

Flora of India
Series 3

FLORA OF NASIK DISTRICT

P. LAKSHMINARASIMHAN
&
B.D. SHARMA



BOTANICAL SURVEY OF INDIA

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Date of Publication : September 23, 1991

Price :

Cover Photo : A flowering twig of *Crinum defixum*

Published by the Director, Botanical Survey of India,
P-8, Brabourne Road, Calcutta-700 001 and Printed at
Deep Printers, 3/26, Ramesh Nagar, New Delhi-110 015

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PREFACE

The Botanical Survey of India since its reorganization in 1954, has been engaged in floristic survey of unexplored and under - explored parts of the country. From early 1980s, the department has taken up publication of new flora of India under four series : Series 1 on the national flora comprising taxonomic revisions of families, tribes and genera primarily of flowering plants for the whole country ; Series 2 on the floristic inventories of different states/Union Territories ; Series 3 pertaining to the floras of important districts and Series 4 to include special publications. Several districts of floristic significance from different states have been taken up for survey and study to eventually build up a good base material for writing the state floras and family revisions for the national flora.

The Nasik district in Maharashtra state with different topographical, edaphic and climatic features comprising a rich flora in its varied types of forests was not too well - known botanically. Accordingly, a systematic study of the flora was carried out by the authors from the Western Circle, Botanical Survey of India, Pune.

The study carried out by one of us (P.L.) while working as a Research Scholar under the supervision of the other (B.D.S.) was initially prepared as a thesis for award of Ph. D. degree of the Pune University. The thesis was suitably modified for publication by the Botanical Survey of India as a district flora.

In this work, the introductory chapter outlines the location, general topographical, climatic features, the past and present botanical surveys, general vegetation types and plants of medicinal, economic, horticultural and fodder value. Information on the ethnobotany and plants used in industry has also been provided.

The taxonomic parts deals with keys to the families, genera, species and infraspecific taxa. Notes on distribution, frequency, phenology and field collection numbers have been provided for each taxon. Line drawings for some species have been included. Every effort has been made to bring the nomenclature upto date following the latest International Code of Botanical Nomenclature.

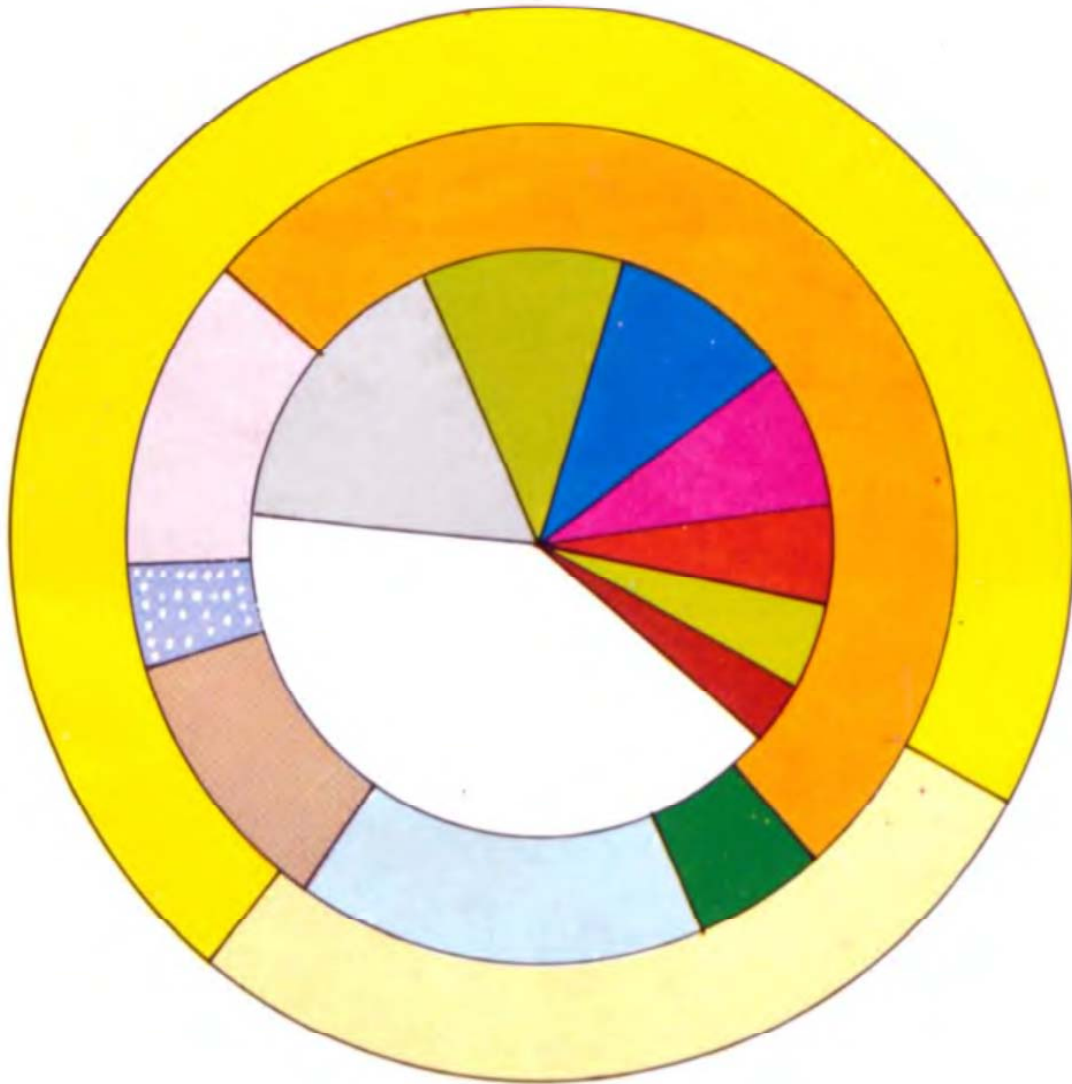
The authors wish to record their sincere thanks to Dr. M.P. Nayar, former Director, Botanical Survey of India for approving the publication.

















Thanks are also due to Sarvasree S.C. Pal, R.G. Bhakta, P.K. Dutta, H.M. Mukherjee, Samiran Roy and S.K. Sur of the Publication Section, Botanical Survey of India for their help in printing this book. One of us (P.L.) gratefully acknowledges the Director, Botanical Survey of India, Calcutta for the award of Research Fellowship and for facilities to carry out this work.

Botanical Survey of India
Calcutta
September 9, 1991

P. LAKSHMINARASIMHAN
B. D. SHARMA

SPECTRUM



	DICOTS 72.68%		SHRUBS 9.3%
	MONOCOTS 27.32%		WEEDS 18.80%
	HERBS 61.2%		ECONOMIC PLANTS 8.3%
	EPIPHYTES 1.5%		AQUATIC PLANTS 7.86%
	TREES 15%		MEDICINAL PLANTS 5.14%
	CLIMBERS 12%		HORTICULTURAL PLANTS 4.51%
	PARASITES 1%		FODDER PLANTS 2.62%
	OTHERS 52.46%		POISONOUS PLANTS 0.31%



A fruiting twig of *Miliusa tomentosa*



A flowering twig of *Crinum defixum*



A flowering twig of *Calycophytus floribunda*



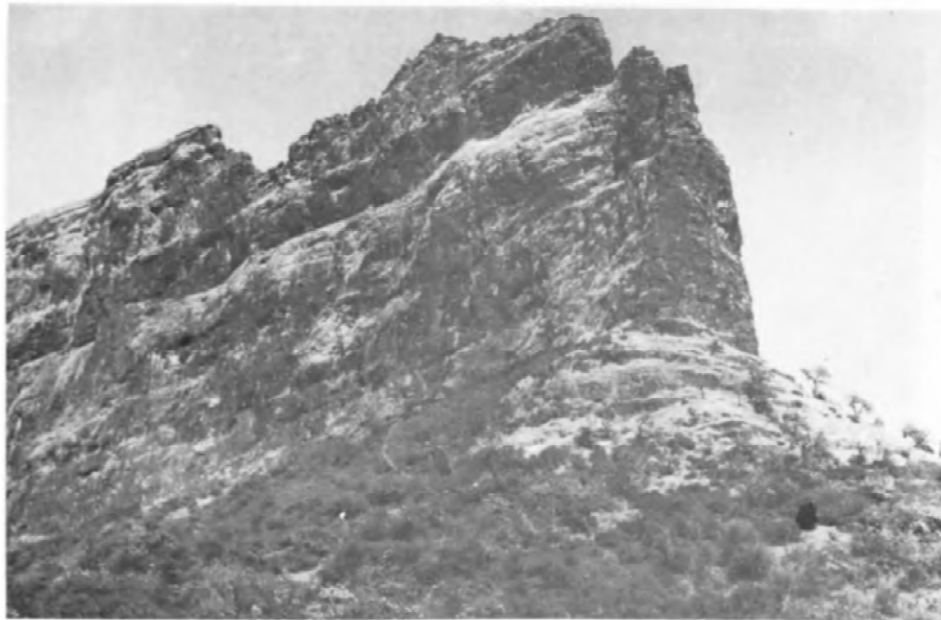
Carya arborea in full bloom



A flowering twig of *Climatis triloba*



Heterophragma quadrilobulare in flowers and young fruits



General view of Saptashringi hill comprising *Carvia callosa*, *Dendrocalamus strictus*,
Ficus amplissima, *Heterophragma quadriloculare*, *Maytenus emarginata*, etc.



Markandey hill showing *Carvia callosa*, *Ficus racemosa*, *Heterophragma quadriloculare*, *Syzygium cumini*, *Tectona grandis*, *Terminalia crenulata*, etc.



Vegetation on either side of nallah at Pimpalsorda comprising *Acacia chundra*, *Dendrocalamus strictus*, *Lannea coromandelica*, *Mitragyna parvifolia*, *Tectonia grandis*, *Terminalia crenulata* and *Wrightia tinctoria*



General view of forests at Pimpalsonda comprising *Acacia chundra*, *Holarrhena anti-dysenterica*, *Lannea coromandelica*, *Tectonia grandis*, *Terminalia crenulata* and *Wrightia tinctoria*



General view of the top plateau of Trimbak hill covered with *Nilgrianthus reticu-*
latus and *Smilax setulosa*



General view of forests at Deodongra comprising *Bombax ceiba*, *Haldina*, *Mitragyna parvifolia*, *Tectona grandis*, *Terminalia crenulata* etc



Vegetation along Kalsubai hill comprising *Macaranga peltata*, *Lagerstroemia parviflora*, *Syzygium cumini*, *Terminalia crenulata* etc.



Vegetation along Umbda nadi (Thopi village) comprising *Butea monosperma*, *Ficus amplissima*, *Mangifera indica*, *Pongamia pinnata*, *Terminalia bellirica* etc.

INTRODUCTION

The district Nasik is located between latitudes 19°35' and 20°50' and longitudes 73°30' and 74°55' and extends over an area of 15,582 sq. km. Nasik district is bounded on the north-west by the Dangs and Surat districts of Gujarat, on the north by the Dhulia district, on the east by the Jalgaon and Aurangabad districts, on the south by the Ahmednagar district and towards the south-west by the Thane district.

