Flora of India
Series 3

FLORA OF MAHABALESHWAR AND ADJOININGS, MAHARASHTRA

Volume 1

SANDHYA DESHPANDE
B.D. SHARMA
&
M.P. NAYAR

BOTANICAL SURVEY OF INDIA

FLORA OF MAHABALESHWAR

Vol. 1

(Ranunculaceae to Thunbergiaceae)

Flora of India
Series 3

FLORA OF MAHABALESHWAR AND ADJOININGS, MAHARASHTRA

Volume 1

SANDHYA DESHPANDE
B. D. SHARMA
&
M. P. NAYAR

BOTANICAL SURVEY OF INDIA

Date of Publication : February 18, 1993

Price : Rs. 228.00 or $ 48.00

Cover Photo : *Echinops echinatus* Roxb. —a common composite with flower heads.

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.

CONTENTS

PREFACE

The Botanical Survey of India since its reorganisation in 1954 has been engaged in studies on vegetation and flora and inventorisation of the rich floristic diversity in the country. Since early 1980s, the department has taken up publication of Flora of India under four series : Series 1 comprise taxonomic revisions of families, tribes and genera primarily of flowering plants for the whole country (Fascicles of Flora of India) ; Series 2 on the Floras of States/Union Territories.; Series 3 pertain to the floras of phytogeographically interesting and floristically rich districts, and Series 4 to include special and topical subjects on the plant wealth. Several districts of floristic significance in different states have been intensively and extensively botanized to eventually develop a good base for writing the State Floras and to prepare taxonomic revisions of different plant families for Flora of India volumes.

The present work on the flora of Mahabaleshwar and its adjoinings in Satara district, Maharashtra, is one such study to assess and inventorise the rich plant diversity in the area. The area encompasses varied eco-climatic zones which have given rise to interesting vegetation types and plant associations. The flora has a rich assemblage of many rare plants. Panchgani Plateau in the Sahyadri hills which is commonly called the 'Table Land' is a very interesting geomorphological location which harbours many endemics in the flora and is the Type locality of dozens of new species described since the time of Blatter and McCann. Unfortunately, the area being a tourist spot, is subjected to severe anthropogenic activities which are causing extreme stress conditions on the habitats and the plants. The plateau and other flora rich areas in the Sahyadri ranges in the vicinity need immediate attention for conservation.

The flora in two volumes deals with a description of the vegetation and its associated factors, taxonomic treatment of 1398 taxa, each with notes on distribution, frequency, phenology, collectors' names, field numbers, uses, etc. Line drawings for some interesting species have also been provided. Efforts have been made to bring the nomenclature upto-date as per the present Botanical Code.

The authors wish to express their sincere thanks to Sarvasree S. C. Pal, P. K. Dutta, Samiran Roy, S. K. Sur, S. K. Das, D. Sardar and A. K. Chatterjee of the Printing & Publication Section, Botanical Survey of India for help in bringing out this publication. One of us (S. D.) gratefully acknowledges the Director, Botanical Survey of India for the award of Research fellowship and facilities in carrying out this work.

Authors

Alysicarpus pubescens var. *vasavadae* (Hemadri) Sanjappa

Crotalaria retusa L.

Smithia agharkarii Hemadri

Echinops echinatus Roxb.

Artemisia parviflora Buch.-Ham. ex D. Don

Swertia densifolia (Griseb.) Kashyapa

Hoya wightii Hook. f.

INTRODUCTION

General note : The area dealt with is situated at the Western limit of the Deccan tableland between latitudes 10°75' and 18°15' N and longitudes 73° 60' and 76° 40' E and covers an area of 10492 sq. km. It is bordered by the Pune district on north, Sholapur district on east, Sangli district on the south and the Ratnagiri on west. These administrative boundaries coincide with some of the physical features like Nira river on the north, Sahyadri range on the west and Mahadeo hills on the east. The forest area is divided into eleven ranges *viz.*, Javali, Karad, Khandala, Khatav, Koregaon, Mahabaleshwar, Man, Patan, Phaltan, Satara and Wai ; and occurs in scattered patches throughout the district. It covers an area of 1697.603 sq km. Out of this, 1521.841 sq km are reserved forests, 58.562 sq km are protected forests, 63.235 sq km are unclassed forests and 53.965 sq km are leased forests. The soil of the area falls under three categories *viz.*, medium black to deep black, malvan or lighter soil and red or laterite soil. The main agricultural products are sugarcane, jowar, bajra, rice, wheat, pulses, cotton, groundnut, safflower, chillies and vegetables and fruits. The major forest produce are timber, firewood and charcoal.

The Koyna Electric Grid Scheme is a landmark in the industrial development of the district and in Maharashtra. It is one of the biggest hydro-electric projects in Maharashtra. There are five power houses situated at Bhatghar, Karad, Koregaon, Satara and Wai which generate electricity.

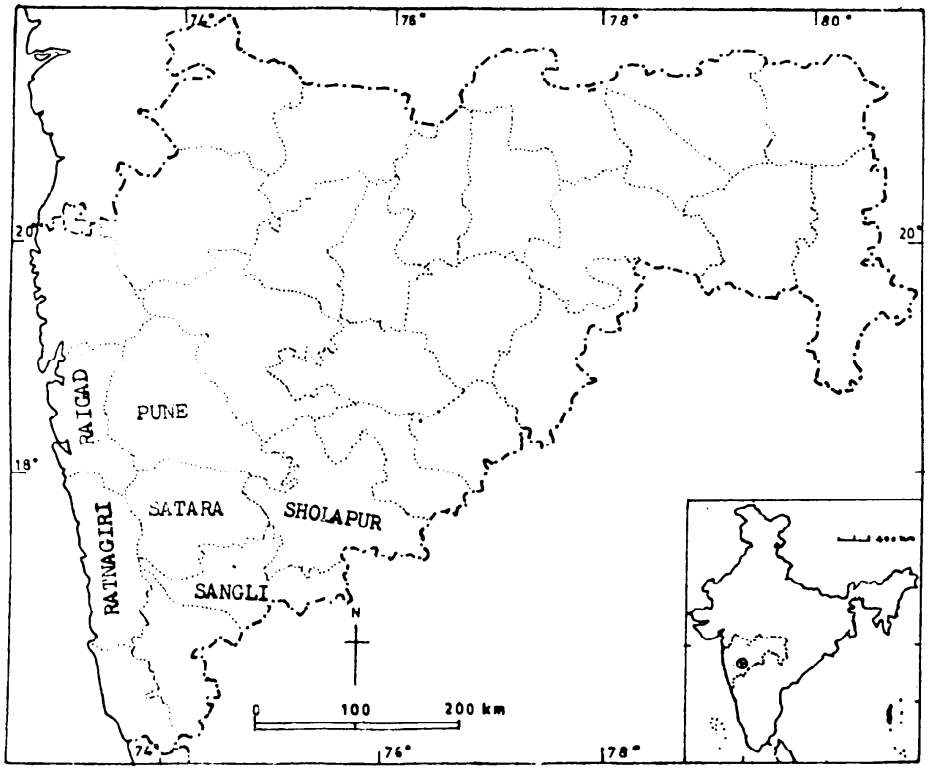
There are six sugar factories and distilleries situated in this area. One glass manufacturing factory is situated at Ogalewadi and two cement manufacturing factories are at Karad and Satara. There are some small scale and large scale engineering units which have a countrywide reputation for the manufacture of engines, spare parts, machine tools and agricultural implements. The others are jaggery making, oilseeds crushing, plastic, weaving and pharmaceutical industries. The main crafts are making gold and silver ornaments, copper and brass pots, cotton weaving, tanning and shoe-making. There are a few forest industries like bee-keeping, charcoal manufacturing, collection of *shikekai*, *hirda* and making of walking sticks.

Historical notes : The oldest known place from this area is probably Karad which is found in inscription of about 200 B.C. Wai is locally

believed to be the 'Viratanagari' where 'Pandavas' lived in the thirteenth year of their exile. Old Mahabaleshwar, which is about 10 km from Mahabaleshwar is regarded as one of the 'kshetras' or holy places. It is the place of origin of the five rivers Krishna, Koyna, Savitri, Venna and Gayatri. The temple known as 'Panchganga temple' is built on the supposed spot of the origin of these five rivers. The Mauryas and Satavahanas ruled over the entire Maharashtra from 230 B.C. to 250 A D. Satara and Southern Maharashtra were held by Chalukyas between 550 and 1189 A.D. which was followed by Yadavas of Devgiri. The first Muslim invasion of the Deccan took place in 1296. In 14th century, the Bahamani territories were divided into eight provinces in which this area was included under Bijapur.

Before the middle of the 16th century, Shivaji, the founder of the Maratha Empire, regained control over the hilly parts of Pune district. In 1656, he built Pratapgad Fort on a high rock near the source of Krishna river. A temple of the Goddess 'Bhavani' from which Shivaji and his Maratha Sardars derived their inspiration was also constructed on this Fort. Shivaji appointed eight officers of which the first was 'Peshva' or head manager, who ruled the area upto 1878. In 1849 this area was annexed by the British Government.

Importance of the project undertaken: Mahabaleshwar and Panchgani are the two popular hill stations situated in Satara district. The variation in altitude, humidity and edaphic factors provide favourable conditions for the growth of tropical, subtropical and temperate species at these places. There is a high concentration of endemic and useful exotic plants introduced by Britishers which have become naturalized component of the local flora in due course of time. A stream of tourists visit these areas due to their grandeur beauty, climate and greenery throughout the year. The variety and richness of vegetation cover of the area always inspired various plant explorers and botanists to visit these places. The investigations carried out by these botanists led to the publication of several floristic accounts. Some of the important contributions are by Dalzell & Gibson (1861), Lisboa (1883), Birdwood (1886 1897), Cooke (1885 1908), Blatter and McCann (1926 1935), Santapau (1952 1962), Puri and Mahajan (1960). Bole & Almeida (1981 onwards) have published a series of papers on the Flora of Mahabaleshwar. Despite the number of accounts by so many botanists, the Flora of Satara district as a whole remained less explored as the adjacent areas which form inseparable part of the composite picturesque panorama of this tract were almost neglected. The present studies were undertaken to fill up this lacuna and to bring out a comprehensive floristic account of the Satara district as a whole.



Map 1 : Showing Satara district in Maharashtra

Although fortyfour new species have been reported from this area by different workers, but many of them have not been recollected for many decades. Some of these are known only by their type collections, while in other cases, even the types do not exist in any of the Indian herbaria. It was, therefore, thought fit to make a fresh attempt to collect these species and assess the position as it exists today.

Some of the developmental schemes, which are extremely essential for socio-economic upliftment of the rural poor and backward populace, have adversely affected the natural forests. A large chunk of luxuriant semi-evergreen forests of Koyna area have been lost for ever due to the subemergence of catchment area and construction of Koyna Dam and hydro-electric power station. The existence of numerous interesting species occurring in the Koyna valley are indicative and living witness to the richness of the area as a whole. The earlier botanists hardly paid any attention to Koyna area due to its remote location and non-existence of approach roads and hence remained unexplored. In the absence of any recorded floristic data, it is difficult to assess the damage caused by the construction of the dam. Recently on behalf of the Government of India, the Government of Maharashtra has undertaken a scheme "Western Ghats Eco-development" to improve and conserve this centuries-old eco-system.

