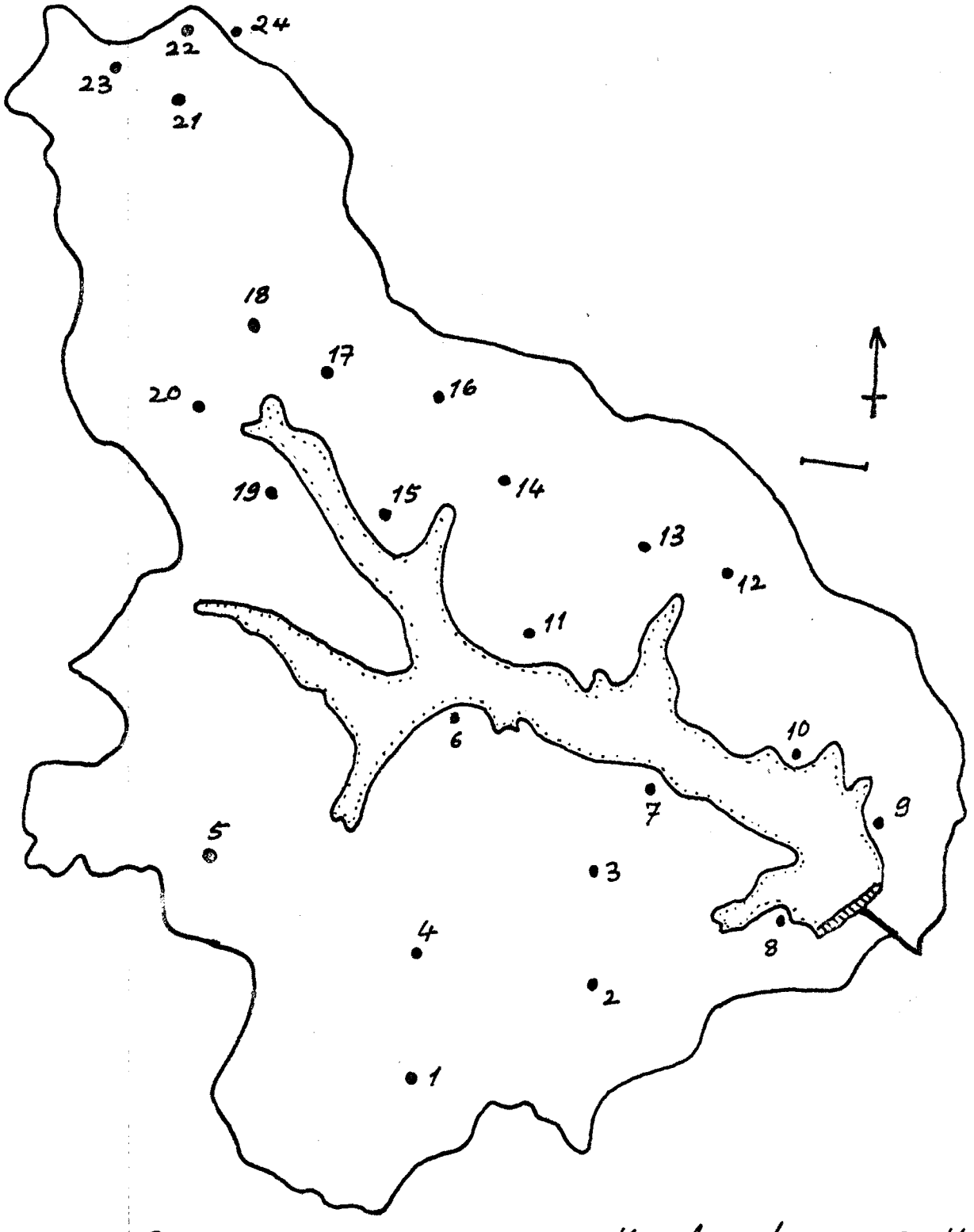

Fig 3: Map showing the locations of the villages in Chandoli Wildlife Sanctuary along with the corresponding numbers.

The climate of the region is much less extreme, almost temperate and uniform. This is mainly because of the high altitude of the area, though in subtropics, which is about 900 meters or more. There are three distinct seasons i.e. summer (March to May), rainy (June to October) and winter (November to February). The seasons do not show abrupt changes or extremes of heat or cold.

The average maximum and minimum air temperatures of the study area are 31.7°C and 19.1°C respectively. The mean summer temperatures were about 29.5, 25, 26.12 and 27.8°C in the years 1984, 1985, 1986 and 1987 respectively. However, periodic local temperature fluctuations beyond the range are very remote but are not uncommon. The average wind velocity recorded at certain fixed stations in the area was 11 km/hr.