The district derives its name from Nasik town the district headquarters. The origin of the name is attributed to two beliefs (1) the town is situated on the nine peaks or *narashikhara* and hence its name and (2) relates to an incident in the great epic, Ramayana – this is the place where Lakshmana is said to have chopped off the nose (*nasika*) of Surpanakha, the sister of the demon king, Ravana.

The district is divided into thirteen revenue talukas viz.; Baglan (Satana), Malegaon, Sargana, Kalwan, Peint, Dindori, Chandwad, Nandgaon, Nasik, Niphad, Yeola, Igatpuri and Sinnar. The forests of the district are divided into fifteen ranges (Map-1) which are grouped under two forest divisions viz., East and West Nasik Forest Divisions. The forests of the district cover an area of 3,446.28 sq. km of which 3,338.85 sq. km are in the charge of Forest Department, whereas 107.43 sq. km are governed by the Revenue Department of Maharashtra State. The area under the control of the former consists of reserved forests covering 2,970.08 sq. km, the protected forests covering 245.45 sq. km and the unclassified forests extending to 173.32 sq. km. The district has ca 20 towns and 1652 villages. The population of the district (1981 census) is ca 29,91,750.

The western part of the district is rugged as it includes the Western Ghats. The peaks like Kalsubai [1846 m above m.s.l. (19°36', 74°42')] and Trimbak [1294 m above m.s.l. (19°56' 73°31')] are well known. The Ghats extend eastwards and along these are located a few peaks rising to heights of 1200 m or more, above sea level. In the northern part, however, a cluster of high hills are found. The eastern and southern parts of the district are plain with general ground level being 500–550 m above sea level. The Godavari which is supposed to be the Ganges of south, rises near Trimbak, has carved a wide valley. In the north, the Girna constitutes the main drainage. These two rivers have easterly courses. Vast areas of the district are under cultivation. Large areas are irrigated by canals of these two rivers.



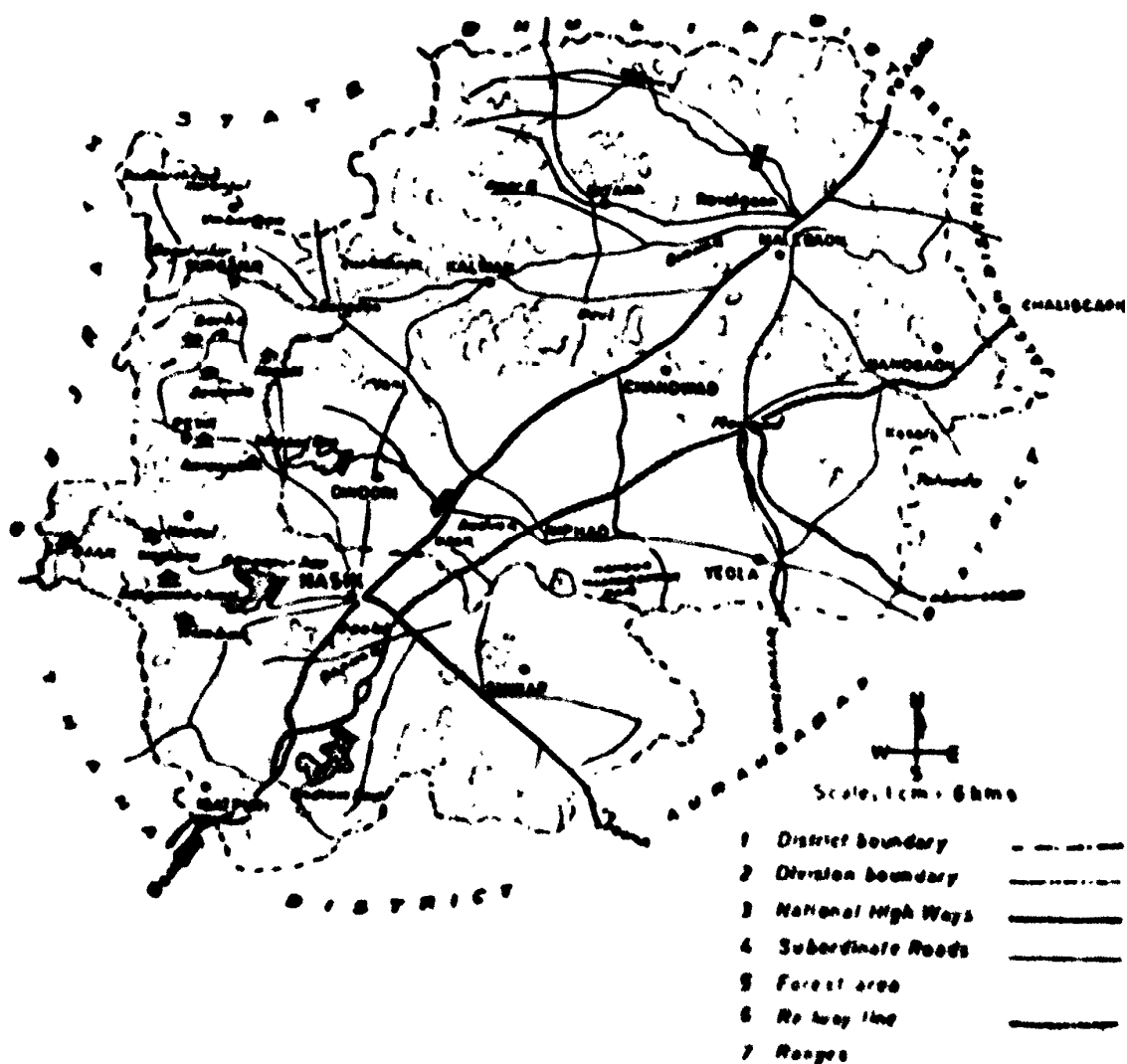
General view of forests at Decodongra comprising *Bombax ceiba*, *Albizia cordifolia*,
Mitragyna parvifolia, *Tectona grandis*, *Terminalia crumulata* etc



Vegetation along Kalsubai hill comprising *Macaranga peltata*, *Lagerstroemia parviflora*, *Syzygium cumini*, *Terminalia crenulata* etc.

Historical note

The land of Nasik district has an interesting historical background. According to the earlier history, when the Aryans invaded Deccan, the entire region was covered by thick forests, which extended southwards from central India. The celebrated sage, Agastya was the first Aryan who crossed the Vindhya and settled on the banks of the river Godavari. According to mythology, Agastya asked Vindhya mountains to remain in the bending posture until he returns from south, which he never did. It is learnt from the Ramayana that on the insistence of Agastya, Rama lived for some days at a place called Panchavati - the name derived from five great Banyan trees which grew there. Even now, there are some caves near Panchavati on the banks of Godavari which goes in the name of *Sita Gumph*. It is believed that Sita was abducted by Ravana from this sacred place.



Map 1 - Nasik District in general

Janasthana, the group of hermitages established by Agastya and Panchavati were situated on the fringes of the great forest *Dandakaranya*, the story of which is narrated in detail in Uttarakanda of the Ramayana. Danda or Dandaka, the son of Ikshvaku and grandson of Manu, ruled the country between the Vindhya and Shaivala mountains with his capital at Madhumanta. The sage Bhargava cursed the king for his misdeed that his entire kingdom would be devastated. Consequently, the country turned into a great forest known as *Dandakaranya*.

In mythology, Madhmeshwar temple situated on the banks of Godavari river features significantly. It is believed that when Sita asked for the Golden deer (Marich in disguise), Rama went after it and killed the deer at the place where Madhmeshwar temple stands today (Rane, 1984).

After Ala-ud-din Khilji's conquest (1294), most of the present district formed a part of the dominions of the tributary Yadavas of Devagiri. In 1636 after the over-throw of the Nizamshahi dynasty, Nasik was included in the Moghul province of Aurangabad.

The Nasik district passed under the Maratha rule on terms concluded between Salabat Jung and Marathas signed at Bhalki in 1752. The district after it came into the hands of Marathas, formed part of Baglana and Gangathadi Subha. In 1867, Nasik was made a full fledged district.

Reasons for undertaking the present work and its importance

The present study was undertaken to explore this rich and under-explored area extensively and intensively, with a view to bring out a comprehensive floristic account and plant wealth of Nasik district. The data thus generated would help preparing the Flora of Maharashtra State and subsequently contribute to some extent in preparation of the Flora of India.

The vegetation of district Nasik is quite varied and interesting. The area is also rich in a number of economically important species. The timber rich forests in the district are major source of revenue earning for the state.

The district is studded with number of tribal (adivasi) pockets, where people invariably depend on the forest produce for their sustenance. The modern system of medicine and technology have hardly influenced their way of life. These people use a number of plant species as medicine, food, fodder, fuel, fibre, fish poison, ornamentals and for magico-religious purposes. Some of the forest pockets, rich in local flora, are preserved as sacred groves (Dev-rai) where idols of various Gods and Goddesses are housed. Felling of trees, cutting of branches or even the removal of fallen

plant parts is completely forbidden. This has led to natural conservation. Some of the endemics and rare plants are restricted to these sacred groves. There is a great scope for exploring and scientifically evaluating the potentialities of the plant species used by the ethnic tribes.

Vaitarna, Trimbak, Kalsubai, Anjaneri, Spatashringi, Markandey, Galna etc. are some of the places of tourist interest. The present work will open new vistas for the tourists interested in studies of nature.

The Government of Maharashtra has a number of developmental schemes for this district. Nandur - Madhmeshwar tank and surrounding area in Niphad taluka is being converted into a Bird Sanctuary. A small park near Pandu Lena is also being started by the Forest Department.

Construction of new roads, dams, culverts, high tension electric towers, industries and various other developmental activities result in depletion or destruction of forest area. It, therefore, becomes relevant to inventorise the plant wealth of the area. *Flora of Nasik District* will go a long way towards better understanding of the plant wealth of the district.

PAST AND PRESENT WORK

Past work

Though Nasik district has been visited by a number of botanists from time to time, a major portion of the area remains unexplored and thus the available floristic data is meagre. Graham (1839) has recorded just one species from the district, Dalzell & Gibson (1861) 6 species, Nairne (1894) 4 species, Lisboa (1896) 5 grass species, Woodrow (1898) 18 species, Cooke (1901-1908) has recorded 51 species from this district which was based in addition to his own collection on the collections of Graham, Dalzell & Gibson, Edgeworth, Woodrow, Vadekar, Wadthekar, Bhiva, Kanitkar, Lisboa and Willis. Talbot (1909-1911) has recorded 7 species from the district. These collections do not precisely indicate the locality, also in many cases important field notes are wanting. Much of these collections are hardly available in Indian herbaria such as *BSI*, *BLAT*, *CAL*, *DD* etc.

Blatter & Hallberg (1918) have reported 6 species of Lythraceae from the district. Blatter & Almeida (1922) have reported 10 Pteridophytes. Blatter (1926-1935) has reported 150 species mainly from Igatpuri, Deolali, Gangapur etc. but much of the forest area had not been included. Blatter & McCann (1935) have reported 82 grass species from this area. Santapau (1951) has reported 9 species of Acanthaceae and 3

species of Euphorbiaceae (1954). Chakravarty (1959) has reported just one species of Cucurbitaceae. Santapau & Irani (1962) reported 2 species of Asclepiadaceae. Santapau & Kapadia (1966) recorded 8 species of Orchids. However, it may be noted that none of the aforesaid publications are directly connected with the Flora of Nasik district and they deal with the plants of whole of former Bombay Presidency of which Nasik forms a part.