Past work : A number of botanists *viz.*, Nairne (1897), Graham (1839), Dalzell & Gibson (1861), Birdwood (1886 1897), Woodrow (1897 1901) and Talbot (1894, 1909 1911) have contributed to the flora of the then Bombay Presidency which included Satara district also. Cooke in his *Flora of the Presidency of Bombay* (1901 1908) has reported 2337 species belonging to 944 genera and 146 families out of which 401 species comprising 273 genera and 88 families were reported from the present district.

Since the publication of Cooke's *Flora* a lot of taxonomic literature has appeared in the form of monographs and revisions of various plant groups, based on additional information available to-date and modern techniques, etc., have led to changes in taxonomic and nomenclatural concepts (Karthikeyan *et al.* 1981). With a view to revise the 'Flora of Bombay Presidency' Blatter published a series of articles alone and in collaboration with McCann too (1926 - 1935) with updated nomenclature and critical comments wherever necessary, which included *ca* 90 species from the area under study. He also listed 93 species of grasses in collaboration with McCann (1935). Vartak (1957, 1959a, 1959b) recorded 31 species from the district. Puri & Mahajan (1960) published 347 species of Angiosperms and 34 species of Cryptogams from Mahabaleshwar. Santapau & Kapadia

(1966) described 36 species and varieties of orchids. Chavan *et al.* (1973) have enumerated 128 species from Kas.

In recent years Bole & Almeida (1981 onwards) are publishing a series of articles exclusively on Mahabaleshwar plateau and have described *ca* 716 species so far.

The flora is further enriched by addition of 44 new species, 5 varieties and 1 forma described by different authors *viz.*, Baker (1898), Cooke (1901), Fyson (1921), Blatter (1927 - 1930), Blatter & McCann (1927 - 1932), Gravely and Mayuranathan (1932), McCann (1934), Santapau & Patel (1958), Santapau & Merchant (1964), Bor (1961), Ansari (1968, 1972), Govindarajalu (1972), Deb & Das Gupta (1976), Raghavan *et al.* (1982), Taylor (1983) and Ved Prakash & Jain (1983). Out of these new taxa, only 28 species, 3 varieties and 1 forma are valid today as evidenced by the recent monographs and revisions.

Present work : The present work has been undertaken to bring out a comprehensive floristic account of the Satara district as a whole. It also fulfills a part of the aims and objects of the Botanical Survey of India to assess and inventorise the plant wealth of the country.

The present work is the outcome of three years (1983 - 1985) of extensive and intensive studies on the Flora of Satara district. During this period eight field trips were undertaken covering all the seasons, and 950 field numbers comprising *ca* 5700 specimens of angiosperms and a few of ferns have been collected. Out of these, 106 species have been collected for the first time. Special attention was paid to the areas which remained under - or unexplored so far.

The present data is based on the recent collections made by the senior author (1983 - 1985) as well as on the collections housed in the herbarium of the Botanical Survey of India (*BSI*) and Blatter Herbarium, St. Xavier's College, Bombay (*BLAT*). The present flora deals with 1398 species belonging to 697 genera and 141 families. Of these, 1201 occur in wild and 197 are cultivated or introduced ones. Further details are provided in Floristic analysis.

MATERIALS AND METHODS

Field study : The area, which is divided into 11 forest ranges, was covered by State Transport buses wherever available. The interior areas were covered on foot. Catchment areas of Koyna and Dhom dam were

covered by motor launches which ply for a very short period during the year and the camping stations were either P.W.D. or Forest rest houses. The plant exploration period varied from 10 - 12 days.

While collecting the specimens, the data such as habit, habitat, flower colour, fragrance if present, frequency of distribution, local names and uses, if any, were recorded in the field itself. Besides the wild species, some major cultivated plants and weeds of cultivated fields and road sides have also been collected.

These specimens were dried in the field using blotters and newspapers. The flowers of some of the species which could not be identified in the field or of interest otherwise were fixed in 4% Formalin for further studies in the laboratory.

Herbarium study : After returning to the headquarters, all the specimens were poisoned and dried using standard herbarium techniques and mounted on standard herbarium mounting sheets. The field identification was confirmed by using relevant floras *viz.*, *The Flora of British India* by J. D. Hooker *et al.* (1872 - 1897), *The Flora of the Presidency of Bombay* by T. Cooke (1901 - 1908) and recent monographs and revisions, which are too many to be cited here ; however, they have been cited at the appropriate places in the enumeration. The tentatively identified specimens were matched with the authentically identified specimens deposited in the herbarium of Botanical Survey of India, Pune (*BSI*), and identification was thus confirmed. These specimens have been incorporated in the same herbarium.

Plan of the Flora : The 'flora' starts with a short introduction and a key to the families. The genera under a family and the species under a genus have been arranged in alphabetical order. The families are arranged according to the Bentham and Hooker's system of classification (1862 - 1883) with slight modification based on Hutchinson (1959). The family key is adapted from Gamble's *Flora of Presidency of Madras* (1957 Repr. ed.). Dichotomous keys for genera and species are mainly based on macroscopic characters. The generic key for the family Poaceae is adapted with slight modification from Karthikeyan's synopses of Awned and Unawned grasses of former Madras Presidency (1972 & 1980).

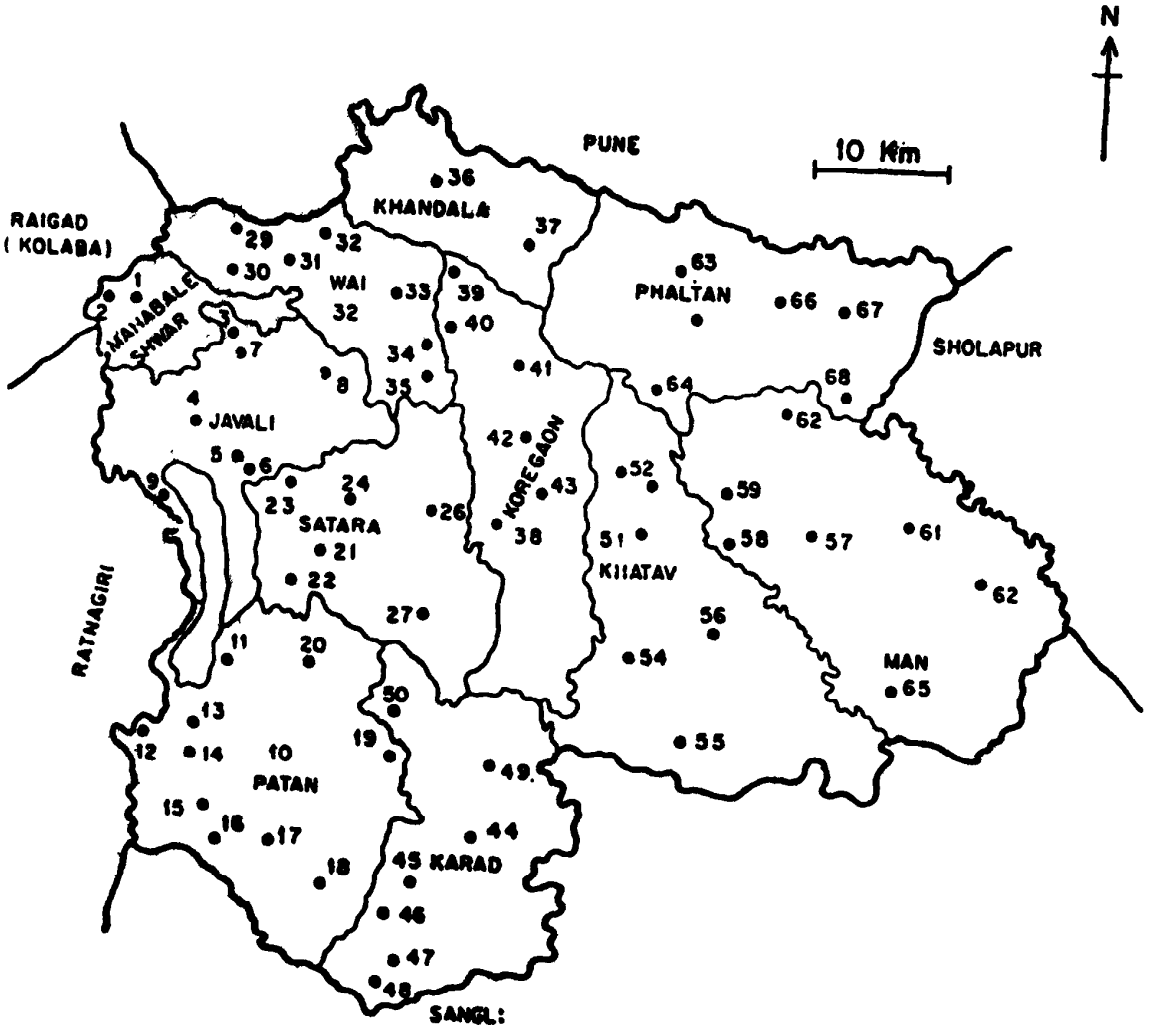
The correct name of the species is followed by basionym, if any, and synonyms if necessary to connect the name with the regional floras. The reference to the *Flora of British India*, *Flora of the Presidency of Bombay* and recent literature, wherever available is followed by local name in 'Marathi' or common English name if available in inverted

commas at the end of citations. The species are briefly described eliminating the characters already reflected in the keys. This is followed by phenological data, reference to the illustration (Illus.) if available and distribution (Distrib.). Under distribution, after frequency, collection localities are given alphabetically. In the case of rare species, collector's name and field numbers are also provided. The specimens collected by the senior author are indicated by only field number(s) immediately after locality. The specimens available in herbaria other than *BSI* are indicated accordingly. The critical comments, if any, are added at the end. Cultivated species are listed at the end of the respective families or genera. After systematic enumeration of Angiosperms a list of Pteridophytes is given. Conventional abbreviations are used throughout the text.

Topography : There is a marked difference in the general topographic features of the area. The main range of the Sahyadri stretching about 100 km from north to south forms the western boundary of the tract. The Mahadeo range originates from the Sahyadrian complex about 16 km north of Mahabaleshwar and stretches east and south-east across the whole breadth of the district. These two ranges from the major hill complex of the tract. Within the limits of the tract, the crest of Sahyadris is crowned by several peaks. The main line of the Sahyadris develops into several coles and saddles of which the more accessible ones have become major ghat routes. Besides many small saddles, the Mahadeo range is crossed by three important passes, the Khambatki pass and two breaks near Tadvala about 19 km north-east of Khambatki.

The tops of the main Sahyadris and of the Mahadeo hills especially in the north-western tracts of Wai, Jaoli and Patan look like a succession of fortresses raised on a series of plateaus piled one over the other, the whole surmounted by a wall of rock. The top of Mahabaleshwar, the highest point in the tract is about 1,436 m above the mean sea level. From the high Deccan tableland on the east, the Sahyadris seem somewhat low and tame but from the western edge of their crest great forms stand out from the Konkan with bold wild outlines and cliffs which in places have a sheer drop of over 910 metres. For about 48 km after leaving the Sahyadris, the Mahadeo hills attain a height of about 1,220 m above the mean sea level and about 610 m above the plains. The north face of the Mahadeo range falls sharply into the Nira valley to the south. The hill falls much more gently into the valley of the Krishna. Some notable hills which add to the relict of Satara district are - Sonjai (1,003 m), Vardhangad (1,067 m), Pandavgad (1,273 m), Kenjalgad (1,301 m), Vasota (1,302 m) and Kamalgad (1,375).