The rainfall of the region is heavy and is chiefly influenced by the south-west monsoon. The annual average rainfall is 5279 mm. Table 2 shows the monthly and annual average values of precipitation for the period of 7 years i.e. from 1980-1986. The maximum rainfall is observed during the 4 months of rainy season (June-September). Pre and post monsoon thunder storms are also common in the hills. Figure 4 shows the monthly average rainfall for a period of 7 years. There has been consistant decline in the annual rainfall of the study area for the past 6 years (Fig. 5). Though people associate it with the decrease in the vegetation of the region in the last few decades, there is no apparent correlation with the two factors. The drop in

Table 2 : Monthly and annual averages of the rainfall in mm from the Chandoli Wildlife Sanctuary during 1980 to 1986.

Month	1980	1981	1982	1983	1984	1985	1986	Average
January	0	0	0	0	0	0	0	0
February	0	0	0	0	5.36	0	0	0.76
March	0.12	9.05	0	0	16.03	30.02	0.70	7.98
April	64.65	14.65	0.1	0	13.95	1.72	9.88	14.99
May	19.56	17.68	90.82	26	0	42.84	161.24	51.16
June	1400.73	753.88	604.88	1163.69	1178.29	931.86	1238.25	1038.79
July	2265.27	1839.12	1802.00	1691.48	1927.08	1608.89	1169.44	1757.61
August	2920.10	1690.55	2109.83	1873.69	1275.46	1428.26	1394.47	1813.19
September	280.27	490.99	1621.7	452.38	270.77	144.52	90.08	478.67
October	16.87	48.64	91.24	85.86	111.91	175.36	27.62	79.64
November	58.57	20.1	64.04	28.28	0.03	6.39	38.31	30.81
December	41.00	0	0	2.28	0	0	0	6.18
Annual rainfall	7067.17	4884.68	6384.61	5786.05	4798.90	4369.87	4129.99	5279.80