Some of the earlier workers from Botanical Survey of India, Pune such as Puri, Jain, Vasavada, Gangurde, A.S. Rao and Rolla Rao collected plants during the period 1956-1962 mainly for enriching the *BSI* herbarium and their collections come to ca 110 species. Cherian & Pataskar (1971, 1972) studied the flora of the district in some detail and reported 495 species. The senior author has collected 700 species, of which nearly 200 species have not been collected by earlier workers from this area. The resulting collections from the district are now available in four major herbaria viz., *K*, *CAL*, *BSI* (which also houses the collections of Cooke and Talbot) and *BLAT*.

Present work

The present comprehensive floristic account of the Nasik district is the outcome of three years (1983-1985) intensive and extensive studies on the vegetation of the area.

A. Materials and methods

Field study : Exploration in the remote forest areas of the district was carried out by trekking. During the monsoon period (July-September) approach to the interior forest areas was difficult due to swollen rivers and nallahs. Such difficult areas were covered by camping in the huts offered by villagers. Otherwise camping was mainly in rest houses of Forest Department, Public Works Department, Irrigation Department and Zilla Parishad. Explorations to all the ranges of the district was undertaken during different seasons. The duration of each study tour ranged between 5-30 days. While carrying out the floristic survey, every effort was made to collect the plants in three seasons viz., premonsoon, monsoon and postmonsoon. In addition to the collection of wild plants, an effort had been made to collect weeds which cover a wide range of ecological habitats. Only a few cultivated plants have been collected as the work has been undertaken mainly to study the wild flora of the district. Special care has been given to record data pertaining to habit, habitat, flower colour, odour, plants associated, distribution, frequency and such other features which cannot be deduced from examination of the mounted herbarium specimens. In addition to this,

local names and uses, if any, have been gathered from the villagers and ethnic tribes. Bulbs of some rare and interesting wild plants have been collected and cultivated in the experimental garden of Botanical Survey of India, Pune and detailed studies were made on them.

During the present study a total of 1364 field numbers comprising ca 8184 specimens have been collected and deposited in *BSI* and *CAL*. The type specimen of *Dicliptera nasikensis* Naras. et Sharma has been deposited in *CAL*. One herbarium specimen of *Asparagus africanus* Lam. a new record for India has been deposited in *K*.

Herbarium study: The plant specimens have been tentatively identified in the field. After drying, poisoning and mounting following conventional methods, they have been carefully and critically studied and their identification confirmed by reference to the *Flora of British India* (J.D. Hooker *et al.* 1872-1897), *Flora of Presidency of Bombay* [T. Cooke, 1958 (Repr. ed.)], *Flora of Presidency of Madras* [J.S. Gamble & C.E.C. Fischer, 1957 (Repr. ed.)] etc. besides many other recent and relevant monographs and revisions. These specimens were then matched with authentic specimens available in *BSI*. Some specimens which could not be confirmed at *BSI* and *BLAT* were sent to *CAL* and *K* for expert opinion. In the preparation of the present flora, besides field notes and collections of the senior author, we have also studied and incorporated some earlier collections pertaining to this district and available in *BSI* and *BLAT*. In this work, such data available on all taxa collected so far have been incorporated to help, understand the distribution pattern of species in this district.

B. Plan of the Flora

The arrangement of the families followed in the present work, is based primarily on Bentham & Hooker's (1862-1883) system of classification in general, as is followed in most of the major floras published in India. However, in a number of cases, the circumscription of the families has been restricted after Hutchinson (1959) and Airy Shaw (1973). The genera under a family and the species under a genus have been arranged in alphabetical order for the sake of convenience.

Dichotomous keys have been provided for the families, genera and species. These keys are artificial and are largely based on exomorphic characters. The family keys with modifications wherever necessary has been largely adapted from Gamble (1936). Cultivated species have not been included in the keys to genera and species. They have been arranged alphabetically at the end of their respective families or genera.

The nomenclature of plants has been made so far as possible up-to-date as per ICBN (1978).

For each species latest botanical name and basionym, if any, have been given, with full citations. Synonyms wherever found necessary to connect the name with Cooke's *Flora of Presidency of Bombay* and Hooker's *Flora of British India* have also been given. All local Marathi names are given in inverted commas after citation.

The species have been described showing primarily characters not reflected in the keys. It is followed by relevant data on flowering and fruiting and the references to illustrations wherever available.

Under the distribution the details such as frequency, associated species (majority of the cases) and the exact locality of the collections have been alphabetically given. In case of plants which are rare to the district, the collector's name is given followed by the field number and the indication of the herbarium where these species are available if it is other than *BSI*. The rare plants collected by the senior author has been cited by field numbers only. Under the notes mostly nomenclatural point and uses if any, are given.

Throughout the present work decimal and metric systems have been used while showing the measurements.

Selective bibliography is appended at the end. Indices to the names of the taxa dealt within the present work inclusive of both botanical and local names have been provided.

Appropriate maps and tables representing various data in connection with the present work are given. 52 line drawings have been included. Some colour and black & white photographs depicting the vegetation and interesting species are also presented.

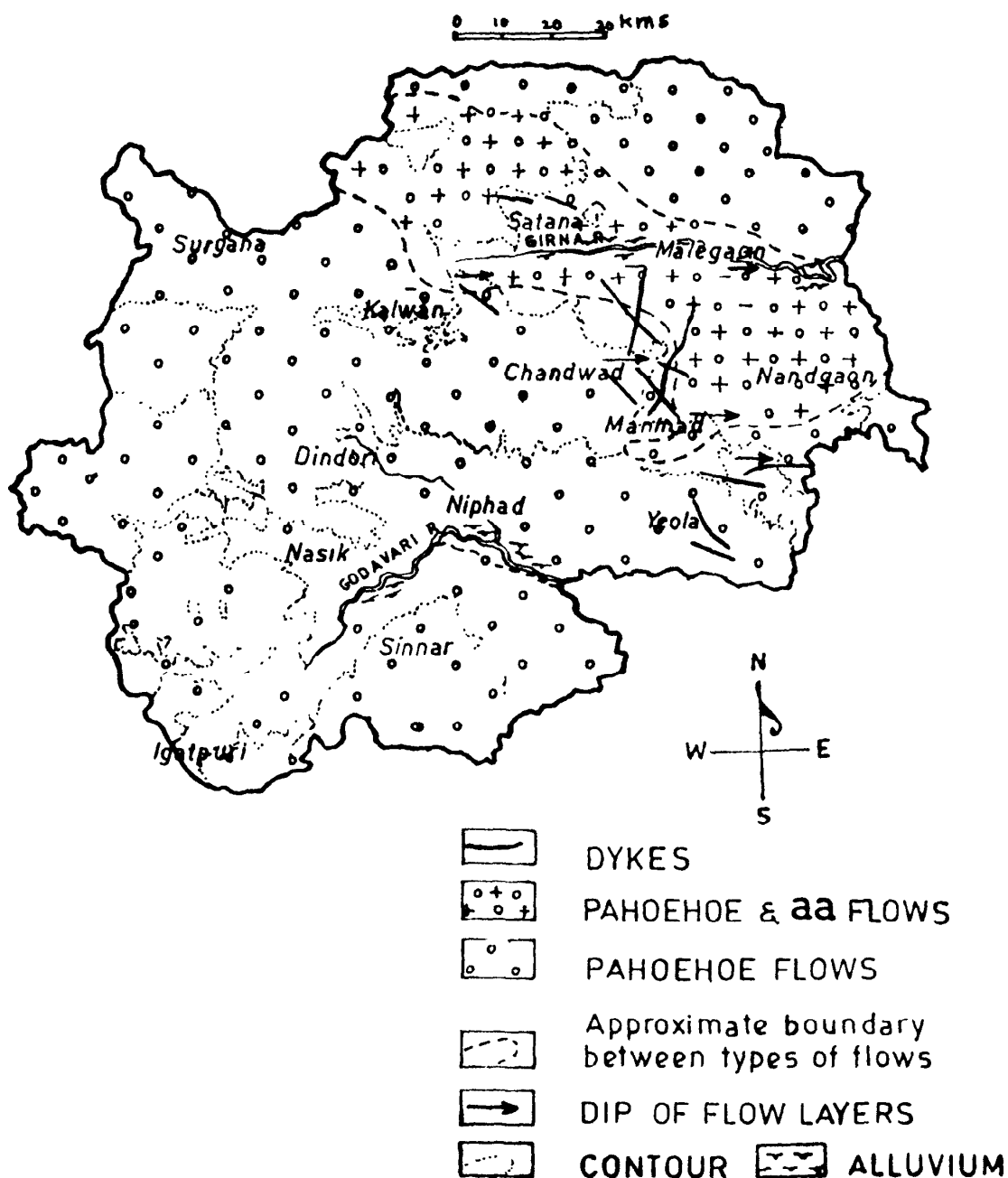
TOPOGRAPHY AND GENERAL FEATURES

Geology and soil

The entire district is covered with basic volcanic lava which is commonly referred to as Deccan traps (Anonymous, 1976). In between the flows, at places, thin beds of volcanic tuffs are found. The flows are intruded by dykes. Along the courses of the major rivers alluvium is found (Map-2).

Deccan traps: The Deccan traps are upper cretaceous-lower eocene in age and are the products of fissure type of volcanic eruptions. The basaltic flows are of two types, viz., pahoehoe and aa. The pahoehoe flows weather easily and give rise to mature type of topography

with smooth hill slopes and conical peaks. Broad valleys are common. The aa flows weathers resulting in large boulders which accumulate at the base of hills. Cliffs, terraces and benches are common. Valleys with broad bottoms are found, even at high levels along the hill ranges. Kalsubai hill exposes a 620.5 m thick pile of compound pahoehoe flows and one aa flow.



Map 2 : Geology of Nasik District

Tuffs : Thin beds of volcanic tuffs are found at places between the flows. Good exposures of tuffs are seen near mile stone 177 on the Bombay-Agra highway road near Thengode and Khalap etc.

Dykes : The basalts are intruded by a number of dykes. In the Satana area, the dykes trending N 10° E - S 10° W form depressions, while the east-west dykes give rise to ridges.

Alluvium : Along the banks of Godavari, Girna and other rivers a few metre thick alluvium is deposited at places. This comprises of pebble beds, sand and silt derived mostly from the traps.

Soil : The pahoehoe flows, which are generally altered, weather easily and give rise to pink or red soils with much chert or zeolite fragments. The fragmental tops of aa flows also give rise to similar type of soils. The middle dense portions of aa flows generally yield dark soils.

Economic rocks and minerals

Copper : Minor disseminations of native copper in the form of thin scales and as ribbons are noticed in the vesicular cavities of a pahoehoe flow in the section of well near Shirondi.

Semi-precious stones : Well developed and transparent crystals of quartz are seen in geodes and vugs in the 110 m thick flow unit in the southern spur of hillock 2217'

Construction material : The basal parts of aa flows yield tough, dark rock which is extensively used as road metal and as concrete aggregate. Dyke rocks are extensively quarried for use as road metal as near Dahivad and Machi. The pahoehoe flows being softer have been selected for carving cave temples near Manmad. The same has been used for temple structures as at Trimbak.