Drainage : The area is drained by four major rivers *viz.*, the Nira in the entire Northern belt, the Man in the East and the Yerla and the



Map 2 : Satara District : Plant collection localities

LEGEND TO PLANT COLLECTION LOCALITIES

1. Mahabaleshwar
2. Pratapgad
3. Panchgani
4. Medha
5. Bamnoli
6. Kas
7. Kelghar ghat
8. Kudal
9. Vasota
10. Patan
11. Devgad
12. Kumbharli ghat
13. Mirgaon
14. Rasati
15. Morgiri
16. Salve
17. Sanbur
18. Dhebewadi
19. Chaphal
20. Tarle
21. Satara
22. Asangaon
23. Kanher
24. Yavteshwar
25. Dhavadi
26. Mahuli
27. Borgaon
28. Wai
29. Kenjalgad
30. Kamalgad
31. Dhom dam
32. Pandavgad
33. Kumbharli ghat
34. Shirgaon ghat
35. Chandan-vandan fort
36. Khandala
37. Lonand
38. Koregaon
39. Solshi
40. Pimpoda
41. Wathar
42. Kinhai
43. Vardhangad
44. Karad
45. Kole
46. Kolewadi
47. Nandgaon
48. Yelgaon
49. Masur
50. Chorjwadi
51. Khatav
52. Lalgun
53. Budh
54. Aundh
55. Nimsod
56. Vaduj
57. Dahivadi
58. Pingli tank
59. Malvadi
60. Mograla ghat
61. Mardi
62. Mhasvad
63. Phaltan
64. Tathavada
65. Vathar
66. Vidni
67. Nimblak
68. Javali

Krishna in the South. The Krishna is one of the three sacred rivers of southern India. It rises on the eastern brow of the Mahabaleshwar plateau 6 km west of Jor in the extreme west of Wai. Like Godavari and Kaveri, it flows across almost the entire breadth of the peninsula from west to east.

Today Koyna has become the most important river in Maharashtra on account of the hydro-electric project developed at Koyna Nagar near Helwak. The river Nira has acquired economic importance on account of the Bhatgar and the Vir dams supporting an extensive network of canals for irrigation.

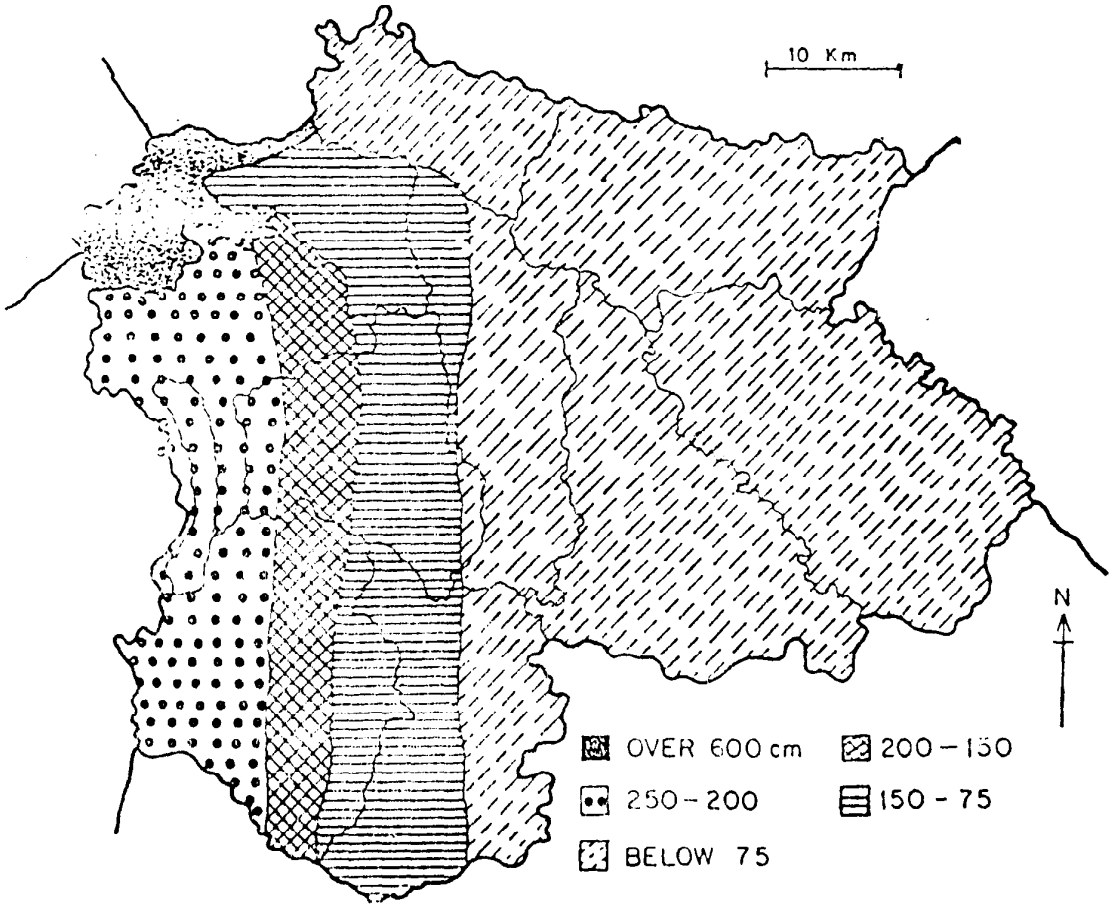
Geology : The district is covered by basaltic lava flows of upper cretaceous lower eocene age. The basalts capped by laterite are found in the plateaus above 900 m mean sea level. Along the sources of the major rivers, alluvium has been deposited in recent times.

Deccan trap : The basalt flows of the area are of two types. The aa flow, which is common, shows a basal section having chilled basalt or greyish clinkar which shows fragments of highly vesicular or dense purple trap cemented by zeolites or secondary silica or glass. The middle section of the flow comprises dark or dark grey, dense basalt. Over this is found a section of flow breccia which also consists of sub-rounded to angular blocks of vesicular trap cemented by zeolites, glass and pulverised rock. The top-most layer is pinkish or purplish glass which at places gives rise to clay-like material after weathering. The product of weathering comprises fine fragments and gives rise to smooth slopes. Owing to this difference in weathering characters, cliffs, benches and terraces are formed. In addition, wide plateaus of plains are also formed. Broad bottomed valleys are derived wherever the erosion is arrested by the dense sections of the flows. Amphitheatre - like geomorphological features are also conspicuous in these areas.

Dyke : Dykes are rare. The rock of the dyke is similar to that of porphyritic basalt

Laterite : Laterite occurs on the plateau tops as tabular masses. It is well exposed in the Panchgani - Mahabaleshwar plateaus and in the plateaus on either side of Koyna river. In Mahabaleshwar area, the laterite is seen from 1370 m to 1440 m and again around 1290 m indicating two levels. In the area south of Panchgani the level falls from 1265 m in the north to 1045 m in the south near Koyna dam.

Alluvium : Occurs in patches along banks of rivers like the Krishna, Venna, Kudali, Koyna and others. It consists of beds of pebbles and boulders of trap and chert, silt and sand.



Map 3 : Satara District : Annual average rainfall

Soil : The breccia portion of aa flows and the pahoehoe flows give rise to purplish or reddish soil mixed with grains of zeolite, chert and quartz, etc. The dense sections of the flows give rise to dark clayey soil. In the western part, where the laterite is extensively eroded the reddish brown soil is conspicuous.

Economic rocks and minerals : *Bauxite* : Bauxite occurs in the laterite plateaus near Panchgani and at a few places in the east Koyna valley. It occurs as large lenses or pockets and shows variation in thickness.

Construction material : The dense section of flows yield tough rock suitable for road making and as railway ballasts and concrete aggregate.

Kankar : Along the courses of streams and in alluvial patches, kankar and calc-tufa occur as irregular patches. These are excavated and used locally for making lime.

Groundwater : The alluvial patches are good aquifers. Wherever the trap rocks are weathered, the joints and fractures become open and help in groundwater movement Laterite, which is full of voids, helps in seepage of rain water and such water comes out as springs along the lithomargic clay contact. Several such springs are the sources of domestic and to some extent, agricultural needs of many villages, at higher levels in the east Koyna valley.

Climate : The climate can be broadly divided into four seasons *viz.*, the cold, the hot, the south-west monsoon and the post monsoon seasons. The cold season starts by about the end of November and continues up to middle of February. It is followed by hot season from the middle of February till the on-set of the monsoon in the first or second week of June. The south-west monsoon is from June to September. The post monsoon months are October and November.

Rainfall : The narrow strip along the western border gets heavier rainfall whereas the major part under study lies in the rain shadow area. The variation in the annual rainfall is very significant. Mahabaleshwar, in the Ghats, receives over 633 cm rainfall and it suddenly drops down to 76 cm at Wai which is only 32 km away from and at its base. The tract can be roughly divided into the following zones :

Zone	Rainfall (in cm)	Areas
I	Below 75	Eastern parts of Khandala, Karad, Koregaon and Khatav, Man and Phaltan ranges.
II	75 150	Western rounds of Karad, Khandala, Koregaon, Satara and Wai round.
III	200 250	Dhebewadi range, Eastern parts of Satara, valleys of Krishna, Koyna, Venna and Warna.
IV	Above 250	Mahabaleshwar.