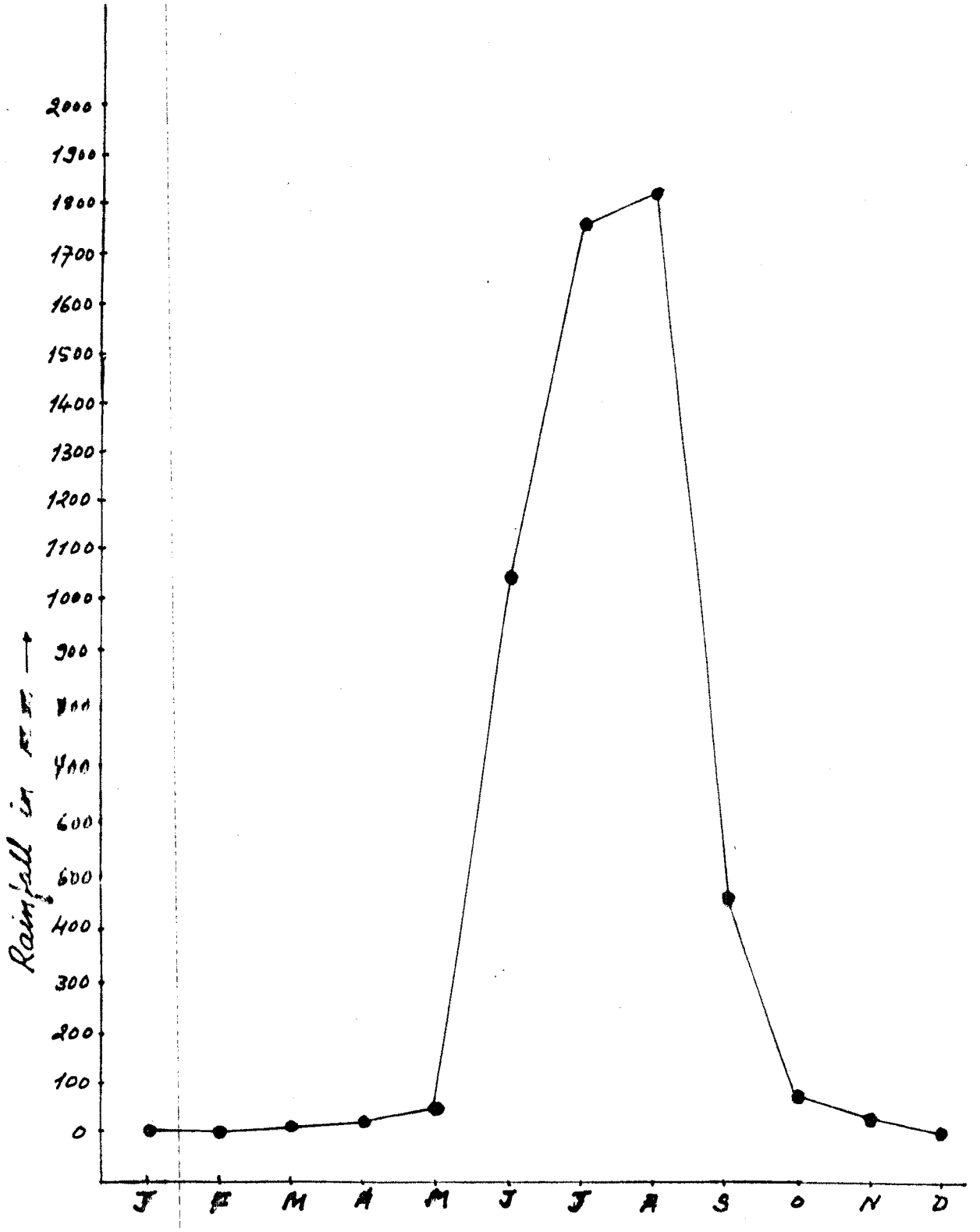

Fig 4 : Average monthly rainfall for 7 years, (1980 - 1987), from the Warna Dam Catchment.