Kankar : Along the banks of the rivers and streams kankar is found in alluvium and soil. It is used for making limestone.

Ground water : Many wells located close to dykes yield large quantities of water, as the dykes arrest ground water movements. The low lying areas close to Godavari, Girna and other small rivers are favourable areas for sinking wells, as the ground water level is closer to surface in these places.

There is a small hot spring (70° C) ca 3 km, ENE of Pimpalsonda (Umbarthan range).

Climate

The climate of Nasik district is characterised by dryness except in the south-west monsoon season. The year is divided into four main seasons. The winter season from (December-February), summer season (March-May), monsoon season (June-September) and postmonsoon season (October-November).

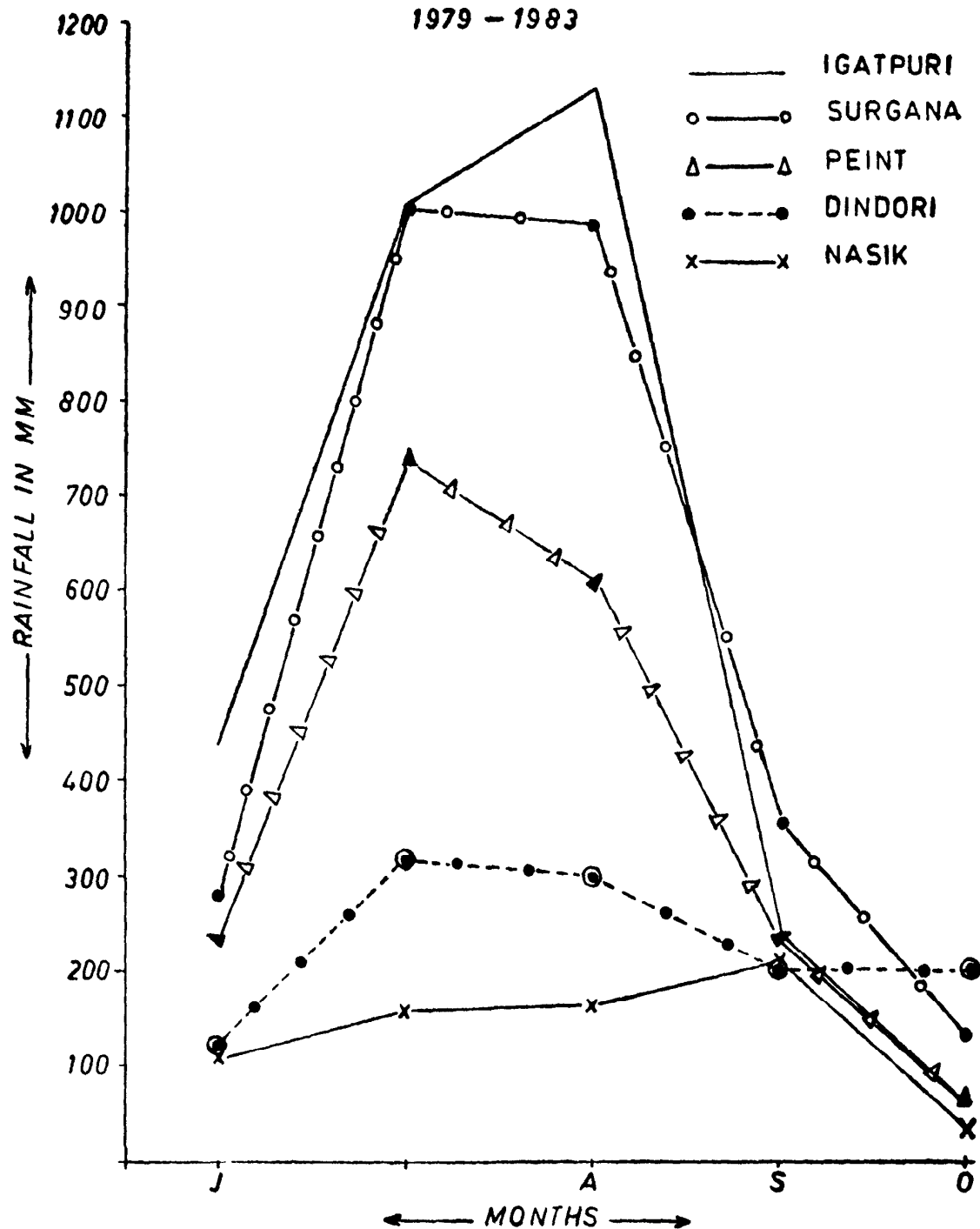
Rainfall : Though the south-west monsoon breaks by middle of June, regular rainy season starts by end of June and lasts till the middle of October. Occasional showers in November-December are received due to north-eastern monsoon. Table I gives the rainfall at selected centres in Nasik district (*see also graph 1*).

The average annual rainfall in the district is *ca* 1,034.5 mm. In the narrow strips of the district in close proximity of Western Ghats, the rainfall is heavier than in the rest of the district. On an average, the rainfall in this narrow strip increases from 2,351.6 mm at Peint in the north to 3,341.6 mm at Igatpuri in the south. Heaviest rainfall recorded at Peint was 3,626 mm (1961). Lowest rainfall recorded was 1,513.40 mm (1960). The maximum precipitation recorded at Surgana is 2500 mm (1958-59), the lowest is 1,335.70 (1960-61). In the plateau region to the east of Western Ghats, the rainfall decreases from west to east, with some local variations due to topography. The rainfall in this region varies from 477.3 mm at Satana to 753 mm at Dindori. About 88% of the annual rainfall in the district is received during the south-west monsoon season (June-September). July is the rainiest month. During May and postmonsoon months of October-November some rainfall mainly occur in the form of thunder showers.

On an average there are 51 rainy days (*i.e.* days with rainfall of 2.5 mm or more) in a year in the district. As in case of rainfall, the number of rainy days are high on the narrow strip of the district in close proximity to the Western Ghats and varies from 89 days at Peint in the north to 102 days at Igatpuri in south. Over the plateau the number of rainy days diminishes from west to east and varies from 32 at Satana to 54 at Dindori.

The heaviest rainfall in a day recorded at any station in the district was 473.7 mm at Peint on 2nd July, 1941. Peint is the only place where the record of rainfall is maintained. Average annual rainfall at Surgana and Trimbak is 2,063 and 2,243 mm respectively.

RAIN FALL IN NASIK DISTRICT (JUNE - OCT.)
1979 - 1983



Graph 1

*Table 1 : Rainfall (mm) at selected Centres
in Nasik District (1979-1983)*

[source : Meteorological Department, Pune]

Name of the month	Nasik	Igatpuri	Niphad	Yeola	Nandgaon
January	8.0	6.3	1.3	4.2	0.0
February	0.0	0.0	0.0	0.0	0.0
March	8.6	0.0	1.8	0.0	0.0
April	0.0	0.0	0.0	0.0	0.0
May	0.0	0.0	4.2	7.9	9.8
June	104.3	442.9	89.8	82.4	70.2
July	155.1	1004.5	102.3	78.1	89.0
August	161.9	1127.9	115.8	108.1	130.4
September	208.4	243.5	183.2	170.8	201.8
October	34.9	49.6	23.6	43.8	37.0
November	28.4	58.3	23.3	14.7	20.4
December	3.1	15.4	1.0	7.6	4.4
Average	712.7	2948.4	546.3	517.6	563.0

Table 1 : Contd.

Name of the month	Surgana	Somthane	Kolegaon-Mal	Satana	Kalwan
January	2.8	3.8	9.6	8.0	6.4
February	1.2	0.0	0.0	0.0	5.4
March	0.0	0.0	0.0	0.0	3.4
April	0.0	0.0	0.0	0.0	0.0
May	8.4	1.2	0.4	0.0	4.6
June	278.6	49.2	70.5	132.2	146.9
July	1002.8	106.4	59.2	124.3	184.9
August	981.7	172.7	65.0	210.1	209.3
September	351.0	137.2	113.6	187.9	267.3
October	136.0	37.2	10.8	59.4	44.6
November	60.6	9.7	21.6	29.9	47.4
December	4.0	1.7	1.2	0.8	4.4
Average	2827.1	519.1	351.9	752.6	924.6

Table I - Contd.

Name of the month	Chandwad	Dindori	Peint
January	2.2	0.6	0.0
February	0.0	0.0	0.0
March	2.0	0.3	0.0
April	0.0	3.3	0.0
May	0.0	7.7	3.5
June	134.3	119.6	239.2
July	143.3	320.9	736.6
August	198.3	299.2	612.6
September	210.0	205.4	234.6
October	58.0	201.4	51.4
November	22.0	16.9	14.9
December	10.7	17.5	8.0
Average	780.8	1292.9	1900.8

Temperature : The eastern part of the district experiences extremes of climate with temperature going down to 5°C in winter and rising upto 43°C in summer. The western part of the district, which is hilly, enjoys a more equitable climate.

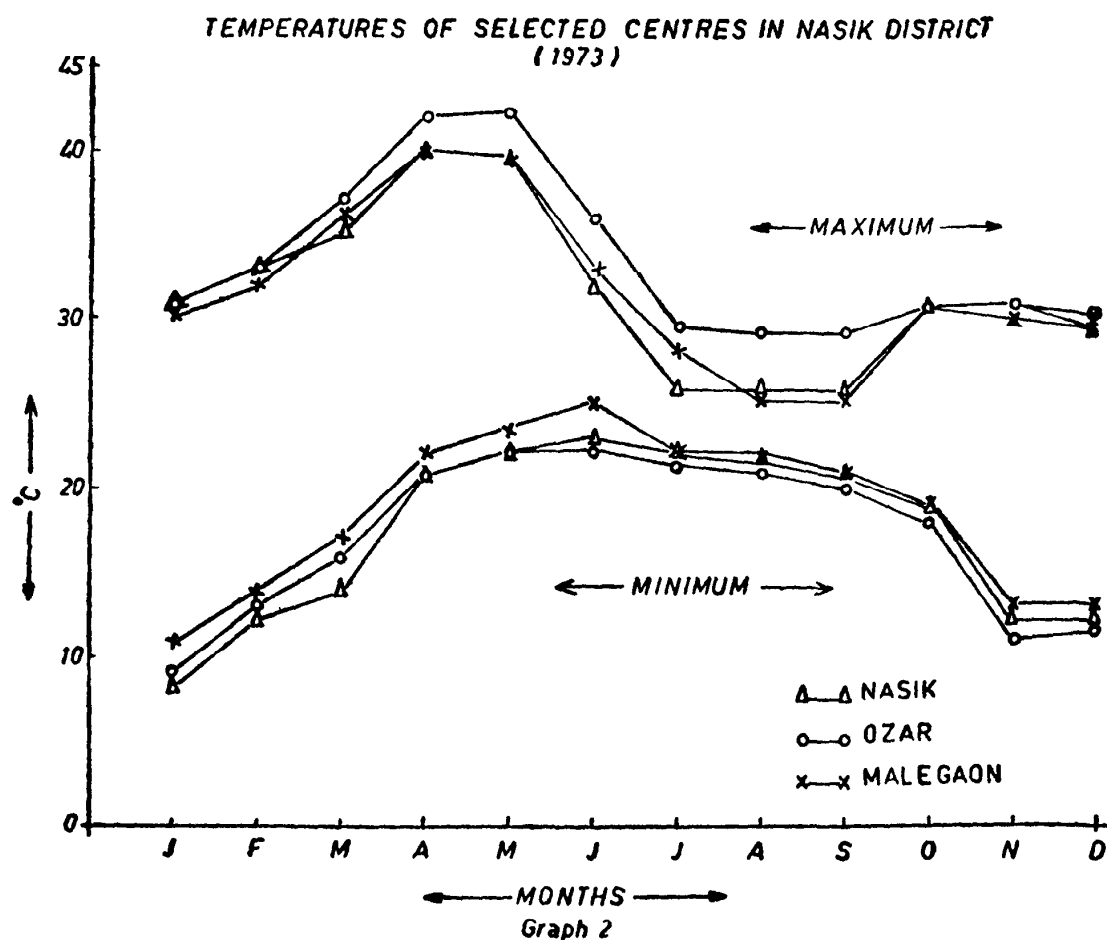
After February, temperature progressively increases till May which is the hottest month with the mean daily maximum temperature being 40.6°C at Malegaon and 37.4°C at Nasik. In the height of summer, on some days the heat is so intense that the temperature may go above 46°C in the eastern parts of the district at comparatively lower elevations. The oppresiveness is relieved on some days by afternoon thunder-showers. Night temperature in June is slightly higher than in May. With the onset of south-west monsoon in the middle of June, day temperatures decrease appreciably and the weather during the monsoon season is pleasant. From beginning of October, the day temperatures increase by 2 or 3°C on the average in October as the south-west monsoon withdraws but there is a progressive decrease in night temperatures after September. Temperature rapidly decreases from November onwards. December is the coldest month with the mean daily minimum temperature at 11.3°C at Malegaon and 10.2°C at Nasik. The mean daily maximum temperature in this month is 29.5°C at Malegaon and 28.3°C at Nasik. In association with