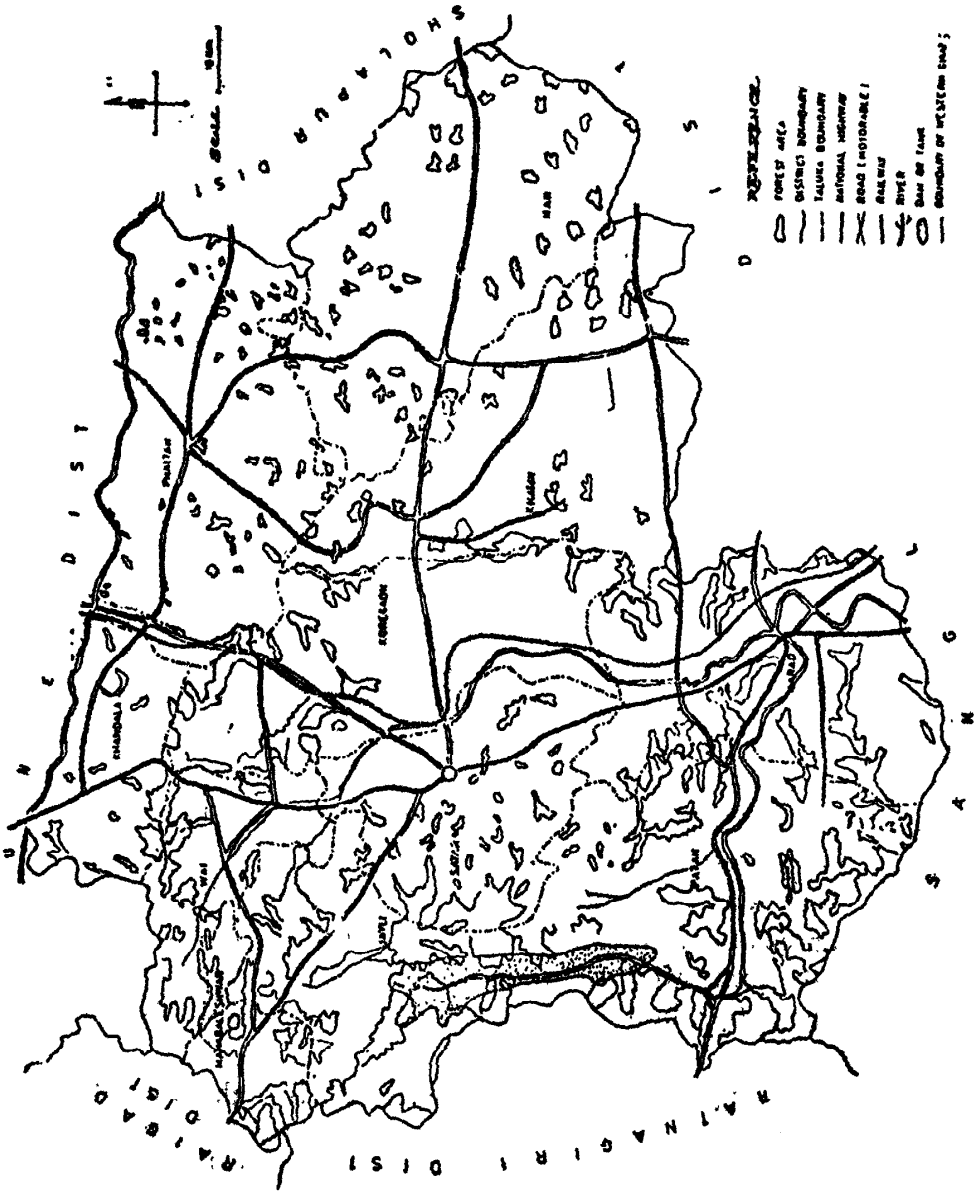
The major precipitation is from south west monsoon winds. Some rainfall in the form of pre-monsoon showers occur in May but main rainy season is from June to September. The precipitation during these months accounts for about 71% of the total annual rainfall. July is the month with heaviest rainfall. About 18% of the annual rainfall is received in the post monsoon months *i.e.* October and November.

Temperature : The cold season starts from about the end of November and continues up to the middle of February. December is the coldest month of the year. During the period from middle of February to May end, there is continuous increase in temperature and the rise is more marked in the plains than on the hills. The hottest month is May and mean daily maximum and minimum temperatures are 39.3°C and 23.8°C respectively in plains, while at Mahabaleshwar it is 28.8°C and 18.2°C respectively. The onset of the south-west monsoon brings down the temperature appreciably in the first or second week of June. After the withdrawal of the south-west monsoon day temperature shows an increase in October. Thereafter, both day and night temperatures begin to drop.

Humidity : In the south-west monsoon the air is highly humid but in the summer and the cold seasons the air is dry, particularly in the afternoons. In the plains, the dryness is more marked than in the hills.

Winds : Strong winds are witnessed particularly on the hills in the south west monsoon season. During rest of the year winds are light to moderate. Thunderstorms occur in hot and post monsoon months.

Forest biota : The wild life in the district is found in small number and is confined to the hilly regions of the Sahyadris and its foot hills.



Map 4 : Satara District : Forest areas

The western parts, comprising Mahabaleshwar, Satara, Patan and Dhebewadi forest ranges have good forests, and provide natural protection to the animals.

Among the wild animals tigers are rarely found in Koyna valley and in some portions of Dhebewadi range. However, panthers are found in large numbers in Kas area near Satara, Koyna valley, Panchgani and Mahabaleshwar. Their main prey are only cheetals, sambars and stray cattle. The wild cat is found in large numbers in open forests and scrub jungles. The wolves, jackals and Indian fox are found in the plains of the eastern side. Of the smaller animals, mongoose is sometimes a serious threat to poultry, due to its mass slaughtering habit.

The bears are restricted to Bamnoli and Kas areas. They live on honey combs, tubers and fruits of forest trees, ants and insects. Due to indiscriminate hunting and poaching, the hares and deers have been considerably depleted. Sambars, barking deers and kalvits are some of the rare animals met within the area. The gaur or Indian bison, the largest of all the bovines is rarely found on way to Arthur point, Mahabaleshwar.

The wild bears and monkeys are found in abundance in all hilly forests. Snakes, both poisonous and non-poisonous are common in the forests.

The common game birds like sandgrouse, pigeon, grey partridge, the grey jungle fowl, the pea-fowl, the common teal and the blue winged teal are found scattered throughout the district.

GENERAL VEGETATION TYPES

The flora of the district has great diversity of its own supplemented by many exotic species. The area is rich in endemic species the details of which are given separately. The type of vegetation occurring in any area is largely governed by factors such as altitude, rainfall, soil types, humidity and temperature. The vegetation of Mahabaleshwar and Panchgani has been discussed by botanists like Puri & Mahajan (1960), Santapau (1962), Rolla Rao (1978) and Mahabale (1979). Champion (1936) had classified the forests at Mahabaleshwar as subtropical evergreen, however, since then the situation has deteriorated and such vegetation is now restricted to a few sheltered pockets because of shifting cultivation and constant lopping and other biotic interferences. There are some enclaves or sacred groves called as 'Dev - Rais' present at Kas near Satara and Mandhardevi near Wai. The forests around temples are protected in this area.

According to Champion & Seth (1969) the vegetation can be classified into the following types :

1. **Western (Montane) subtropical hill forests (8A/C2)**

This type is restricted around Mahabaleshwar plateau at an altitude between 1000 and 1400 m with annual rainfall above 600 cm and red soil. The typical multistoreyed vegetation is almost absent because of biotic factors, with an exception of few sheltered pockets. The height of trees ranges between 5 and 12 metres. The dominant trees forming top canopy are *Actinodaphne angustifolia*, *Artocarpus heterophyllus*, *Cinnamomum macrocarpus*, *C. zeylanica*, *Emblica officinalis*, *Ficus nervosa*, *Glochidion ellipticum*, *Ligustrum perrottetii*, *Memecylon umbellatum*, *Murraya koenigii*, *Nothapodytes nimmoniana*, *Olea dioica*, *Symplocos beddomei*, *Syzygium cumini* and *Terminalia chebula*. These trees are loaded with mosses during monsoon season.

The common shrubby elements are *Allophylus cobbe*, *Cajanus lineatus*, *Canthium dicoccum*, *Capparis rotundifolia*, *Carvia callosa*, *Clerodendrum serratum*, *Colebrookea oppositifolia*, *Crotalaria retusa*, *Gnidia glauca*, *Impatiens acaulis*, *Indigofera cassioides*, *Pavetta tomentosa*, *Pogostemon benghalensis* and *Solanum giganteum*. The climbers are represented by species like *Acacia sinuata*, *Clematis wightiana*, *Elaeagnus conferta*, *Piper hookeri*, *Rosa multiflora*, *Rubia cordifolia* and *Smilax zeylanica*.

The herbaceous flora is represented by *Achyranthes aspera*, *Anisochilus carnosa*, *A. verticillata*, *Blepharis asperrima*, *Begonia crenata*, *Canscora decurrens*, *Curculigo orchioides*, *Cynoglossum zeylanicum*, *Euphorbia laeta*, *Flemingia strobilifera*, *Hedychium coronarium*, *Hypoxis aurea*, *Leucas stelligera*, *Pinda concanensis*, *Polygonum plebeium* var. *indica*, *Rungia repens* and *Senecio edgeworthii*. The grasses like *Apluda mutica*, *Arundinella pumila*, *Sporobolus coromandelianus* and *Themeda quadrivalvis* are of common occurrence.

The orchids found in this type are *Aerides crispum*, *A. dalzelliana*, *Bulbophyllum fimbriatum*, *Dendrobium barbatum*, *D. crepidatum*, *Eria dalzellii* and *Oberonia recurva*.

2. **West coast semi-evergreen Forest (2A/C2)**

This type is found in the valleys of Krishna, Koyna, Venna and Warna at an altitude between 450 and 1050 m receiving 200 to 250 cm rainfall per annum. The height of trees varies from 12 to 20 m. Some of the common trees found in this type are — *Diospyros sylvatica*, *Elaeocarpus serratus*, *Garcinia indica*, *Holigarna grahamii*, *Lagerstroemia micro-*

carpa, *Maesa indica*, *Mallotus philippinensis*, *Symplocos beddomei*, *Syzygium cumini*, *Terminalia chebula* etc. Representative components of evergreen forests such as *Actinodaphne angustifolia*, *Memecylon umbellatum* and *Olea dioica* are also extended to the semievergreen forests.

The shrubs found in this area are *Allophylus cobbe*, *Buddleja asiatica*, *Cajanus lineatus*, *Carvia callosa*, *Colebrookea oppositifolia*, *Embelia ribes*, *Glycosmis mauritiana*, *Holarrhena antidysenterica*, *Ixora nigricans*. *Justicia betonica*, *Lycianthus laevis*, *Microcos paniculatus*, *Pavetta tomentosa*, *Pittosporum wightii*, *Turraea villosa* and *Vigna khandalensis*. The common climbers are *Acacia sinuata*, *Argyreia boseana*, *Cayratia elongata*, *Cissus discolor*, *Clematis gouriana*, *Dioscorea pentaphylla*, *Diplocyclos palmatus*, *Embelia basaal*, *Jasminum malabaricum*, *Mucuna pruriens*, *Oxyceros rugulosus*, *Paracalyx scariosa*, *Teramnus labialis*, *Trichosanthes tricuspidata*, *Wattakaka volubilis* and *Zehneria scabra*. The rare climbers are : *Ceropegia hirsuta*, *Dumasia villosa*, *Entada pursaetha* and *Paramignya monophylla*.

The ground flora is represented by *Achyranthes aspera*, *Cassia pumila*, *Centella asiatica*, *Cynoglossum zeylanicum*, *Desmodium laxiflorum*, *Glinus lotoides*, *Indigofera dalzellii*, *Hedyotis corymbosa*, *Heracleum grandis*, *Pinda concanensis*, *Polygonum glabrum*, *Solena amplexicaulis*, *Smithia bigemina*, *Sonerila scapigera*, *Sopubia delphiniifolia*, *Striga densiflora*, *S. gesneroides* and *Swertia densiflora*.

3a. Southern moist mixed deciduous forest (3B/C2)

This type is represented in the tract at Dhebewadi, Patan and western parts of Satara range. The dominant trees are *Careya arborea*, *Casearia graveolens*, *Cassia fistula*, *Catunaregam spinosa*, *Dalbergia melanoxylon*, *D. montana*, *Emblica officinalis*, *Ficus exasperata*, *F. racemosa*, *Flacourtia indica*, *Grewia tiliaefolia*, *Ixora arborea*, *Kydia calycina*, *Lagerstroemia parviflora*, *Terminalia bellirica*, *Toona ciliata*, *Xantolis tomentosa* and *Ziziphus xylopyrus*, *Chukrasia tabularis*, *Eriolaena quinqueloculari*s and *Sterculia guttata* are of rare occurrence.