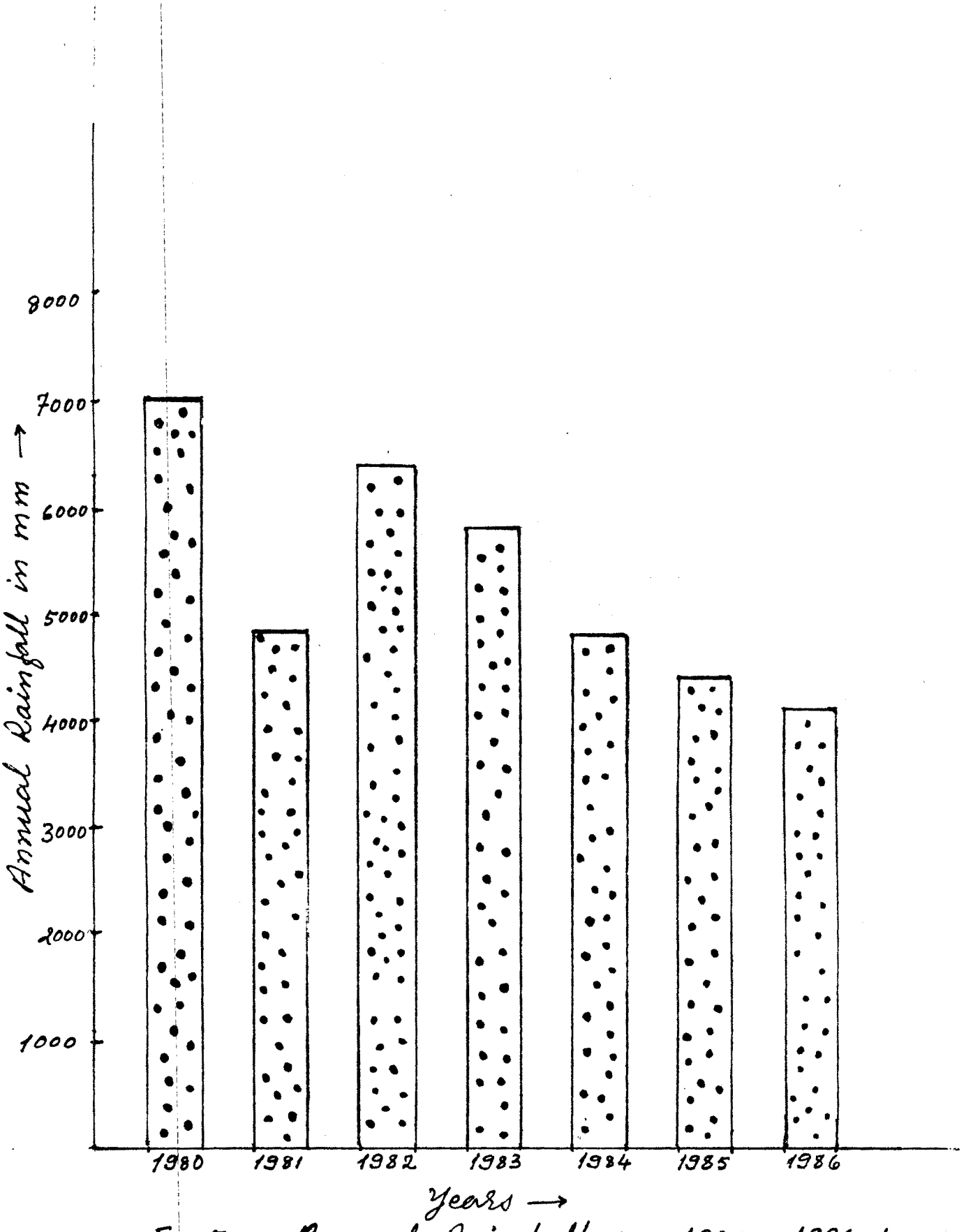

Fig 5 : Annual Rainfall in 1980 - 1986, in the Warna Dam Catchment.

the rainfall in the catchment, from 1980 till 1986 is estimated to be about 41.56 %. The rainfall in the year 1987 was expected to be even lesser than the previous years.

The vegetation of the study area is primarily of sub-tropical semievergreen type with patches of evergreen type. On the basis of Champion and Seth (1968) the vegetation could be classified as a mixture of tropical semievergreen and moist deciduous forest.

Samant et al. (1986) reported that this part of the Western Ghats harboured 230 sp. of common plants out of which 132 sp. were evergreen and semievergreen type, 87 moist deciduous and 11 drydeciduous type. These plants are later classified into 53.47% trees, 29.56 % shrubs and creepers and 16.98 % grasses and herbs. During the present studies 162 species of plants have been recorded. Out of these only 4.93 % abundant, 19.13 % common and 75.92 % uncommon (Table 4).

The study area i.e. Chandoli Wildlife Sanctuary is 308.9 sq.km. and is created by Govt. of Maharashtra on 16 September 1985 to conserve the excellent flora and fauna of the region(Fig.2). This study area includes the entire catchment of Warna Dam (301 sq.km.) and some adjoining area (7.9 sq.km.) of Gothane (Nav) village, part of which is outside the Chandoli Wildlife Sanctuary.

The Chandoli Wildlife Sanctuary (CWS) is spread in the four districts of Sangli (Taluka Shirala), Satara (Taluka Patan), Kolhapur (Taluka Shahuwadi) and Ratnagiri (Taluka Sangmeshwar) of South Maharashtra. Prior to the construction of the Warna Dam

across river Warna at Chandoli the catchment area of the river had 33 villages with a population of 11,300 people. The high rainfall area having a somewhat flat peripheral region with ridges and slopes towards the centre forms a depression which had excellent potential of damming river Warna, a major tributary of River Krishna in its upper watershed. The river warna originates near village Patharpunj in Satara district at an elevation of 3200 feet. It flows down stream in south east direction and enters Sangli district. A 40 meter high waterfall named 'Kandardov' with a 70 meter diameter pool at the bottom is an interesting feature in the upper catchment of the river warna. The pool is surrounded by steep slopes with thick vegetation on three sides. This spot is situated near the village Chandoli Khurd. Another major source of perennial water to the river is 'Kaswacha Vadha' a rivulate with its origin near village Dhakale. The rivulate runs downstream in the north-east direction and near village Tanali it has a waterfall. A micro hydro-electric project has been proposed on this waterfall. The river Warna and Kaswacha Vadha confluence near the village Tambave (now submerged in the reservoir).

The table 3 gives the profile of the villages in the study area. By the time the study was initiated 9 villages in river basin were shifted out of the catchment as the village areas were submerged completely. They were Sidheshwar, Atoli, Bhogiv, Kanholi, Karde, Wadihudumb, Ambole, Devare, Chandoli (Br). The flooding of the dam also partially submerged 5 villages namely Tambave, Petlond, Nandoli, Kundalpur and Sonarli.

Table 3 : Profile of the 33 villages from the Chandoli Wildlife Sanctuary (Based on 1981 Census).