western disturbances which move across north India, in the winter season, cold waves affect the district and minimum temperature at times drops to freezing point and frosts causing damage to crops. Table II shows the maximum and minimum monthly temperatures of selected centres in Nasik district (see also graph 2).

The highest temperature recorded was 46.7°C on 23rd May, 1916 at Malegaon while it was 42.4°C at Nasik on 12th May, 1960. The lowest temperature at Malegaon was 0.1 C on 1st February, 1929 and 0.6°C at Nasik on 7th January, 1945 respectively.

Humidity : The air is humid during the monsoon season. In the postmonsoon, winter and summer seasons, the air is dry. The summer season is the driest part of the year with relative humidities between 20% & 25% only in the afternoons.

Cloudiness : During the monsoon season, the sky is heavily clouded to overcast whereas the sky is mostly clear or lightly clouded during rest of the year.



Winds : Winds are generally light to moderate except in the latter part of the summer and monsoon season when they are stronger. In the monsoon season, winds are south-westerly or westerly, in the postmonsoon season, winds are light or variable in direction in the mornings and north-easterly or easterly in the afternoons. Winds blow from in between south-

Table II : Maximum & Minimum Monthly Temperatures of selected Centres in Nasik District (1973) in °C.

[source : Meteorological Department, Pune]

Name of month	Nasik		Ozar		Malegaon	
	Max.	Min.	Max.	Min.	Max.	Min.
January	31.0	8.6	29.8	9.5	31.2	10.8
February	33.3	12.3	32.1	13.0	33.0	14.1
March	35.08	14.4	36.0	15.9	37.2	17.1
April	39.8	20.7	39.9	20.7	41.7	22.2
May	38.0	22.3	38.7	22.3	42.1	n.a.
June	32.4	23.4	33.3	22.6	36.1	25.4
July	26.4	22.2	27.6	21.5	29.8	22.7
August	26.3	21.5	26.8	21.1	29.1	22.6
September	25.8	20.6	27.2	20.0	29.0	21.1
October	30.7	19.4	30.7	18.0	31.2	19.0
November	30.9	12.1	30.4	11.1	30.7	13.0
December	29.4	12.1	29.1	11.7	29.7	13.3
Average	31.7	17.5	13.8	16.8	33.4	18.3

n.a. : Not available

west and north-west in the mornings and north and east in the afternoons during the winter season whereas the winds are from south-west and north-west in the summer season.

Special weather phenomena : During the latter half of summer and in the postmonsoon season due to storms and depressions in Arabian sea, the district and its neighbourhood are affected resulting in widespread rains. In the latter half of the summer season and in the postmonsoon season thunderstorms occur.

Table III : Relative humidity

Month	Nasik		Malegaon	
	08.30 hrs.	17.30 hrs.	08.30 hrs.	17.30 hrs.
January	73%	n.a.	53%	25%
February	66%	„	45%	25%
March	51%	„	39%	20%
April	53%	„	37%	19%
May	63%	„	47%	25%
June	77%	„	68%	50%
July	85%	„	75%	67%
August	85%	„	77%	64%
September	85%	„	76%	64%
October	75%	„	63%	38%
November	66%	„	58%	33%
December	69%	„	57%	23%
Average	71%	n.a.	58%	39%

n.a. : Not available

FOREST BIOTA

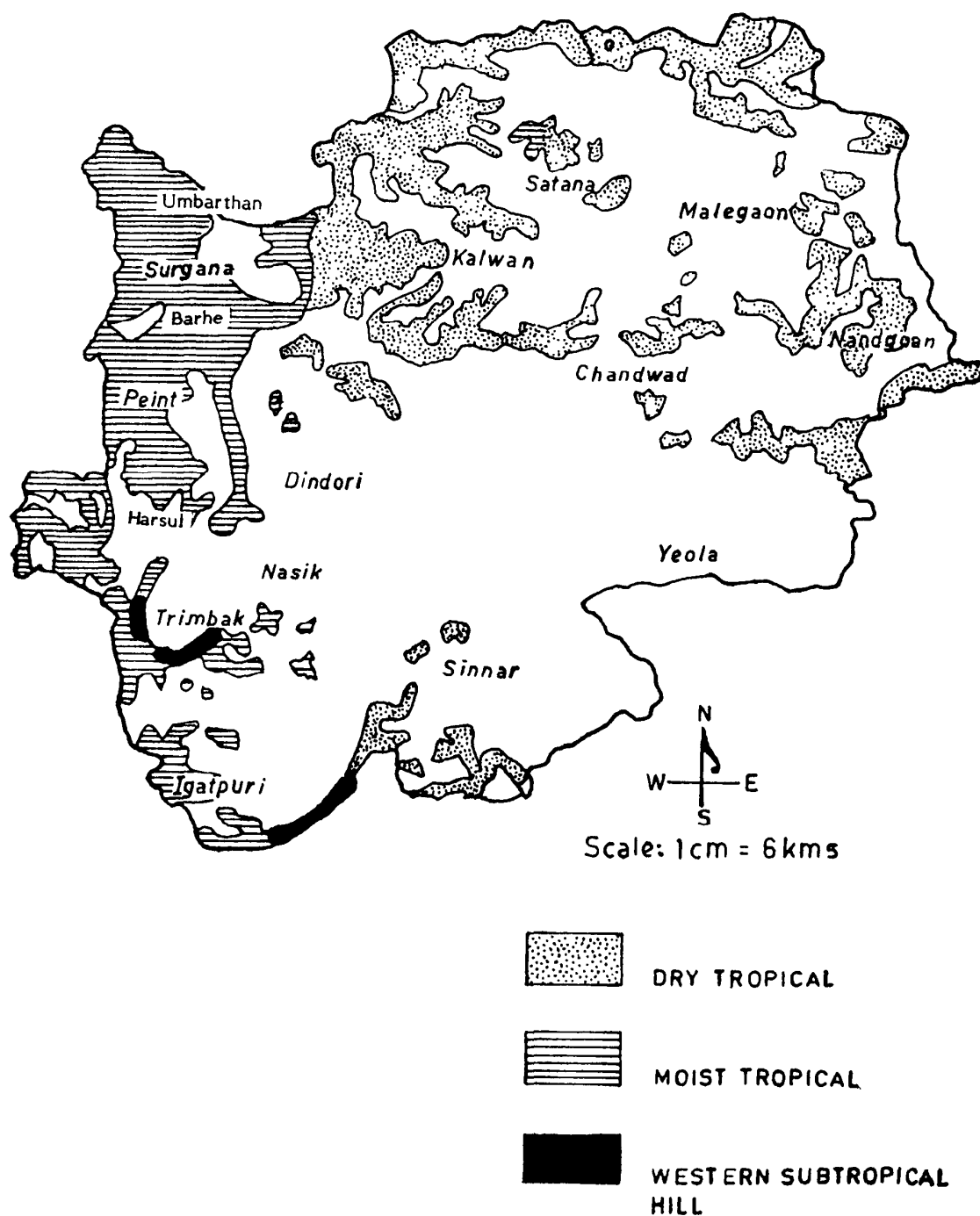
The district is reported to have had abundant wild life and birds a score of years ago (Anonymous, 1975). Their disappearance from the area could be attributed mainly to the opening up of these forests, felling of forests for cultivation and *shikar* activities of the adivasis. Of the wild animals, *Panthera tigris* (Tiger ; *Wagh*) that was common in Baglan, Malegaon and in the west of the district, *Acinonyx jubatus* (Hunting Leopard ; *Chitta*), *Axis axis* (Spotted Deer ; *Chittal*), *Boselaphus tragocamelus* (Blue Bull ; *Nilgai*), *Melursus ursinus* (Indian Black Bear ; *Aswal*) and various other animals which were in considerable number prior to 1880 have now disappeared. The present position of game is precarious. The very existence of animals in the district forests is in danger unless serious

Canis aureus (Jackal ; Kolha), *Cervus unicolor* (Stag ; Sambar), *Felis chaus* (Jungle Cat; Ram manjar), *Funambulus* sp. (Squirrel; Khar), *Hyaena hyaena* (Hyaena ; Taras), *Hystrix indica* (Porcupine ; Salu), *Lepus nigricollis* (Common Hare ; Sasa), *Muntiacus muntjak* (Barking Deer ; Bhekar), *Panthera pardus* (Panther; Bibalya), *Paradoxurus hermaphroditus* (Toddy Cat; Ud manjar), *Sus scrofa* (Wild Boar; Dukkar), *Tetracerus quadricornis* (4 Horned Antelopes ; Chowsingha), *Vulpes bengalensis* (Grey Fox ; Khokkad) etc.