The common shrubs are *Callicarpa tomentosa*, *Canthium rheedii*, *Carissa congesta*, *Clerodendrum viscosum*, *Desmodium triangulare*, *D. triquetrum*, *Eranthemum roseum*, *Gnidia glauca*, *Grewia abutilifolia*, *Holarrhena antidysenterica*, *Ixora brachiata*, *Leea indica*, *Rhus mysorensis*, *Vitex negundo*, *Woodfordia fruticosa*, *Wrightia tinctoria* and *Ziziphus rugosa*. The common climbers are *Argyreia cuneata*, *Cayratia auriculata*, *Cocculus hirsutus*, *Dioscorea oppositifolia*, *Elaeagnus conferta*, *Jasminum malabaricum*, *Mezoneuron cucullatum*, *Moullava spicata* and *Stephania japonica*.

The common herbaceous species are *Alysicarpus* spp., *Desmodium laxiflorum, Hemigraphis latebrosa, Hibiscus furcatus, Lepidagathis cuspidata, L. prostrata, Mukia maderaspatana, Ophiorrhiza prostrata, Smithia setulosa, Solena amplexicaulis* and *Tephrosia tinctoria. Rauvolfia serpentina, Smithia sensitiva* and *Tephrosia purpurea* are of occasional occurrence.

3b. Southern dry mixed deciduous forest (5A/C3)

This type is represented in the central belt of the tract, receiving annual rainfall between 75 and 150 cm. The common trees are *Acacia chundra, A. nilotica, Albizia amara, A. chinensis, Anogeissus latifolia, Bauhinia racemosa, Bombax ceiba, Butea monosperma, Cassia fistula, Dalbergia volubilis, Diospyros melanoxylon, Embelia tsjeriam-cottam, Erinocarpus nimmonii, Erythrina stricta, Ficus hispida, F. retusa, Lagerstroemia microcarpa, Maytenus emarginata, Pongamia pinnata, Semecarpus anacardium, Terminalia bellirica* and *Wrightia tinctoria.*

The common shrubs are *Acacia torta, Barleria prionitis, Boehmeria macrophylla, Breynia retusa, Capparis zeylanica, Carissa congesta, Carvia callosa, Cassia auriculata, Catunaregam spinosa, Celastrus paniculata, Clerodendrum serratum, Helicteres isora, Lepidagathis cuspidata, Pogostemon benghalensis, Rhus mysorensis, Tamilnadia uliginosa* and *Woodfordia fruticosa.* The common climbers are *Acacia sinuata, Argyreia cuneata, Calycopteris floribunda, Cayratia elongata, Combretum ovalifolium, Cryptolepis buchanani, Dioscorea oppositifolia, D. pentaphylla, Gloriosa superba, Jasminum malabaricum, Mucuna pruriens, Paracalyx scariosa* and *Tylophora dalzellii.*

The herbaceous species are represented by *Blepharis asperrima, Blumea eriantha, B. malcolmii, Celosia argentea, Centranthera indica, Commelina forsskalaei, Corchorus olitorius. Crotalaria filipes, Cyanotis fasciculata, Elephantopus scaber, Evolvulus alsinoides, Exacum bicolor, Geissaspis cristata, Hemigraphis latebrosa, Phyllanthus lawii, Polygala persicariaefolia, Scilla hyacinthina, Solanum indicum, Trachyspermum stictocarpum, Vigna radiata* and *Wedelia urticaefolia.*

4. Southern thorn forest (6A 1)

This type is found in drier parts of the district receiving annual rainfall less than 75 cm. It is found in eastern parts of Khandala, Koregaon, Karad and Khatav ranges, also Man and Phaltan ranges. The common species are *Acacia chundra, A. leucophloea, Albizia odoratissima, Azadir-*

achta indica, Capparis moonii, C. zeylanica, Cassia auriculata, Maytenus emarginata and *Ziziphus mauritiana.*

Because of biotic factors some areas are devoid of trees and major portion is occupied by dry grasslands. The common components are *Aristida funiculata, Chrysopogon fulvus, Cymbopogon martinii, Cynodon dactylon, Dichanthium annulatum, Eragrostis unioloides, Heteropogon contortus* and *Sehima nervosum.* These are associated with *Corchorus aestuans, C. trilocularis, Crotalaria nana, C. vestita, Euphorbia laciniata, E. neriifolia* and *Triumfetta rotundifolia.*

Weed Flora : A number of weeds are found in and around cultivated fields, fallow fields, wastelands, roadsides etc. Some of the common weeds in cultivated fields are *Aeschynomene indica, Ageratum conyzoides, Alysicarpus procumbens, Anagallis arvensis, Apluda mutica, Aristida adscensionis, Arundinella metzii, A. pumila, Asclepias curassavica, Blumea eriantha. B oxyodonta, Caesulia axillaris, Capsella bursa-pastoris, Chromolaena odorata, Chrozophora rottleri, Cleome viscosa, Coix lacryma jobi, Commelina forsskalaei. Corchorus olitorius, Cyanotis cristata, C. fasciculata, Cyperus digitatus, C. iria, Digitaria ciliaris, Desmodium triflorum, Echinochloa colonum, E. frumentacea, Eleusine indica, Eragrostis pilosa, E. unioloides, Eulalia trispicata, Fagonia cretica, Fimbristylis dichotoma, F. littoralis, Flaveria trinervia, Hackelochloa granularis, Indigofera linifolia, Ipomoea hederifolia, I. triloba, Iseilema anthephoroides, Leucas aspera, L. lavandulaefolia, Linum mysorensis, Lobelia alsinoides, Pennisetum glaucum, P. hohenackeri, Physalis minima, Polygala arvensis, Rhynchosia minima, Setaria intermedia, Scoparia dulcis, Sida rhombifolia, Sonchus oleraceus, Themeda quadrivalvis, Tribulus terrestris, Vicoa indica,* and *Withania somnifera.*

Weeds of fallow fields are *Bidens biternata, Biophytum sensitivum, Blainvillea acmella, Caesulia axillaris, Eclipta erecta, Emilia sonchifolia, Eragrostis unioloides, Gnaphalium luteo album, Hackelochloa granularis, Heteropogon contortus, Leucas lavandulaefolia, Sphaeranthus indicus, Tribulus terrestris, Tridax procumbens, Vicoa indica* and *Xanthium strumarium.*

Weeds commonly found in wastelands and along roadsides are— *Acanthospermum hispidum, Achyranthes aspera, Alternanthera sessilis, Amaranthus spinosus, Argemone mexicana, Bidens biternata, Blainvillea acmella, Boerhavia diffusa, Cassia occidentalis, C. tora, Commicarpus chinensis, Convolvulus arvensis, Corchorus aestuans, Datura suaveolens, Dinebra retroflexa, Echinops echinatus, Euphorbia hirta, E. indica, E. thymifolia, Girardinia zeylanica, Lagascea mollis, Lantana camara, Leucas*

aspera, L. longifolia, Malvastrum coromandelianum, Nicandra physaloides, Nicotiana plumbaginifolia, Oxalis corniculata, Parthenium hysterophorus, Pilea microphylla, Plectranthus mollis, Solanum nigrum, S. surattense, Synedrella nodiflora, Trichodesma indicum, Tridax procumbens, Triumfetta rhomboidea, Verbascum chinense and *Veronica javanica.*

AQUATIC VEGETATION

The district has numerous ponds, lakes and rivers in addition to catchment areas and other wetlands During the monsoon season temporary streams and puddles are also formed. All these places provide an ideal habitat to the aquatic plants for their luxuriant growth. These aquatics can be classified as follows :

1. *Free floating herbs* : *Aponogeton satarensis, Lemna perpusilla, Nymphaea nouchali* and *Spirodela polyrrhiza.*

2. *Submerged herbs* : *Blyxa auberti, B. echinosperma, B. octandra, Hydrilla verticillata, Limnophila indica, L. sessiliflora* and *Vallisneria spiralis.*

3. *In marshy places* : *Alternanthera sessilis, Bacopa monnieri, Caesulia axillaris, Canscora decurrens, Centaurium centaurioides, Chrozophora prostrata, C. rottleri, Coelachne minuta, Coix lacryma-jobi, Crinum defixum, Cyathocline purpurea, Cyperus compressus, C. digitatus, C. distans, C. globosus, C. iria, C. nutans* var. *nutans, C. nutans* var. *eleusinoides, C. tenuispica, Drosera indica, Echinochloa colonum, E. crusgalli, E. frumentacea, Eclipta prostrata, Eleocharis acutangula, E. geniculata, Eragrostis gangetica, E. japonica, E. unioloides, Eriocaulon breviscapum, E. cuspidatum, E. eleanorae, E. odoratum, E. quinquangulare, E. setaceum, E. stellatum, Eriochloa procera, Fimbristylis aestivalis, F. bis-umbellata, F. dichotoma, F. ferruginea, F. ovata, F. tenera, Floscopa scandens, Geissaspis cristata, Glinus lotoides, Homonoia riparia, Hygrophila auriculata, Isachne elegans, I. globosa, I miliacea, Jansenella griffithiana, Lindernia anagallis, L. hyssopioides, Lobelia alsinoides, Ludwigia octovalvis* ssp. *sessiliflora, Myriophyllum oliganthum, Oryza rufipogon, Paspalum scrobiculatum, Phyla nodiflora, Phyllanthus lawii, Pogostemon deccanensis, P. salicifolius, Polygonum glabrum, P. plebejum, Rorippa indica, Rotala floribunda, R. serpyllifolia, Rotula aquatica, Schoenoplectus articulatus, S. corymbosus, Sphaeranthus indicus, Typha angustata, Utricularia arcuata, U. graminifolia, U. reticulata* and *Wahlenbergia marginata.*

EXOTIC SPECIES

Foreigners mostly Britishers treated Mahabaleshwar and Panchgani as their summer health resorts. It is probable that they brought seeds of seedlings of interesting species, in order to quench their nostalgia and to create native surroundings when they returned to India from their mother lands. As a result, there is a high concentration of exotic species in the local flora introduced for food, ornamental or medicinal purposes. A number of weeds also came along accidentally with food grains, seeds or other economic plants and packing materials of the imported goods. Many of them are now naturalised in this area. Some of the common exotic species are listed below :

Acacia auriculiformis, *Adansonia digitata*, *Agave angustifolia*, *Ageratum houstonianum*, *Annona reticulata*, *A. squamosa*, *Bixa orellana*, *Brassica oleracea* var. *botrytis*, *B. oleracea* var. *capitata*, *Capsicum annum*, *Carica papaya*, *Cassia tora*, *Cestrum nocturnum*, *Coronopus didymus*, *Datura metel*, *Duranta erecta*, *Eucalyptus* spp.. *Euphorbia gaudichaudii*, *E. thymifolia*, *Ficus carica*, *Fragaria vesca*, *Galinsoga parviflora*, *Gomphrena celosioides*, *G. globosa*, *Helianthus annuus*, *Hibiscus rosa - sinensis*, *Iberis amara*, *Jatropha curcas*, *Lantana camara*, *Linum usitatissimum*, *Litchi chinensis*, *Lycopersicon esculentum*, *Manilkara zapota*, *Mimosa pudica*, *Mirabilis jalapa*, *Nerium oleander*, *Opuntia elatior*, *Oxalis* spp., *Parkinsonia aculeata*, *Parthenium hysterophorus*, *Passiflora edulis*, *Portulaca oleracea*, *Prunus amygdalus*, *P. persica*, *Psidium guajava*, *Punica granatum*, *Quisqualis indica*, *Ricinus communis*, *Scoparia dulcis*, *Sesbania sesban*, *Sonchus oleraceus*, *Stellaria media*, *Tagetes erecta*, *Tecoma stans*, *Thevetia peruviana*, *Thunbergia alata*, *Tridax procumbens* and *Veronica anagallis - aquatica*.