Sr. No.	Name of Villages	Total area (ha)	Altitude (feet)	Total Population	Total No. of households	Completed Schedule	Remark
	Dist. Ratnagiri Tal. Sangameshwar						
1.	Gothane (Khadi)	2296	2878	501	102	57	N.S.
	Dist. Kolhapur Tal. Shahuwadi						
2.	Nivale	1409	3250	354	82	35	N.S.
3.	Tanali	819	2750	244	60	20	N.S.
4.	Dhakale	1504	3000	414	94	50	N.S.
5.	Chandel	2321	3084	396	61	36	N.S.
6.	Sonarli	996	2250	687	132	18	P.S.
7.	Durgawadi	822	2000	567	120	52	N.S.
8.	Tambave	693	2230	377	71	21	P.S.
9.	Wadihudumb	244	-	205	44	-	C.S.
	Dist. Sangli Tal. Shirala						
10.	Khundalapur	684	2750	722	159	32	P.S.
11.	Nandoli	987	2170	848	173	35	P.S.
12.	Petlond	947	2000	767	158	26	P.S.
13.	Zolambi	1800	2976	368	51	38	N.S.
14.	Takale	899	2750	350	82	37	N.S.
15.	Veti	898	2750	121	37	24	N.S.
16.	Lotiv	647	2750	145	32	21	N.S.
17.	Nivale	945	3250	147	38	25	N.S.

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Table 3 (Contd..)

18. Gave	548	2939	55	12	11	N.S.
19. Chandoli Kh.	1161	3232	80	19	14	N.S.
20. Jawali	609	2014	137	28	19	N.S.
21. Rundiv	1812	2500	119	24	18	N.S.
22. Sidheshwar	1909	-	273	64	-	C.S.
23. Ambole	618	-	346	84	-	C.S.
24. Atoli	324	-	339	78	-	C.S.
25. Davare	277	-	238	51	-	C.S.
26. Kanholi	280	-	326	60	-	C.S.
27. Karade	711	-	636	134	-	C.S.
28. Bhogiv	777	-	136	35	-	C.S.
29. Chandoli Bk.	384	-	603	131	-	C.S.
Dist.Satara Tal. Patan						
30. Male	1690	2962	281	57	31	N.S.
31. Kolne	474	3116	146	26	12	N.S.
32. Patherpunj	963	3116	163	40	20	N.S.
33. Gothane	1132	3200	209	41	23	N.S.
Total :-	32580		11300	2380	675	N.S.= 19 C.S.= 9 P.S.= 5

The initial 33 villages in the pre-impoundment stage had an area of 32580 ha which would be reduced to 28,268 ha after the 4312 ha of submergence in the impoundment. The average area per village was estimated to 987 ha and population per village was 342 individuals. The total number of households in the area were 2380 which came to about an average of 72 house per village. After the completion of the 4th phase out of the 7th phases and also after declaring the area as wildlife sanctuary the picture has changed as the following. Now there are 19 complete and 5 partial villages in the study area with a total population of 7320; with 1220 households (1986-87). Therefore about 5556 individuals have been shifted out of the study area. The villages shifted being comparatively larger in size and population as they were located in the fertile Warna river basin, about 49.16 % the original population has been or is being shifted out of the catchment area.

Warna Dam is going to be the tallest earthern dam in the country. It is a multi-purpose project mainly for hydel and irrigation. Its initial construction cost was estimated to be 81.97 crore rupees in 1976 but now it has been elevated to a minimum of 257 crores in 1986 i.e. 300 times more within 10 years. This excludes the rehabilitation costs and non tangiable environmental costs. The Warna irrigation project has been funded by the World Bank. The salient features of the dam in nut shell are given below.

The Salient features of the Warna Irrigation Project.

1. Location of dam : Near villages Chandoli and Amboli in districts Sangli and Kolhapur respectively.

2. Catchment area	:	301 sq.km.
3. Rainfall range in the Catchment	:	3170 to 6980 mm.
4. Type of dam	:	Central earth dam in the gorge with masonary dam on either flanks with irrigation outlets.
5. Length of dam	:	158 meters
6. Height above river bed	:	75.70 meters
7. Gross storage	:	963.97 Mcum.
8. Area under submergence	:	4312 ha
9. Command Gross	:	109.498 ha
Irrigation	:	87,000 ha.
10. No.of villages affected		
a) With gaothan	:	16
b) Only land	:	9
11. Population affected	:	4730
a) Kolhapur Dist.	:	1709
b) Sangli Dist.	:	3021

METHODS :

The study was conducted for a period of two years from June 1986 till July 1988. Initially after identifying the research problem, a detail review, of the available literature and Government reports on dam catchments and Wildlife Sanctuaries in Maharashtra State, was taken to design the plan of work.