GENERAL VEGETATION TYPES

I. Moist Tropical Forests :

1. West coast semi-evergreen forests
 - *Mangifera* *Syzygium* *Glochidion*
Carissa subtype
 - *Terminalia* *Mangifera* *Heterophragma*
Ixora subtype
2. South Indian moist deciduous forests
 - (a) Moist teak forests
 - *Tectona* *Terminalia* *Wrightia*
Meyna subtype
 - *Tectona* *Anogeissus* *Butea* *Carissa*
subtype
 - (b) Southern moist mixed deciduous forests
 - *Terminalia* *Anogeissus* *Emblica*
Woodfordia subtype
 - *Garuga* *Lannea* *Heterophragma*
Carvia subtype
 - (c) Southern secondary moist mixed deciduous forests



Map 3 Forest Types in Nasik District

II. Dry Tropical Forests :

1. Southern tropical dry deciduous forests
 - (a) Dry teak forests
 - (b) Southern dry mixed deciduous forests
 - (c) *Hardwickia* forests
2. Southern tropical thorn forests

III. Western subtropical Hill Forests :

Mangifera Syzygium subtype

Mangifera Memecylon subtype

I. Moist Tropical Forests

They are subdivided as follows :

1. *West coast semi-evergreen forests*: The compact block of forests from Kalmusta in the south and Varasvhihir in the north, which is commonly known as the 'ghat fuel forests' belongs to this type. The tree growth on the plateau and upper slopes is inferior in quality and density consists mainly of *Mangifera* and *Syzygium*. In the lower valleys the tree growth is more akin to the moist deciduous type of forests with a few evergreen species. It could be a post climax of the moist deciduous type of forests. Two subtypes are recognised as follows:

Mangifera Syzygium Glochidion Carissa subtype :

The top storey includes species like *Albizia lebbeck*, *A. procera*, *Bombax ceiba*, *Erythrina stricta*, *Ficus racemosa*, *Mangifera indica*, *Schleichera oleosa*, *Syzygium cumini*, *Terminalia chebula* and *T. crenulata*. The second storey consists of *Acacia ferruginea*, *Bauhinia racemosa*, *Bridelia retusa*, *B. squamosa*, *Butea monosperma*, *Careya arborea*, *Cassia fistula*, *Cassine glauca*, *Cordia dichotoma*, *Dalbergia lanceolaria*, *Dillenia pentagyna*, *Emblica officinalis*, *Ficus benghalensis*, *Garuga pinnata*, *Glochidion hohenackeri*, *Grewia tiliaefolia*, *Haldina cordifolia*, *Heterophragma quadriloculare*, *Hymenodictyon orixense*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Macaranga peltata*, *Mallotus philippensis*, *Miliusa tomentosa*, *Mitragyna parvifolia*, *Piliostigma foveolatum*, *Spondias pinnata* etc.

Bamboos are absent in this type of forests. The shrubs include *Carissa congesta*, *Carvia callosa*, *Casearia graveolens*, *Catunaregam spinosa*, *Helicteres isora*, *Ixora brachiata*, *Meyna laxiflora*, *Vitex negundo*, *Woodfordia fruticosa*, *Ziziphus glaberrima* etc.

Terminalia Mangifera Heterophragma Ixora subtype :

Those forests which are situated in the valleys and sheltered pockets belong to this subtype. This is akin to moist deciduous forests with a few evergreen species.

The top storey includes trees like *Albizia lebbeck*, *A. procera*,

Anogeissus latifolia, *Bombax ceiba*, *Erythrina stricta*, *Garuga pinnata*, *Haldina cordifolia*, *Lagerstroemia parviflora*, *Mangifera indica*, *Mitragyna parvifolia*, *Schleichera oleosa*, *Terminalia bellirica*, *T. chebula*, *T. crenulata* etc. The second storey consists of *Acacia ferruginea*, *Bauhinia racemosa*, *Bridelia retusa*, *B. squamosa*, *Butea monosperma*, *Careya arborea*, *Cassia fistula*, *Cassine glauca*, *Cordia dichotoma*, *Dillenia pentagyna*, *Embllica officinalis*, *Ficus racemosa*, *Glochidion hohenackeri*, *Grewia tiliaefolia*, *Heterophragma quadriloculare*, *Holoptelea integrifolia*, *Hymenodictyon orixense*, *Lannea coromandelica*, *Macaranga peltata*, *Madhuca longifolia* var. *latifolia*, *Mallotus philippensis*, *Miliusa tomentosa*, *Piliostigma foveolatum*, *Pongamia pinnata*, *Spondias pinnata*, *Syzygium cumini* etc. Occasionally *Bambusa arundinacea* and *Dendrocalamus strictus* are seen. The shrubs include *Carissa congesta*, *Casearia graveolens*, *Catunaregam spinosa*, *Helicteres isora*, *Meyna laxiflora*, *Pavetta crassicaulis*, *Vitex negundo*, *Woodfordia fruticosa*, *Ziziphus glaberrima* etc.

2. *South Indian moist deciduous forests* : Dominants are mainly deciduous but subdominants and lower storeys mostly evergreen. The canopy is dense and even. These are further subdivided as follows :

(a) *Moist teak forests* : These are high forests, growing mostly over 20 m in height and are restricted mainly to hill terrain. Teak is the dominant species throughout and it occupies major portion of the canopy. The rest of the canopy is covered by its miscellaneous associates. The entire top storey consists of deciduous species. Lower storey, however, contains a few semi-evergreen species like *Mangifera indica* and *Meyna laxiflora*. Bamboos are characteristic of these areas. Canes are conspicuous by their absence. Climbers are abundant. Soil cover consists of *Carissa congesta*. Grasses are restricted to open areas. These are further subdivided as follows :

Tectona Terminalia Wrightia Meyna subtype :

This type is found in reserved as well as protected forests of Peint, Harsul, Surgana, Barhe and Umbarthan ranges. Teak forms ca. 20-30% of the top canopy in the reserved forests whereas it is more than 30% in the protected forests. The best forests of this subtype are seen near Sawarna and Amba in Peint range, Rakshasbhuwan and Palsan in Barhe range, Karanjul in Surgana range, Ragatvihir and Hadkaichond in Umbarthan range. It occurs in black, grey and brown soils. The top storey includes trees such as *Acacia chundra*, *A. ferruginea*, *Albizia lebeck*, *A. procera*, *Anogeissus latifolia*, *Bombax ceiba*, *Dalbergia lanceolaria*, *D. latifolia*, *Garuga pinnata*, *Haldina cordifolia*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Mitragyna parvifolia*, *Ougeinia oojeinensis*, *Pterocarpus marsupium* var. *acuminatus*, *Schleichera oleosa*, *Terminalia bellirica*, *T. crenulata* etc. The second storey consists of *Bauhinia racemosa*, *Bridelia retusa*, *Butea monosperma*, *Careya arborea*,

Cassia fistula, *Cordia dichotoma*, *Dendrocalamus strictus*, *Dillenia pentagyna*, *Diospyros melanoxylon*, *Emblica officinalis*, *Ficus racemosa*, *Grewia tiliaefolia*, *Heterophragma quadriloculare*, *Holarrhena antidysenterica*, *Madhuca longifolia* var. *latifolia*, *Mallotus philippensis*, *Miliusa tomentosa*, *Oroxylum indicum*, *Sterculia urens*, *Syzygium cumini*, *Trewia polycarpa*, *Wrightia tinctoria* etc. The shrubs include *Carissa congesta*, *Carvia callosa*, *Casearia graveolens*, *Catunaregam spinosa*, *Flacourtia indica*, *Helicteres isora*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Woodfordia fruticosa*, *Ziziphus glaberrima* etc.

Tectona Anogeissus Butea Carissa subtype :

This subtype is found scattered all over Harsul, Peint, Barhe, Surgana and Umbarthan ranges and occupies portions of the hills having grey and brown soils. The forest is inferior as compared to *Tectona Terminalia Wrightia Meyna* subtype. Top canopy consists of 20-25% teak. The top storey include *Acacia chundra*, *Albizia lebbeck*, *Anogeissus latifolia*, *Bombax ceiba*, *Dalbergia lanceolaria*, *D. latifolia*, *Erythrina stricta*, *Garuga pinnata*, *Haldina cordifolia*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Mitragyna parvifolia*, *Ougeinia oojeinensis*, *Pterocarpus marsupium* var. *acuminatus*, *Schleichera oleosa*, *Tectona grandis*, *Terminalia bellirica*, *T. chebula*, *T. crenulata* etc. The second storey consists of *Acacia polyacantha*, *Albizia procera*, *Bauhinia racemosa*, *Bridelia retusa*, *Butea monosperma*, *Careya arborea*, *Cassia fistula*, *Cordia dichotoma*, *Dendrocalamus strictus*, *Dillenia pentagyna*, *Diospyros melanoxylon*, *Emblica officinalis*, *Ficus racemosa*, *Grewia tiliaefolia*, *Heterophragma quadriloculare*, *Holoptelea integrifolia*, *Kydia calycina*, *Madhuca longifolia* var. *latifolia*, *Mangifera indica*, *Miliusa tomentosa*, *Piliostigma foveolatum*, *Spondias pinnata*, *Sterculia urens*, *Syzygium cumini*, *Wrightia tinctoria* etc. The shrubs include *Carissa congesta*, *Carvia callosa*, *Casearia graveolens*, *Catunaregam spinosa*, *Flacourtia indica*, *Helicteres isora*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Woodfordia fruticosa*, *Ziziphus glaberrima*, *Z. mauritiana* etc.

(b) *Southern moist mixed deciduous forests* : The evergreen species is usually larger than in the case of teak bearing forests, except for the moist subtype, teak is present occasionally and may be an indicator of secondary succession.

Terminalia Anogeissus - Emblica Woodfordia subtype :

It spreads over most of mixed deciduous forests, occurring in both protected as well as reserved forests. It is generally found in black and grey soils. This type is seen on upper slopes of Shribhuwan, Songir, Karanjul, Sawarna etc. They are restricted mainly to a belt, below hill tops and badly drained flat areas.

The top storey consists 10-15% of teak, the other associates are *Acacia chundra*, *Albizia lebbeck*, *A. procera*, *Anogeissus latifolia*, *Bombax ceiba*, *Dalbergia lanceolaria*, *D. latifolia*, *Erythrina stricta*, *Garuga pinnata*, *Gmelina arborea*, *Haldina cordifolia*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Mitragyna parvifolia*, *Ougeinia oojeinensis*, *Pterocarpus marsupium* var. *acuminatus*, *Schleichera oleosa*, *Terminalia bellirica*, *T. chebula*, *T. crenulata* etc.

The second storey consists of *Acacia polyacantha*, *Albizia procera*, *Bambusa arundinacea*, *Bauhinia racemosa*, *Bridelia retusa*, *Butea monosperma*, *Careya arborea*, *Cassia fistula*, *Cordia dichotoma*, *Dendrocalamus strictus*, *Dillenia pentagyna*, *Diospyros melanoxylon*, *Embllica officinalis*, *Ficus racemosa*, *Grewia tiliaefolia*, *Heterophragma quadriloculare*, *Holoptelea integrifolia*, *Hymenodictyon orixense*, *Kydia calycina*, *Madhuca longifolia* var. *latifolia*, *Mallotus philippensis*, *Mangifera indica*, *Miliusa tomentosa*, *Piliostigma foveolatum*, *Pongamia pinnata*, *Spondias pinnata*, *Sterculia urens*, *Syzygium cumini*, *Wrightia tinctoria* etc.

The shrubs include *Carissa congesta*, *Carvia callosa*, *Casearia graveolens*, *Catunaregam spinosa*, *Flacourtia indica*, *Helicteres isora*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Woodfordia fruticosa*, *Ziziphus glaberrima* etc.

Garuga Lannea Heterophragma Carvia subtype :

It is present in small portions of the mixed deciduous forests with poor quality soil. It is also found on steep slopes where *Garuga* and *Lannea* are found in high proportion with thick undergrowth of *Carvia*.