FLORISTIC ANALYSIS

The present flora deals with 1,398 species belonging to 697 genera and 141 families. Of the total flora, 197 species are either cultivated or exotics. They are tabulated below. In addition to the Angiosperms, 48 species of Pteridophytes belonging to 29 genera and 23 families have also been recorded.

Groups	*Number of families*	*Number of genera*	*Number of species*	*Number of sub species*	*Number of varieties*	*Number of forma*
Dicots	121	565	1046	2	11	—
Monocots	20	132	352	—	5	1
Total	141	697	1398	2	16	1

Out of 141 families, 44 families are monotypic.

Comparison between the Cooke's Flora and the present flora :

	Families	Genera	Species	Sub-species	Varie-ties	Forma
Taxa reported in Cooke's Flora (excluding Sind)	146	944	2337	—	150	—
Taxa reported by Cooke from Satara District	88	273	401	—	—	—
Taxa reported in the pres flora	141	697	1398	2	6	1

Ten dominant families compared with those of Cooke's Flora are given below :

Flora of the Presidency of Bombay (excluding Sind)			*Flora of Satara district*		
Family	*Number of genera*	*Number of species*	*Family*	*Number of genera*	*Number of species*
1. Fabaceae	81	284	1. Poaceae	60	141
2. Poaceae	72	223	2. Asteraceae	46	70
3. Asteraceae	52	104	3. Fabaceae	41	111
4. Euphorbiaceae	37	101	4. Acanthaceae	25	44
5. Acanthaceae	36	109	5. Rubiaceae	22	39
6. Rubiaceae	34	80	6. Euphorbiaceae	20	39
7. Orchidaceae	31	74	7. Scrophulariaceae	19	33
8. Scrophulariaceae	26	51	8. Asclepiadaceae	17	25
9. Asclepiadaceae	25	51	9. Orchidaceae	16	46
10. Lamiaceae	21	57	10 Lamiaceae	14	36

It is interesting to find that the families which are dominant in erstwhile Bombay Presidency and those of the area under study are the same though their positions vary a bit.

PLANTS OF MEDICINAL VALUE

This district abounds in medicinal plants. The following plants are used for the medicinal value in treatment of various ailments by local vaidyas.

Abrus precatorius, Abutilon indicum, Acacia leucophloea, A. nilotica ssp. *indica, A. sinuata, Acalypha indica, Achyranthes asper, Actinodaphne hookeri, Adhatoda vasica, Aerva lanata, Agave americana, Ageratum conyzoides, Albizia lebbeck, Allium cepa, A. sativum, Anacardium occidentale, Argemone mexicana, Asparagus racemosus, Azadirachta indica, Bacopa monnieri, Balanites aegyptiaca, Barleria cristata, B. prionitis, Bauhinia purpurea, B. racemosa, Bixa orellana, Blumea eriantha, B. lacera, Boerhavia diffusa, Boswellia serrata, Brassica campestris, Butea monosperma, Caesalpinia bonduc, Calendula officinalis, Calotropis gigantea, Calycopteris floribunda, Capparis decidua, C. spinosa, Cardiospermum halicacabum, Carica papaya, Carissa congesta, Carthamus tinctorius, Cassia auriculata, C. fistula, C. tora, Catharanthus roseus, Celastrus paniculatus, Celosia argentea, Centella asiatica, Ceropegia bulbosa, Chenopodium album, Cinnamomum zeylanicum, Cissampelos pareira, Citrullus colocynthis, C. lanatus, C. vulgaris, Clematis triloba, Clerodendrum serratum, Clitoria ternatea, Coix lacryma-jobi, Commelina benghalensis, Crotalaria retusa, Curculigo orchioides, Curcuma aromatica, Cynodon dactylon, Datura metel, Dioscorea oppositifolia, Diospyros melanoxylon, Echinochloa crusgallii, Echinops echinatus, Eclipta prostrata, Emblica officinalis, Emilia sonchifolia, Evolvulus alsinoides, Ficus benghalensis, Garcinia indica, Gnidia glauca, Gloriosa superba, Helicteres isora, Hemidesmus indicus, Hibiscus rosa-sinensis, Hiptage benghalensis, Holarrhena antidysenterica, Homonoia riparia, Impatiens balsamina, Jatropha curcas, Lantana camara, Lawsonia alba, Leonotis nepetaefolia, Leucas aspera, Malvastrum coromandelianum, Mangifera indica, Memecylon umbellatum, Mirabilis jalapa, Momordica charantia, Moringa oleifera, Mitragyna parviflora, Ocimum* spp. *Pergularia daemia, Pittosporum wightii, Plantago major, Plumbago zeylanica, Rauvolfia serpentina, Ricinus communis, Rosa multiflora, Rubia cordifolia, Santalum album, Scilla hyacinthina, Semecarpus anacardium, Sesamum indicum, Solanum nigrum, S. surattense, Sphaeranthus indicus, Swertia densiflora, Tagetes erecta, Terminalia bellirica, T. chebula, Tinospora cordifolia, Tribulus terrestris, Tylophora indica, Verbascum chinense, Vitex negundo* and *Wattakaka volubilis.*

ECONOMICALLY IMPORTANT PLANTS

The plants used for various domestic and industrial purposes viz., food, fodder, fibre, shelter can be broadly classified as follows :

1. **Cereals** : The main cereals grown in the district are - '*Jowar*' (*Sorghum bicolor*), '*Bajra*' (*Pennisetum typhoides*), '*Wheat*' (*Triticum aestivum*), '*Rice*' (*Oryza sativa*), '*Vari*' (*Panicum sumatrense*) and '*Maize*' (*Zea mays*).

2. **Pulses** : '*Gram*' (*Cicer arietinum*), '*Tur*' (*Cajanus cajan*), '*Watana*' (*Pisum sativum*), '*Mug*' (*Phaseolus aureus*), '*Masur*' (*Lens esculenta*), '*Black gram*' (*Phaseolus mungo*), '*Horse gram*' (*Vigna unguiculata*) and '*Chavali*' (*Vigna unguiculata* ssp. *cylindrica*).

3. **Oil seeds** : '*Groundnut*' (*Arachis hypogaea*), '*Sesamum*' (*Sesamum indicum*), '*Safflower*' (*Carthamus tinctorius*), '*Castor*' (*Ricinus communis*) and '*Mustard*' (*Brassica nigra*).

4. **Drugs and Narcotics** : '*Tobacco*' (*Nicotiana tabacum*) and '*Betel*' leaves (*Piper betel*).

5. **Condiments and spices** : '*Chillies*' (*Capsicum annum*), '*Coriander*' (*Coriandrum sativum*), '*Turmeric*' (*Curcuma longa*), '*Garlic*' (*Allium sativum*) and '*Ginger*' (*Zingiber officinale*).

6. **Fibres** : '*Cotton*' (*Gossypium herbaceum*), '*Deccan hemp*' or '*Ambadi*' (*Hibiscus cannabinus*) and '*Bombay hemp* or *tag*' (*Crotalaria juncea*).

7. **Fruits** : The most common are '*Banana*' (*Musa paradisiaca*), '*Guava*' (*Psidium guajava*), '*Pomegranate*' (*Punica granatum*), '*Lemon*' (*Citrus medica*), '*Mango*' (*Mangifera indica*), '*Phanas*' (*Artocarpus integrifolia*), '*Grapes*' (*Vitis vinifera*), '*Papaya*' (*Carica papaya*), '*Strawberry*' (*Fragaria vesca*) and '*Raspberry*' (*Rubus niveus*) are grown on small scale at Mahabaleshwar.

8. **Vegetables** : '*Potato*' (*Solanum tuberosum*), '*Onion*' (*Allium cepa*), '*Sweet potato*' (*Ipomoea batatas*), '*Carrot*' (*Daucus carota*), '*Tomato*' (*Lycopersicon esculentum*), '*Brinjal*' (*Solanum melongena*), '*Radish*'

(*Raphanus sativus*,) '*Cucumber*' (*Cucumis sativus*), '*Cabbage*' (*Brassica oleracea* var. *capitata*), '*Lady's finger* or *bhendi*' (*Abelmoschus esculentus*) and '*Gavar*' (*Cyamopsis psoralioides*).

9. **Sugarcane** : '*Sugarcane*' (*Saccharum officinarum*) is grown on large scale as an irrigated crop.

10. **Timber** : Among the timber species which are mostly used for furniture, construction of buildings, agricultural implements are - '*Sagwan*' (*Tectona grandis*), '*Ain*' (*Terminalia crenulata*), '*Khair*' (*Acacia chundra*) and '*Subabul*' (*Acacia leucophloea*).

FODDER SPECIES

The plants known for their fodder value are mostly grasses *viz.* *Andropogon pumilus*, *Arundo donax*, *Brachiaria eruciformis*, *Cenchrus ciliaris*, *Chloris virgata*, *Coix lacryma - jobi*, *Cynodon dactylon*, *Dactyloctenium aegyptium*, *Dichanthium annulatum*, *D. foveolatum*, *Dinebra retroflexa*, *Diplachne fusca*, *Echinochloa colonum*, *E. crus-galli*, *Eleusine indica*, *Eragrostis gangetica*, *E. tenella*, *E. unioloides*, *E. viscosa*, *Hackelochloa granularis*, *Heteropogon contortus*, *Isachne globosa*, *I. miliacea*, *Iseilema anthephoroides*, *Oplismenus burmannii*, *Panicum antidotale*, *Paspalum scrobiculatum*, *Pennisetum americanum*, *P. glaucum*, *Saccharum officinarum*, *Sehima nervosum*, *Sorghum halepense*, *Spodiopogon rhizophorus*, *Sporobolus coromandelianus*, *S. indicus* var. *diander*, *Thelepogon elegans*, *Themeda quadrivalvis* and *Urochloa panicoides*.

The leaves, young shoots or pods of the following plants other than grasses, are fed to cattle :

Acacia nilotica ssp. *indica*, *Achyranthes aspera*, *Adhatoda vasica*, *Albizia lebbeck*, *Amaranthus spinosus*, *Hiptage benghalensis*, *Holarrhena antidysenterica*, *Indigofera cordifolia*, *Kydia calycina*, *Lagerstroemia parviflora*, *Lannea coromandelica*, *Mallotus philippinensis*, *Melilotus indica*, *Microcos paniculata*, *Phyllanthus emblica*, *Polygonum barbatum*, *Pongamia pinnata*, *Portulaca oleracea*, *Prosopis cineraria*, *Ziziphus mauritiana*, *Z. rugosa* and *Vigna trilobata*.