Since no other work of the nature and magnitude of the undertaken problem has ever been done in the northern Western

Ghats or in the State of Maharashtra there was no basic data available. Initial visits were made to the study area to get an idea of the practical problems likely to be encountered during the investigations and suitable modifications in the working plan were made in time.

Prior to conducting an extensive survey for biological diversity of the study area, a pilot survey was conducted in December 1986 in which 50 households were randomly surveyed from different villages in the Chandoli Wildlife Sanctuary. This basic data was used in formulating the final questionaire which was administered during the study period.

While in the field, whereever possible assistance of a local guide was always taken for better understanding of the area, to identify local plants, to get help in locating and identifying wild mammals from pug marks and signs and mainly to develop rapport with local people.

The research strategy was based on field observations and survey technique :

a) Study of the present status of wildlife by field observations, dropings and scat analysis, pug marks and signs etc. and study of skins, trophies from the region etc.

b) As there is absoulate lack of any information about the wildlife, and geological changes in the past. It was even more important to collect base line data on the past and present status of wildlife and direct and indirect human impact on it. The most suitable and efficient method found to collect the required data was stratified random sampling method of socio-ecological survey.

A total of 669 households were interviewed from all the 24 villages from the Chandoli Wildlife Sanctuary. During the investigations assessment method was used for the evaluation of the impact of human activities like deforestation, agricultures grazing, hunting, developmental activities etc. The questionaire prepared was very elaborate, having questions on 18 main topics and was 21 printed pages. The respondents were selected randomly from each village where about 60 % of the total households were covered.

During the investigations frequent visits were made to all the remote villages and settlements on foot as there was no transportation facility available of any kind in the hilly and totally isolated catchment in the western ghats.

Average time required for one interview was about 60 minutes. The interviews were taken informaly after developing good rapport with the respondents. Normally the head of the household was interviewed in order to get a better picture of the past status of biological diversity of the area and the various environmental changes taking place for last few decades due to the developmental activities including the construction of Warna Dam. In the absence of the household head his wife was interviewed.

During the field studies the investigator camped in the villages for a period of 3 day to one week to study the flora and fauna of the region and also to get sufficient time for interviews. With the assistance of the local guides the vegetation and wildlife distribution in the region was studied

by visiting remote out of the place areas. Repeated visits were made to the areas of research significance. Due to the scope of the research problem, nature of the work involved and time and resources at disposal the investigations were essentially qualitative in nature. The emphasis of the work was mainly on the general impact of human activities which directly or indirectly affect the animal diversity in the newly created Chandoli Wildlife Sanctuary.

The observations on animal diversity were restricted to mammals as there was more interaction between this vertebrate class and the human population of the area. Though some difficulties were encountered because of the difficult terrain, heavy rainfall and thick vegetation, in the observations of mammals, with the help of local guides the problems were sorted out. Also the nature of the difficulties in direct observations were on account of the ~~nature~~ characteristic of some mammelian species i.e. shy nature, small size, nocturnal or arboral habits etc. Therefore their pugmarks, seats, trails, sounds, nests, kills etc. were profoundly used in studying their distribution and abundance.

As the secondary source of information emphasis was also given on the study of skins and trophies with local hunters and poachers. Personal contacts with them revealed excellent information after the initial difficulties.

The significant data thus generated was coded and transformed on code sheet and later fed to the computer. The computer facility used was the 4th generation computer. Wipro S-6168 having Unex System, with the Computer Centre, Shivaji

University. All the data collected during the present investigations was computer analysed and the print outs were used for the dissertation writing.

The methodology of the present investigations was largely based on "Environmental Science Methods by Haynes (1982) and 'Social Surveys' by Bentham and Moseley (1982). For framing the questionaire help was taken from Prof. K.C. Malhotra, Indian Statistical Institute, Calcutta.

The study was a part of a major research project entitled, "Studies on the Conservation Protential of the Biological Diversity of Animal Origin from the Western Ghats" sponsored by the Department of Environment, Govt. of India. The work was carried cut from June 1984 to January 1988.

The research undertaken was pioneer in nature as no information on similar type of work was available from the Western Ghats in Maharashtra. The scope of the work was limited to the Chandoli Wildlife Sanctuary which is also the catchment of the Warna Dam. Objective of the work was to generate basic data about the present status of important mammals from the study area and evaluate the impact, direct and indirect, of the human activities in the region on the diversity and distribution of the mammals.

The study was expected to generate basic information, for the first time about the Chandoli Wildlife Sanctuary, which could be used in the preparation of the management plan for the sanctuary, rehabilitation of the people in the area and the future developmental activities in this region in the Western Ghats.