The top story consists of *Acacia chundra*, *Albizia lebbeck*, *A. procera*, *Anogeissus latifolia*, *Bombax ceiba*, *Dalbergia latifolia*, *Erythrina stricta*, *Garuga pinnata*, *Gmelina arborea*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Ougeinia oojeinensis*, *Pterocarpus marsupium* var. *acuminatus*, *Tectona grandis*, *Terminalia crenulata* etc.

The second storey consists of *Bauhinia racemosa*, *Bridelia retusa*, *Butea monosperma*, *Careya arborea*, *Cassia fistula*, *Diospyros melanoxylon*, *Embllica officinalis*, *Grewia tiliaefolia*, *Heterophragma quadriloculare*, *Madhuca longifolia* var. *latifolia*, *Mangifera indica*, *Sterculia urens*, *Wrightia tinctoria* etc.

The shrubs include *Carissa congesta*, *Carvia callosa*, *Catunaregam spinosa*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Woodfordia fruticosa*, *Ziziphus glaberrima*, *Z. mauritiana* etc.

(c) *Southern secondary moist mixed deciduous forests* : It is also known as semi-evergreen forests. This is restricted to some of the high

plateaus as in case of Malegaon and Udmal (small patches). The general composition is the same as that of moist deciduous mixed type of forests but with a greater percentage of semi-evergreen species such as *Carissa congesta* and *Mangifera indica*. The floristic components are *Bombax ceiba*, *Careya arborea*, *Erythrina stricta*, *Terminalia crenulata* etc. The shrubs include *Helicteres isora* etc. This type is confined to hill tops with shallow soil and rainfall over 1750 mm.

Climbers such as *Abrus precatorius*, *Acacia pennata*, *A. torta*, *Ampelocissus latifolia*, *Aspidopterys cordata*, *Combretum ovalifolium*, *Cryptolepis buchananii*, *Dioscorea bulbifera*, *D. pentaphylla*, *Gloriosa superba*, *Jasminum malabaricum*, *Solena amplexicaulis* etc. are common in moist tropical forests of Nasik district. Parasitic species like *Cuscuta reflexa*, *Dendrophthoe falcata* and *Viscum articulatum* are common. Epiphytic orchids like *Aerides crispum*, *Eria dalzellii*, *Rhynchostylis retusa* are frequent. Terrestrial orchids include *Hubenaria* sp., *Pecteilis gigantea*, *Nervilea plicata* etc. Aquatic plants such as *Ceratophyllum demersum*, *Limnophila indica*, *Marsilea minuta* are common in ponds.

Herbaceous plants during monsoon are luxuriant, the common species include *Commelina hasskarlii*, *Crotalaria filipes*, *C. nana*, *Desmodium laxiflorum*, *Eriocaulon diana*, *Laportea interrupta*, *Pouzolzia zeylanica*, *Smithia bigemina*, *S. setulosa*, *Wedelia urticifolia* etc.

The grasses comprise mostly *Apluda mutica*, *Arthraxon lancifolius*, *Arundinella pumila*, *Dichanthium annulatum*, *Digitaria ciliaris*, *Isachne globosa*, *Ischaemum indicum*, *Oplismenus compositus*, *Spodiopogon rhizophorus* etc.

Ferns like *Adiantum philippense*, *Athyrium falcatum*, *Cheilanthes farinosa*, *Lygodium flexuosum* etc. are common in the moist tropical forests.

II. Dry Tropical Forests

These are found in drier areas and can be subdivided as follows :

1. *Southern tropical dry deciduous forests* : These forests are situated in moderate rainfall zone (500-750 mm). Trees are stunted. The last vestiges of good forests are near Khambala in Nasik range, Vani and Dindori. Due to excessive biotic interference it resulted in dry condition and so xerophytic species such as *Aloe vera*, *Asparagus racemosus*, *Opuntia dillenii* etc. are coming up predominantly. The following subtypes are recognised :

(a) *Dry teak forests* :

These are found on western side of Dindori, north eastern side of Nasik and are confined to flat and undulating areas, where the depth of soil is good. The forests are open, understocked and large grassy areas are often met with due to biotic interference such as illicit felling, excessive grazing, fires and encroachments. The floristic composition is as follows :

The top storey includes *Acacia chundra*, *A. ferruginea*, *Albizia lebbeck*, *Anogeissus latifolia*, *Boswellia serrata*, *Careya arborea*, *Garuga pinnata*, *Gmelina arborea*, *Heterophragma quadriloculare*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Madhuca longifolia* var. *latifolia*, *Mangifera indica*, *Mitragyna parvifolia*, *Pterocarpus marsupium* var. *acuminatus*, *Syzygium cumini*, *Tectona grandis*, *Terminalia bellirica*, *T. crenulata* etc. The second storey consists of *Acacia leucophloea*, *A. nilotica* ssp. *indica*, *Bauhinia racemosa*, *Butea monosperma*, *Cassia fistula*, *Cassine glauca*, *Diospyros melanoxylon*, *Dolichandrone falcata*, *Emblica officinalis*, *Holarrhena antidysenterica*, *Meyna laxiflora*, *Pongamia pinnata*, *Wrightia tinctoria*, *Ziziphus glaberrima*, *Z. mauritiana* etc. Bamboos are absent. Shrubby growth includes *Carissa congesta*, *Cassia auriculata*, *Catunaregam spinosa*, *Lantana camara* var. *aculeata*, *Securinega leucopyrus*, *Woodfordia fruticosa* etc.

(b) *Southern dry mixed deciduous forests* :

These are found in central part of Nasik district. Forests are open and understocked. The top storey includes *Acacia chundra*, *A. ferruginea*, *Erythrina stricta*, *Terminalia bellirica*, *T. crenulata* etc. The second storey includes *Bauhinia racemosa*, *Mangifera indica*, *Ziziphus glaberrima* etc. Bamboos are absent. Shrubs include *Carissa congesta*, *Carvia callosa*, *Lantana camara* var. *aculeata*, *Woodfordia fruticosa* etc.

(c) '*Hardwickia*' forests :

These forests occur in Malegaon and Nandgaon ranges of Nasik district where the rainfall is low (300-350 mm). The forests are mostly understocked and blank. The area is grazed and hacked and the existing growth is stunted and malformed and also pronounced xerophytic species have come up. The grasses are stunted due to shallow soils.

The top storey includes *Dalbergia lanceolaria*, *Garuga pinnata*, *Hardwickia binata*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Sterculia urens* etc. The second storey includes *Acacia chundra*, *Aegle marmelos*, *Albizia amara*, *A. lebbeck*, *Anogeissus latifolia*, *Bauhinia racemosa*, *Boswellia serrata*, *Butea monosperma*, *Diospyros melanoxylon*,

Embllica officinalis, *Grewia tiliaefolia*, *Wrightia tinctoria*, *Ziziphus glaberrima* etc.

Bamboos are absent. Shrubs include *Cassia auriculata*, *Grewia damine*, *G. flavescens*, *G. tenax*, *Maytenus emarginata*, *Mimosa hamata*, *Rhus mysorensis*, *Securinega leucopyrus* etc.

2. *Southern tropical thorn forests*: These forests are found in Chandwad, Yeola, southern part of Malegaon, Nasik and Sinnar ranges where the rainfall is less (350-500 mm). The forests are blank and restricted to shallow soils. The grasses are stunted (except in fenced kurans) due to poor shallow soil which appears during rainy season. The forests being scattered and surrounded by cultivation on all sides are subjected to heavy grazing, lopping and illicit felling. These two factors combined with poor site quality, frequent fire, sheet and gall erosion proceeding at an alarming pace have contributed to the lack of regeneration of the main species and deterioration of forests. The top canopy includes *Acacia chundra*, *Anogeissus latifolia*, *Terminalia crenulata* etc. Bamboos are absent. Shrubs include *Acacia leucophloea*, *Carissa congesta*, *Cassia auriculata*, *Dichrostachys cinerea*, *Euphorbia ligularia*, *Grewia damine*, *Lantana camara* var. *aculeata*, *Maytenus emarginata*, *Mimosa hamata*, *Mundulea sericea*, *Opuntia dillenii*, *Rhus mysorensis* etc. The common climbers in dry tropical forests are *Aspidopterys cordata*, *Cajanus scarabaeoides*, *Cardiospermum halicacabum*, *Cocculus hirsutus*, *C. pendulus*, *Cryptolepis buechananii*, *Dioscorea bulbifera*, *D. pentaphylla*, *Mukia maderaspatana*, *Rivea hypocrateriformis*, *Wattakaka volubilis* etc.

During the rainy season, members of Fabaceae, Asteraceae, Cucurbitaceae, Vitaceae, Euphorbiaceae, Commelinaceae, Poaceae form the common groups. Seasonal changes bring a luxuriant and dense growth of grasses and herbs over the ground as well as over the slopes with the following common species : *Aeschynomene indica*, *Alysicarpus vaginalis*, *Biophytum sensitivum* var. *candolleanum*, *Cassia pumila*, *Cleome viscosa*, *Crotalaria mysorensis*, *C. orixensis*, *Glossocardia bosvallea*, *Goniogyna hirta*, *Indigofera cordifolia*, *Justicia simplex*, *Launaea procumbens*, *Linum mysorense*, *Polygala arvensis*, *P. persicariaefolia*, *Spermacoce hispida*, *S. pusilla*, *Zornia gibbosa* etc. The common grasses are *Apluda mutica*, *Arundinella pumila*, *Cymbopogon martinii*, *Cynodon dactylon*, *Digitaria ciliaris*, *Dinebra retroflexa*, *Echinochloa colana*, *Eragrostis pilosa*, *Ischaemum indicum*, *Melanocenchris jacquemontii*, *Setaria pumila* etc. Ferns include *Actiniopteris radiata*, *Adiantum philippense* and *Cheilanthes farinosa*.

III. Western subtropical Hill Forests

These are located in western part of Nasik (Anjaneri, Trimbak) and Igatpuri ranges where rainfall is heavy. It includes evergreen/semi-evergreen species and occurs in narrow strips on gentle slopes where soils are good.

Mangifera *Syzygium* subtype :

This subtype is found in plateau portions. There is predominance of *Mangifera indica* and *Syzygium cumini*. Top and second storeys include *Bridelia squamosa*, *Butea monosperma*, *Erythrina stricta*, *Garuga pinnata*, *Heterophragma quadriloculare*, *Ixora brachiata*, *Lannea coromandelica*, *Mangifera indica*, *Schleichera oleosa*, *Syzygium cumini*, *Terminalia chebula*, *T. crenulata*, *Bambusa arundinacea* and *Dendrocalamus strictus* also occurs here. The shrubs include *Carissa congesta*, *Carvia callosa*, *Glochidion hohenackeri* and *Pavetta crassicaulis*.

Mangifera *Memecylon* subtype :

This is found in Ambewadi and Kurangwadi (Igatpuri range). Percentage of evergreen species particularly of *Mangifera* and *Memecylon* is high. They are found in narrow strips. Top and second storeys include *Aglaia lawii*, *Bridelia squamosa*, *Butea monosperma*, *Callicarpa tomentosa*, *Canthium dicoccum* var. *umbellatum*, *Erythrina stricta*, *Garuga pinnata*, *Heterophragma quadriloculare*, *Ixora brachiata*, *Lannea coromandelica*, *Macaranga peltata*, *Mangifera indica*, *Memecylon umbellatum*, *Schleichera oleosa*, *Syzygium cumini*, *Terminalia crenulata* etc. Shrubs like *Actinodaphne angustifolia*, *Boehmeria scabrella*, *Carissa congesta*, *Carvia callosa*, *Glochidion hohenackeri* and *Thelepaepale ixiocephala*.