INTERESTING PLANTS OF BOTANICAL VALUE

Various botanists have described 44 new species, 5 varieties and 1 forma from the Satara district. They are : *Aneilema siennea* Blatt., *Aponogeton satarensis* Raghavan *et al.*, *Arisaema longecaudatum* Blatt.,

Argyreia boseana Sant. & Patel, *Arthraxon satarensis* Almeida, *Balanophora elkinsii* Blatt., *Barleria gibsonioides* Blatt., *Begonia prixophylla* Blatt. & McC., *Caralluma adscendens* var. *fimbriata* Gravely & Mayur., *Ceropegia hispida* Blatt. & McC., *C. noorjahaniae* Ansari, *C. panchganiensis* Blatt. & McC., *Coelachne minuta* Bor, *Crinum eleonorae* Blatt. & McC., *C. eleonorae* var. *purpurea* McC., *C. woodrowii* Baker, *Cryptocoryne tortuosa* Blatt. & McC., *Cyperus decumbens* Govind., *Dichanthium maccannii* Blatt., *D. panchganiense* Blatt. & McC., *Dipcadi maharashtrensis* Deb & Dasgupta, *D. ursulae* Blatt., *Eriocaulon eleonorae* Fyson, *E. horsley-kundae* Fyson, *E. sedgwickii* Fyson, *Euphorbia panchganiensis* Blatt & McC., *Habenaria cerea* Blatt. & McC., *H. cerea* var. *polyantha* Blatt. & McC., *H. grandifloriformis* Blatt. & McC., *H. grandiflora* Lindl. ex Dalz. & Gibs., *H. panchganiensis* Sant. & Kap., *H. rariflora* var. *latifolia* Blatt. & McC., *H. spencei* Blatt. & McC., *H. variabilis* Blatt. & McC., *Iphigenia stellata* Blatt., *Isachne lisboae* Hook. f., *I. swaminathanii* Ved Prakash & Jain, *Kalanchoe bhidei* T. Cooke, *Mariscus blatteri* McC., *Oberonia lingmalensis* Blatt. & McC., *Oldenlandia maheshwarii* Sant. & Merch., *Oxalis corniculata* var. *hispida* Blatt., *Pancratium donaldii* Blatt., *Paspalum canarae* var. *fimbriatum* Bor, *Peristylus xanthochlorus* Blatt. & McC., *Thalictrum obovatum* Blatt., *Urginea polyantha* Blatt. & McC., *Utricularia equiseticaulis* Blatt. & McC., *U. ogmosperma* Blatt. & McC. and *U. praeterita* Taylor.

Of these species mentioned above, *Aneilema siennea*, *Arisaema longecaudatum*, *Arthraxon satarensis*, *Cryptocoryne tortuosa*, *Eriocaulon horsley-kundae*, *Habenaria cerea* var. *polyantha*, *H. rariflora* var. *latifolia*, *H. spencei*, *H. variabilis*, *Oberonia lingmalensis*, *Oldenlandia maheshwarii*, *Paspalum canarae* var. *fimbriatum*, *Peristylus xanthochlorus*, *Utricularia equiseticaulis* and *U. ogmosperma* have been merged under different taxa by various workers as they were *not distinct*.

Abelmoschus angulosus, *Crassocephalum crepidioides*, *Habenaria multicaudata* and *Sagina japonica* are the distributional records for Maharashtra reported from this area.

ENDEMIC AND RARE PLANTS

There is a high concentration of endemic species along Western Ghats due to significant variation in altitude, humidity, soil, temperature and various other factors. Endemic plants occur in a restricted area, isolated from its surrounding regions through geographical, ecological or natural barriers. Western Ghats along this tract form an ecological boundary between the low-lying plains, Konkan and the Deccan tableland

forming an *ideal endemic area*. There are 56 genera endemic to Peninsular India, (Nayar, 1980) out of which the following 10 monotypic genera are endemic to Western Ghats and occur in the area studied here : *Carvia, Dicoelospermum, Erinocarpus, Helicanthes, Indopoa, Moullava, Polyzygus, Pseudodichanthium, Seshagiria* and *Trilobachne*. Ahmedullah and Nayar (1987) have discussed in detail about the concepts, classification and components of endemic plants of Peninsular India.

Species endemic to the district are - *Aponogeton satarensis, Argyreia boseana, Balanophora elkinsii, Barleria gibsonioides, Begonia prixophylla, Caralluma adscendens* var. *fimbriata, Ceropegia noorjahaniae, C. santapaui, Crinum eleonorae, C. woodrowii, Cyperus decumbens, Dichanthium maccannii, D. panchganiense, Dipcadi maharashtrensis, D. ursulae, Drimia polyantha, Euphorbia panchganiensis, Hitchenia caulina, Iphigenia stellata, Isachne swaminathanii, Mariscus blatteri, Oxalis corniculata* var. *hispida, Pancratium donaldii, Thalictrum obovatum* and *Utricularia praeterita*.

Species endemic to the Western Ghats and represented in the district are *Adelocaryum malabaricum, Adenoon indicum, Aeschynanthus perrottetii, Aglaia lawii, Alysicarpus pubescens* var. *vasavadae, Alysicarpus belgaumensis* var. *racemosa, Anisomeles heyneana, Argyreia cuneata, Arisaema caudatum, A. murrayii, Arthraxon lanceolatus* var. *meeboldii, Asystasia dalzelliana, Artocarpus hirsuta, Plachia denudata, Blepharis asperrima, Blumea belangeriana, Cajanus lineatus, C. sericea, Campanula alphonsii, Canscora concanensis, C. pauciflora, C. perfoliata, Carex filicina* var. *glaucina, Carissa inermis, Carvia callosa, Ceropegia occulata, C. vincaefolia, Chlorophytum glaucum, Coelachne minuta, Crotalaria filipes, Cryptocoryne spiralis, Cucumis setosus, Cyanotis concanensis, C. fasciculata* var. *glabrescens, Dalzellia zeylanica, Delphinium malabaricum, Dichanthium jainii, Dimorphocalyx lawianus, Dioscorea belophylla, Eranthemum roseum, Eriocaulon breviscapum, E. dalzellii, E. dianae, E. eleonorae, E. humile, E. odoratum, E. ritchieanum, E. stellulatum, E. vanheurckii, Ervatamia heyneana, Euphorbia ellipticum, E. notoptera, Exacum lawii, Garcinia indica, Haplanthodes neilgherryensis, H. tentaculatus, H. verticillatus, Hedyotis stocksii. Helicanthes elastica, Helixanthera obtusata, Heracleum aequilegifolium, H. grandis, Heteropogon polystachyos, Holigarna grahamii, Impatiens dalzellii, I. minor, I. pulcherrima, Indigofera dalzellii, Isachne bicolor, I. lisboae, Ischaemum diplopogon, I. impressum, I. ritchiei, Ixora brachiata, Jasminum malabaricum, Justicia santapaui, J. trinervia, J. wynaadensis, Kalanchoe bhidei, K. olivacea, Lavandula gibsonii, Litsea stocksii, L. wightiana, Mallotus stenanthus, Meiogyne pannosa, Memecylon malabaricum, M talbottianum, Moullava spicata, Murdannia crocea* ssp. *ochracea, M. lanuginosa, M. versicolor. Mussaenda laxa, Neanotis*

concanensis, *N. hohenackeri*, *N. montholonii*, *N. rheedii*, *Nilgirianthus lupulinus*, *N. reticulatus*, *Phyllocephalum tenue*, *Pimpinella katrajensis*, *Piper hookeri*, *Pittosporum dasycaulon*, *Plectranthus benghalensis*, *P. stocksii*, *Pleocaulis ritchiei*, *Pogostemon deccanensis*, *P. purpurascens*, *Polyzygus tuberosus*, *Porana racemosa*, *Pseudodichanthium serrafalcoides*, *Rhamphicarpa longiflora*, *Senecio dalzellii*, *Seshagiria sahyadrica*, *Smithia agharkarii*, *S. bigemina*, *S. setulosa*, *Sonerila scapigera*, *Supushpa scrobiculata*, *Thalictrum dalzellii*, *Thelepaepale ixiocephala*, *Tricholep's amplexicaulis*, *T. radicans*, *Tolypanthus lagenifer*, *Trilobachne cookei*, *Utricularia arcuata*, *Ventilago bombaiensis*, *Vernonia indica*, *Vigna khandalensis*, *Wendlandia thyrsoidea* and *Zingiber neesanum*.

Rare species - either in distribution or abundance are - *Arnicratea grahamii*, *Beilschmiedia dalzellii*, *Bergia ammannioides*, *Canscora khandalensis*, *Cansjera rheedii*, *Capparis grandis*, *Cayratia trifolia*, *Ceropegia bulbosa*, *Cissus pallida*, *C. repens*, *Cynanchum callialata*, *Dendrophthoe trigona*, *Diospyros nigrescens*, *Holostemma ada - kodien*, *Impatiens lawii*, *Isachne gracilis*, *Kickxia incana*, *Limnophila heterophylla*, *Litsea fuscata*, *Loeseneriella obtusifolia*, *Mussaenda glabrata*, *Myristica dactyloides*, *Phaulopsis imbricata*, *Polygonum barbatum*, *Rauvolfia serpentina*, *Sauromatum pedatum*, *Schefflera elliptica*, *Sterculia guttata*, *Tinospora cordifolia* and *Tylophora fasciculata*.

CONCLUDING REMARKS

The present assessment of the Flora of Mahabaleshwar & its environs is the outcome of the plant exploratory work carried out during 1983 to 1985, based on the collections made by the senior author as well as on the specimens housed at the Herbarium of Botanical Survey of India, Pune (BSI) and Blatter Herbarium, St. Xavier's College, Bombay (BLAT). This flora accounts for 1,398 species, 697 genera and 141 families of Angiosperms and 48 species of Pteridophytes.

The district Satara, as a whole, is rich in endemic flora recording 108 species distributed over 9 genera which are endemic to the Western Ghats viz., *Carvia*, *Dicoelospermum*, *Erinocarpus*, *Helicanthes*, *Indopoa*, *Moullava*, *Polyzygus*, *Pseudodichanthium*, *Seshagiria* and *Trilobachne*.

During this survey it has been evaluated that out of the total of 1,201 wild species, 348 species are reported from places other than Mahabaleshwar and Panchgani which forms *ca* 25% of the total flora.

The remaining 853 species are reported from Mahabaleshwar and Panchgani as well as from the other surrounding areas.

Though forty-four new species, 5 varieties and 1 forma have been reported from this area, only 28 species, 3 varieties and 1 forma are valid, rest having been merged with already described taxa. Sixteen species are known only by their type collections viz., *Argyreia boseana*, *Balanophora elkinsii*, *Barleria gibsonioides*, *Begonia prixophylla*, *Ceropegia noorjahaniae*, *Crinum eleonorae*, *C. woodrowii*, *Cyperus decumbens*, *Dichanthium maccannii*, *Dipcadi maharashtrensis*, *Mariscus blatteri*, *Oxalis corniculata* var. *hispida*, *Pancratium donaldii*, *Thalictrum obovatum* and *Utricularia praeterita*. In some cases even types are not available in Indian Herbaria.

During the present work, *Ischaemum thomsonii* Stapf ex C.E.C. Fischer and *Eragrostis nigra* Nees have been collected for the first time from Maharashtra. *Kalanchoe bhidei* T. Cooke has been recollected after a lapse of 8 decades from the type locality, type of which is deposited at the Royal Botanical Gardens, Kew (K). While updating the nomenclature of the species dealt with in this flora in accordance with International Code of Botanical nomenclature (1978) one new combination has been proposed [*Wattakaka angustifolia* (Hook. f.) Sandhya Deshpande] and one variety has been sunk in the species proper, consequently making it a new synonym (*Paspalum compactum* var. *fimbriatum*).

It is clear from the data collected that the present status of flora is different in floristic composition than what it was in the beginning. Already much of the flora has been lost due to various biotic interferences such as illegal tree felling for fuel, fodder, timber, building and road construction, dams, installation of high power electric towers to power stations and encroachment of forest area for agricultural purposes etc. The havoc caused by the tourists, plant collectors and students by overzealous collections particularly of orchids and various bulbous plants is considerable.

Therefore, it is the apprehension of any nature lover that the continued exploitation of this centuries—old ecosystem will leave Mahabaleshwar and its vicinity barren unless corrective measures are initiated. It is suggested that forest areas around Mahabaleshwar and Panchgani harbouring rich flora and exhibiting significant diversity be declared as biosphere reserves as already done in Koyna catchment area. This is the only solution to ensure protection and conservation of our

natural plant wealth to conserve different types of habitats, rejuvenation of depleted forests, untapped resources for posterity.

One of the major objectives of this work was to prepare an inventory of the plants present in this area, provide a means of identifying them, which is a prerequisite for the actual implementation of conservation plan. It is hoped that the present flora would be useful to botanists, ecologists, foresters, agriculturists, university and college students, people interested in indigenous plant medicines, pharmaceutical companies, plant conservationists and various other nature lovers and professionals interested in the plant wealth of the area.

KEY TO THE FAMILIES

1. Leaves usually with reticulate venation ; flowers usually 4 - 5 - merous ; cotyledons usually 2 :

   2. Perianth 2 - or - multiseriate :

      3. Petals usually free ; stamens often numerous :

         4 Stamens hypogynous ; calyx lobes usually free :

            5. Sepals usually imbricate in bud, if valvate, then sepals free :

               6. Sepals usually free, if united below, then petals dissimilar :

                  7. Stamens usually more than 12, if fewer, then sepals and petals 4 with a 2 - valved capsule or berry :

                     8. Sepals 2 - 3, deciduous :

                        9. Trees ; petals multiseriate ... MAGNOLIACEAE

                        9. Herbs ; petals uniseriate :

                           10. Leaves entire ; sap watery ; sepals 2, petals 4 - 5 ... PORTULACACAE

                           10. Leaves lobed ; sap yellow ; sepals 2 and petals 4 or sepals 3 and petals 6 ... PAPAVERACEAE

                     8. Sepals 4 or more, deciduous or persistent :

                        11. Aquatic plants ; petals many seriate ... NYMPHAEACEAE

                        11. Terrestrial plants ; petals 4 - 8, 1 2 - seriate :

                           12. Sepals deciduous :

                              13. Carpels free when ripe ; ovule 1 ... RANUNCULACEAE

13. Carpels united in a 1 locular ovary ; ovules 2 - many :

14. Sepals 4 ; ovary and fruit borne on a long gynophore ... CAPPARACEAE

14. Sepals 5 ; ovary and fruit sessile :

15. Plants usually thorny ; petals absent ; fruit a glabrous berry ... FLACOURTIACEAE

15. Plants not thorny ; petals present ; fruit a bristly capsule ... BIXACEAE

12. Sepals persistent :

16. Leaves opposite or whorled ... CLUSIACEAE

16. Leaves alternate :

17. Stamens attached to the bases of and deciduous with the petals ... TERNSTROEMIACEAE

17. Stamens free from the petals ... DILLENIACEAE

7 Stamens not more than 10 :

18. Flowers 3 - merous ... MENISPERMACEAE

18. Flowers 4 - 5 - merous :

19. Petals 4 ; stamens 6 ... BRASSICACEAE

19. Petals usually 5, rarely 3 - 4 ; stamens as many as or twice as many as the sepals and petals :

20. Ovary 1 - celled :

21. Herbs ; stamens twice as many as sepals ... CARYOPHYLLACEAE

21. Trees ; stamens as many as the sepals ... PITTOSPORACEAE

20. Ovary 2 - or more - celled ; if 1 - celled then distinctly stipitate :

22. Filaments more or less united ; leaves simple :

23. Flowers regular ; sepals and petals 4 - 5 ; styles 3 - 5 ... LINACEAE

23. Flowers irregular ; sepals 5 ; petals usually 3, if 4 - 5, then keeled ... POLYGALACEAE

22. Filaments free, if united at base then leaves compound or deeply palmately lobed ; leaves simple or compound :

24. Leaves exstipulate ... SAPINDACEAE

24. Leaves stipulate :

25. Seeds many ... ELATINACEAE

25. Seed 1 :

26. Seeds erect... STAPHYLEACEAE

26. Seeds pendulous :

27. Leaves compound, opposite ; stamens 10, free ... ZYGOPHYLLACEAE

27. Leaves simple, if compound, then alternate ; stamens 5 - 10, often united at base :

28. Flowers irregular ; stamens 5 ... BALSAMINACEAE

28. Flowers regular ; stamens 8 - 10 :

29. Climbers ; leaves simple, peltate ; 3 petals fringed at base ... TROPAEOLACEAE

29. Erect herbs ; leaves compound ; petals not fringed ... OXALIDACEAE

6. Sepals more or less united at base :

30. Leaves pellucid gland - dotted ... RUTACEAE

30. Leaves not gland - dotted :

31. Leaves opposite ; stamens 10 ; disk obscure ... MALPIGHIACEAE

31. Leaves alternate, if opposite, then disk large or stamens 5 :

32. Carpels syncarpous :

33. Trees ; leaves 2 3 - pinnate ; staminodes 5 - 7 ; style solitary ... MORINGACEAE

33. Climbing shrubs ; leaves simple ; staminodes absent ; styles 3 ... ANCISTROCLADACEAE

32. Carpels syncarpous and septate or apocarpous :

34. Stamens alternate with the petals :

35. Ovules and seeds pendulous, if horizontal (some Meliaceae) then filaments united into a tube :

36. Leaves simple ... ICACINACEAE

36. Leaves usually compound, if simple, then the filaments united into a tube :

37. Filaments free ; fruit drupaceous ; leaflets opposite ... SIMAROUBACEAE

37. Filaments usually united into a tube, if free, then the fruit capsular or the leaflets alternate ... MELIACEAE

35. Ovules and seeds erect or ascending :

38. Ovary 1 celled, if 2 - 5 - celled, then leaves compound ... ANACARDIACEAE

38. Ovary 3 - 5 - celled ; leaves simple :

39. Stamens 4 - 5 ; seeds arillate, usually albuminous ... CELASTRACEAE

39. Stamens 3 ; seeds not arillate, not albuminous ...HIPPOCRATEACEAE

34. Stamens opposite the petals :

40. Leaves exstipulate, ovules and seeds pendulous ; fruits 1 celled, 1 - seeded ... OPILIACEAE

40. Leaves stipulate ; ovules and seeds erect or ascending ; fruits usually 2 - 6 - seeded :

41. Scandent herbs or shrubs, rarely erect, usually tendrillar ; ovary 2 - celled, cells 2 - ovuled ... VITACEAE

41. Erect shrubs, without tendrils ; ovary 3 - 6 - celled, cells 1 - ovuled ... LEEACEAE

5. Sepals usually valvate in bud, if imbricate, then petals valvate or bisexual flowers 3 - merous :

42. Flowers 3 - merous ; sepals free, rarely united ; leaves simple ... ANNONACEAE

42. Flowers 4 - 6 - merous, if 3 - merous, then leaves compound or petals 5 ; sepals usually united :

43. Filaments united into a column or cup :

44. Stamens usually 15, sometimes few, in a column or cup around the style or if stamens numerous, then petals absent ... STERCULIACEAE

44. Stamens numerous, rarely few, in a column around the style with only short free filaments or dividing into groups opposite the petals :

45. Leaves simple ; epicalyx usually present ... MALVACEAE

45. Leaves digitately compound ; epicalyx absent ... BOMBACACEAE

43. Filaments free, rarely connate at base :

46. Leaves imparipinnate ... BURSERACEAE

46. Leaves simple, entire or lobed ;

47. Stamens as many as and usually adnate to the base of the petals ... RHAMNACEAE

47. Stamens numerous or at least twice as many as and free from the petals :

48. Petals ciliate or laciniate ; stamens inserted on the disk between glands ; fruit a drupe ... ELAEOCARPACEAE

48. Petals not ciliate or laciniate ; stamens borne on a torus, glands absent ; fruit capsular or separating into cocci ... TILIACEAE

4. Stamens epigynous or perigynous calyx lobes united :

49. Stems fleshy, flat, articulated, spiny ... CACTACEAE

49. Stems herbaceous or woody, if fleshy, then not flattened or articulated :

50. Ovary syncarpous, usually free from the calyx, occasionally inferior or semi - inferior, 1 - celled :

51. Flowers unisexual ... CARICACEAE

51. Flowers bisexual :

52. Small herbs ; leaves glandular hairy ; corona absent ... DROSERACEAE

52. Climbers ; leaves not glandular - hairy, corona present ... PASSIFLORACEAE

50. Ovary of 1 - or more free carpels, or if carpels united, then more than 1 - celled or if 1 - celled, then small herbs with pendulous ovules or leaves radical and eglandular :

53. Ovules attached to the inner angles or the bases of the carpels or cells, if to the apex, then ovules many :

54. Carpels solitary ; styles terminal ; leaves usually stipulate ; ovules on the inner angle of carpels ... FABACEAE

54. Carpels many or if solitary, then styles not terminal or ovules at the base of the carpels and leaves exstipulate :

55. Flowers unisexual :

56. Erect herbs, succulent ; stamens many, united ; styles free or united at base only ; fruits winged ... BEGONIACEAE

56. Climbers or prostrate herbs, not succulent ; stamens usually 3 ; styles united or free only at apex ; fruits not winged ... CUCURBITACEAE

55. Flowers bisexual, if polygamous then petals absent :

57. Carpels free or if ultimately united, at least the styles distinct :

58. Stamens numerous ; leaves stipulate ... ROSACEAE

58. Stamens 5 - 10 ; leaves exstipulate :

59. Carpels free ; sepals and petals 4 - 5 ; fruit follicular :

60. Fleshy herbs ; leaves simple, opposite, rarely upper alternate ... CRASSULACEAE

60. Scandent shrubs or trees ; leaves alternate, 1 - foliolate or imparipinnate ... CONNARACEAE

59. Carpels united, or if free, then petals absent ; fruit capsular :

61. Ovary 1 - celled ; ovules pendulous ... VAHLIACEAE

61. Ovary usually 2 - 5 - celled, or if 1 - celled, then petals absent ; ovules axile or basal :

62. Stipules membranous, fugacious ; stamens 3 - 5 ... MOLLUGINACEAE

62. Stipules absent ; petioles dilated ; stamens 5 - 20 ... AIZOACEAE

57. Carpels and styles united throughout :

63. Calyx lobes imbricate, or if valvate, then trees with flowers in long pendulous racemes and fruit a berry :

64. Stamens as many as or twice as many as petals ; petals contorted in bud ... MELASTOMATACEAE

64. Stamens numerous ; petals imbricate in buds :

65. Leaves opposite, usually gland-dotted ... MYRTACEAE

65. Leaves alternate, not gland-dotted ... LECYTHIDACEAE

63. Calyx lobes valvate :

66. Ovary completely or half adnate to the calyx tube ... ONAGRACEAE

66. Ovary free from the calyx tube :

67. Ovary and fruit 10 - 15-celled ... SONNERATIACEAE

67. Ovary and fruit 1 - 6-celled ;

68. Usually herbs or shrubs ; stamens 8 - 12, rarely trees with