Climbers in western subtropical hill forests include *Acacia torta*, *Elaeagnus conferta*, *Jasminum malabaricum*, *Piper trichostachyon* etc. Epiphytic ferns like *Lepisorus thunbergianus* and *Microsorium membranaceum* are frequent on *Mangifera indica*, *Memecylon umbellatum* etc. Orchids like *Aerides crispum*, *Dendrobium aqueum*, *D. herbaceum* are common on *Mangifera indica*. Root parasites includes *Striga gesneroides*. The herbaceous layer is represented by the following species : *Achyranthes aspera*, *Leucas deodikarii*, *Oplismenus burmannii*, *O. compositus*, *Pluchea senecioides* and ferns like *Athyrium hohenackerianum*, *Tectaria macrodonta* etc.

WEED FLORA

A weed in general is a "plant out of place" (Tadulingam & Venkatanarayana, 1955). They are plants which are not wanted where they are growing. Most of the weeds did not exist before agriculture and they probably evolved along with the crops (Sen, 1981). Unlike other plants, weeds are capable of growing everywhere (Kaul, 1986). Weeds are the biggest competitors for the economic crops, lawn grasses and open places left for beautification (Sen, *op. cit.*). They cause tremendous loss to production.

Although, weeds are usually undesirable plants they are useful in many cases as fodder, food or medicine for man and also ornamentals. The weeds of Nasik district can be divided into two main types viz., weeds of crop fields and roadside and wasteland weeds.

Weeds of crop fields :

These weeds are detrimental to the successful growth of crops. The following are found growing in and around cultivated fields of *Eleusine coracana*, *Guizotia abyssinica* and *Oryza sativa* ; weeds which emerge from the barren fields after harvest of crops have also been included.

Adelocaryum coelestinum, *Aerva lanata*, *Aeschynomene indica*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Alysicarpus procumbens*, *Amisophacelus cucullata*, *Ammannia baccifera*, *A. multiflora*, *Anagallis arvensis*, *Apluda mutica*, *Argemone mexicana*, *Arundinella metzii*, *Blainvillea acmella*, *Blumea eriantha*, *Brachiaria ramosa*, *Caesulia axillaris*, *Canscora diffusa*, *Cassia absus*, *C. pumila*, *Catharanthus pusillus*, *Celosia argentea*, *Centaurium centaurioides*, *Chenopodium album*, *C. murale*, *Coix lacrymajobi*, *Commelina benghalensis*, *C. diffusa*, *C. hasskarlii*, *Crotalaria filipes*, *C. linifolia*, *C. medicaginea*, *C. orixensis*, *Cyanotis cristata*, *Cyathocline lutea*, *C. purpurea*, *Cynodon dactylon*, *Cyperus alulatus*, *C. compressus*, *C. difformis*, *C. iria*, *C. rotundus*, *Dactyloctenium aegyptium*, *Desmodium triflorum*, *Desmostachya bipinnata*, *Dichanthium annulatum*, *D. pertusum*, *Digera muricata*, *Digitaria ciliaris*, *Dinebra retroflexa*, *Echinochloa colona*, *Eclipta prostrata*, *Eleusine indica*, *Emilia sonchifolia*, *Eragrostis unioloides*, *Eriocaulon diana*, *Eulalia trispicata*, *Euphorbia geniculata*, *E. hirta*, *E. parviflora*, *E. thymifolia*, *Exacum pumilum*, *Fimbristylis bisumbellata*, *F. miliacea*, *Geissasapis cristata*, *Goniocaulon indicum*, *Hackelochloa granularis*, *Heliotropium indicum*, *H. ovalifolium*, *Hpdrolea zeylanica*, *Hygrophila auriculata*, *H. serpyllum*, *Indigofera astragalina*, *I. cordifolia*, *I. glandulosa*, *I. linifolia*, *I. prostrata*, *Indocourtoisia cyperoides*, *Ipomoea hederifolia*, *I. nil*, *Isachne globosa*, *Ischaemum indicum*, *Iseilema antheophoroides*, *Jansenella griffithiana*, *Justicia procumbens*, *Kohautia aspera*, *Kyllinga tenuifolia*, *Lagascea mollis*, *Launaea procumbens*,

Leucas aspera, *L. lavandulaefolia*, *L. urticifolia*, *Limnophila indica*, *Lindernia ciliata*, *L. crustacea*, *L. parviflora*, *Linum mysorense*, *Lobelia alsinoides*, *Mollugo pentaphylla*, *Nanothamnus sericeus*, *Ocimum americanum*, *Panicum psilopodium*, *Paspalidium flavidum*, *Phyla nodiflora*, *Physalis minima*, *Polygala arvensis*, *Portulaca oleracea*, *Pycnus pumilus*, *Rorippa indica*, *Rotala densiflora*, *R. oculiflora*, *Salvia plebeia*, *Sesamum orientale*, *Setaria pumila*, *Smithia salsuginea*, *S. sensitiva*, *Sopubia delphinifolia*, *Sorghum halepense*, *Spermacoce pusilla*, *Sphaeranthus indicus*, *Striga angustifolia*, *S. densiflora*, *Torenia indica*, *Trachyspermum strictocarpum*, *Tragus roxburghii*, *Tribulus terrestris*, *Trichodesma sedgwickianum*, *Tridax procumbens*, *Urochloa panicoides*, *Vetiveria zizanioides*, *Vicoa indica* and *Zornia gibbosa*.

Roadside and wasteland weeds :

Weeds grow in profusion in waste places—where no useful plant grows and disperse themselves. Roadside weeds are hardy, prostrate, perennials that are capable of withstanding any amount of trampling. The following are some such weeds :

Acanthospermum hispidum, *Achyranthes aspera*, *Ageratum conyzoides*, *Alloteropsis cimicina*, *Alternanthera sessilis*, *Alysicarpus vaginalis*, *Amaranthus* sp., *Argemone mexicana*, *Bidens biternata*, *Biophytum sensitivum* var. *candolleianum*, *Blumea eriantha*, *Boerhavia diffusa*, *Calotropis gigantea*, *C. procera*, *Cassia tora*, *Celosia argentea*, *Cleome speciosa*, *C. viscosa*, *Conyza bonariensis*, *Datura innoxia*, *Dichanthium huegelii*, *Echinochloa colona*, *Euphorbia hirta*, *Evolvulus alsinoides*, *Exacum bicolor*, *Flaveria trinervia*, *Gomphrena celosioides*, *Hygrophila auriculata*, *Ischaemum semisagittatum*, *Justicia neesii*, *Leonotis nepetaefolia*, *Malvastrum coromandelianum*, *Martynia annua*, *Nicandra physalodes*, *Oplismenus burmannii*, *Oxalis corniculata*, *Parthenium hysterophorus*, *Peristrophe paniculata*, *Phyllanthus fraternus*, *Plectranthus mollis*, *Pseudanthistiria heteroclita*, *Psoralea corylifolia*, *Rungia elegans*, *Scoparia dulcis*, *Sesamum orientale*, *Solanum surattense*, *Sonchus oleraceus*, *Sphaeranthus indicus*, *Syndrella nodiflora*, *Tephrosia villosa*, *Themeda quadrivalvis*, *Tridax procumbens*, *Triumfetta rhomboidea*, *T. rotundifolia*, *Urena lobata* ssp. *sinuata*, *Verbascum chinense*, *Vernonia cinerea* and *Xanthium strumarium*.

AQUATIC VEGETATION

The common habitats of the aquatic and marshy species in this area are a number of tanks (Chankapur), rivers (Kadva, Girna, Mosam), nallahs, ponds, puddles and dam sites (Gangapur, Nandur—Madhmeshwar). Karthikeyan *et al.* (1982) have reported 26 species of aquatic angiosperms

from Nasik district. We have collected *ca* 55 species. The hydrophytes of Nasik district can be classified into the following four life forms on the basis of their contacts with soil, water and air (Maheshwari, 1960).

Attached submerged hydrophytes : These are, entirely or for the most part in contact with soil and water. They are found in tanks and ponds and include such herbs like *Hydrilla verticillata*, *Limnophila indica*, *Vallisneria spiralis* etc.

Suspended hydrophytes : These are rootless, submerged hydrophytes that are in contact with water only, like *Ceratophyllum demersum*.

Free floating hydrophytes : These are plants that are in contact with water but not with soil. The following plants are found floating in tanks lakes and ponds. *Eichhornia crassipes*, *Ipomoea aquatica*, *Marsilea minuta*, *Paspalidium geminatum*, *Pistia stratiotes*, *Trapa natans* var. *bispinosa*, *Wolffia arrhiza* etc.

Wetland hydrophytes : These are rooted to the soil that is usually saturated with water, atleast in the early part of their life. They grow in wet places around cultivated fields, margins and edges of tanks, lakes and nallahs which include the following species : *Aeschynomene aspera*, *A. indica*, *Ageratum conyzoides*, *Alternanthera sessilis*, *Anmannia baccifera*, *A. multiflora*, *A. senegalensis*, *Bacopa monnieri*, *Bergia ammannioides*, *Bolboschoenus maritimus* ssp. *affinis*, *Brachiaria reptans*, *Caesulia axillaris*, *Cardamine trichocarpa*, *Centaurium centaurioides*, *Chrozophora prostrata*, *Coix gigantea*, *C. lacryma-jobi*, *Commelina diffusa*, *C. hasskarlii*, *Cyathocline purpurea*, *Cyperus compressus*, *C. corymbosus*, *C. iria*, *C. laevigatus*, *C. nutans* ssp. *eleusinoides*, *C. tenuispica*, *Echinochloa colona*, *Eclipta prostrata*, *Eleocharis atropurpurea*, *Eragrostis japonica*, *E. unioides*, *Eriocaulon diana*, *E. eleanorae*, *Eusteralis malabarica*, *Fimbristylis dichotoma*, *F. sieberiana*, *F. tenera*, *Geissaspis cristata*, *Hydrolea zeylanica*, *Hygrophila auriculata*, *Ischaemum rugosum*, *Justicia quinqueangularis* var. *peploides*, *Lindernia parviflora*, *Lobelia alsinoides*, *Ludwigia perennis*, *Mariscus sumatrensis*, *Panicum paludosum*, *Persicaria glabra*, *Phyla nodiflora*, *Polygonum plebium*, *Pycneus flavidus*, *Rotala occultiflora*, *R. serpyllifolia*, *Salvia plebeia*, *Schoenoplectus articulatus*, *Sesbania bispinosa*, *Smithia conferta*, *S. purpurea*, *Veronica anagallis-aquatica* etc.

The vegetation along wet banks of rivers, nallahs or water logged areas or rocky crevices along water courses includes the following species : *Chrysopogon fulvus*, *Crinum defixum*, *Dicanthium huegelii*, *Eragrostis gangetica*, *Glinus lotoides*, *Melanocenchris jacquemontii*, *Rorippa indica*, *Rotula aquatica*, *Solanum surattense*, *Spodiopogon rhizophorus*, *Tamarix ericoides* etc.