

**Flora of India
Series 3**

FLORA OF RAIGAD DISTRICT MAHARASHTRA STATE

**M. J. KOTHARI
&
S. MOORTHY**



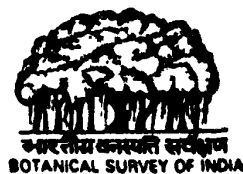
BOTANICAL SURVEY OF INDIA

FLORA OF RAIGAD DISTRICT
MAHARASHTRA STATE

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M. J. KOTHARI M. Sc., Ph. D., F. I. A. A. T.
and
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FOREWORD

The Botanical Survey of India has been actively engaged in survey and assessment of the plant wealth of the country. The results are being published by the Survey under four series, viz., Flora of India Fascicles, State Flora Analysis, District Floras and Special / Miscellaneous publications. The printing of important and selected District Floras under the Series 3 provides considerable data towards preparation of State Floras and Flora of India volumes.

The Flora of Raigad district was extensively explored by the authors during the years 1976-80. The district covers an area of 7,19,889 sq.km. The flora is phytogeographically interesting and rich in plant diversity with dry deciduous and evergreen types of forests in the hilly region, riparian flora along the river banks and mangroves along the Arabian coast. 1248 species including 33 pteridophytes and 1 gymnosperm have been dealt in the flora. The area is rich in endemic content; ca 114 endemic species of India are represented in the district of which some are very rare and threatened. A new species, *Cassia kolabensis*, was collected and described from the area.

The Flora of Raigad district in Maharashtra provides comprehensive data on floristic elements of the area with their nomenclature, identity, description, distribution, uses (tribal, industrial, medicinal etc.) and information on rare plants with possible measures for their conservation.

It is hoped that this work would be much useful to students and teachers of botany, foresters, agricultural scientists, environmentalists and others interested in biological resources and allied aspects.

Botanical Survey of India,
Calcutta.
4th January, 1993.

B.D. Sharma
Director

PREFACE

Plants are useful to man and animals in many ways. For that reason, our late Prime Minister Smt. Indira Gandhi stated that "the survival of man is dependent on the survival of animal and plant life"

In order to update the information on plant resources and their uses, the Botanical Survey of India has taken up the projects of rewriting the Flora of India. As a result, several fascicles on the Flora of India, State Flora analysis such as Flora of Karnataka (Sharma, *et al.* 1984) and many District Floras viz. Flora of Jowai (Balakrishnan, 1981), Flora of Raipur, Durg and Rajnandagaon (Verma, *et al.* 1985) etc. were published.

The Raigad (Kolaba) district in Maharashtra is well known in Indian history because of the 'Raigad Fort' an old capital of Chatrapati Shivaji's empire. Recently the district is named after its famous fort 'Raigad'. Other historical forts and noteworthy places in the district are the Elephanta caves (Gharapuri), Gheramanikgad, Ghosale Fort, Janjira Fort, Karnala Bird Sanctuary (Abhayaranya), Phansad (Panther) Wild Life Sanctuary, Sarasgad, Sudhagad and two old temples of Lord Ganesh among 'Astavinayaka' at Pali and Madh.

Over and above, the district is rich in plant wealth with different vegetational types. The present work on the 'Flora of Raigad district, Maharashtra State deals with 1136 species and 39 varieties belonging to 620 genera under 151 families in Phanerogams or Flowering plants. In addition, 40 cultigens are also recorded. Besides, 33 pteridophytes belonging to 19 families in Cryptogams or Non-flowering plants are also enumerated. Results of our observations are supported by Maps (3), Tables (3), line drawings of a few species and rare/threatened plants (13 plates), photographs (12 plates) depicting the vegetation at Raigad, other forts and hill tops; in sanctuaries and sacred groves; different forest types; some economic, rare and noteworthy plants. This contribution is based on extensive field work and intensive laboratory/herbarium studies.

The authors wish to express their deep sense of gratitude to Dr.B.D.Sharma, Director and Dr. M.P. Nayar, ex-Director, Botanical

Survey of India, Calcutta for providing facilities and to Shri A.R.K. Sastry, Scientist 'SE' & In-charge, Publication Unit, Botanical Survey of India, Calcutta for kindly going through the typescript and also for making valuable suggestions and corrections.

The authors are much thankful to Dr. S. Karthikeyan, Scientist 'SD' In-charge, Botanical Survey of India, Western Circle, Pune for his constant encouragement and also for his useful suggestions from time to time. The authors are also thankful to all the Officers and staff of Western Circle, Pune as well as Northern Circle, Dehra Dun of Botanical Survey of India for their help in various ways. Thanks are also due to Shri P.D. Modak for photography, to Shri L.D. Sangle, Smt. Gopalan and to Shri K. Perumal for typing and to Shri S.R. Gupta and his staff of Flamingo Business Systems, Pune for printing. Last but not least the authors wish to thank the Forest Department officials of Raigad district for their kind help in the exploration work during 1976-1980.

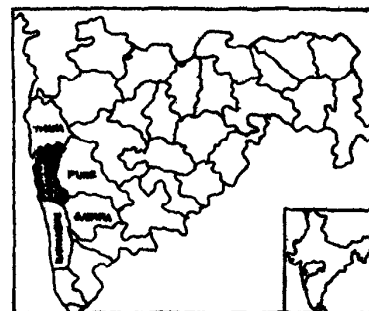
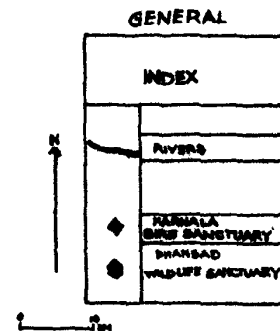
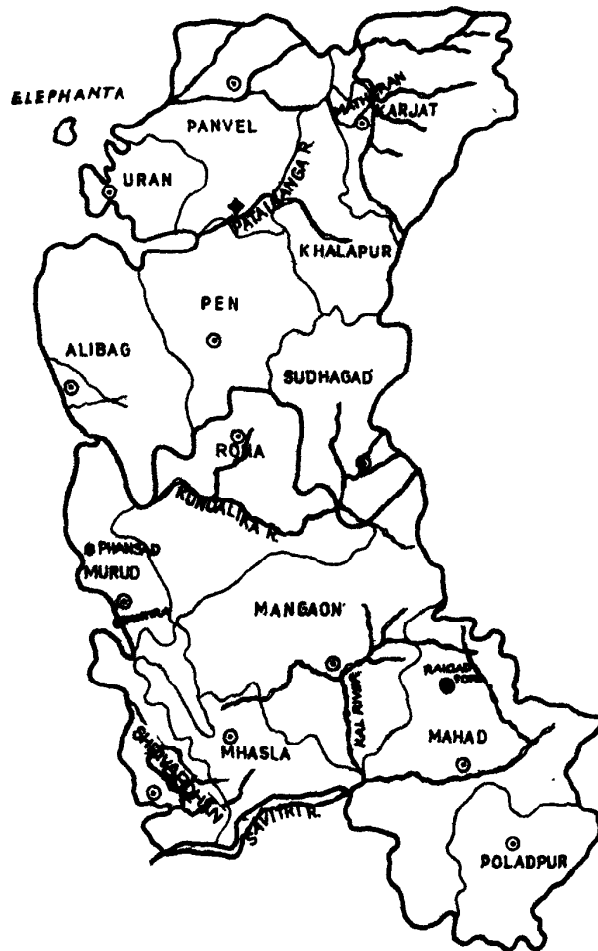
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1993.

M. J. Kothari
and
S. Moorthy

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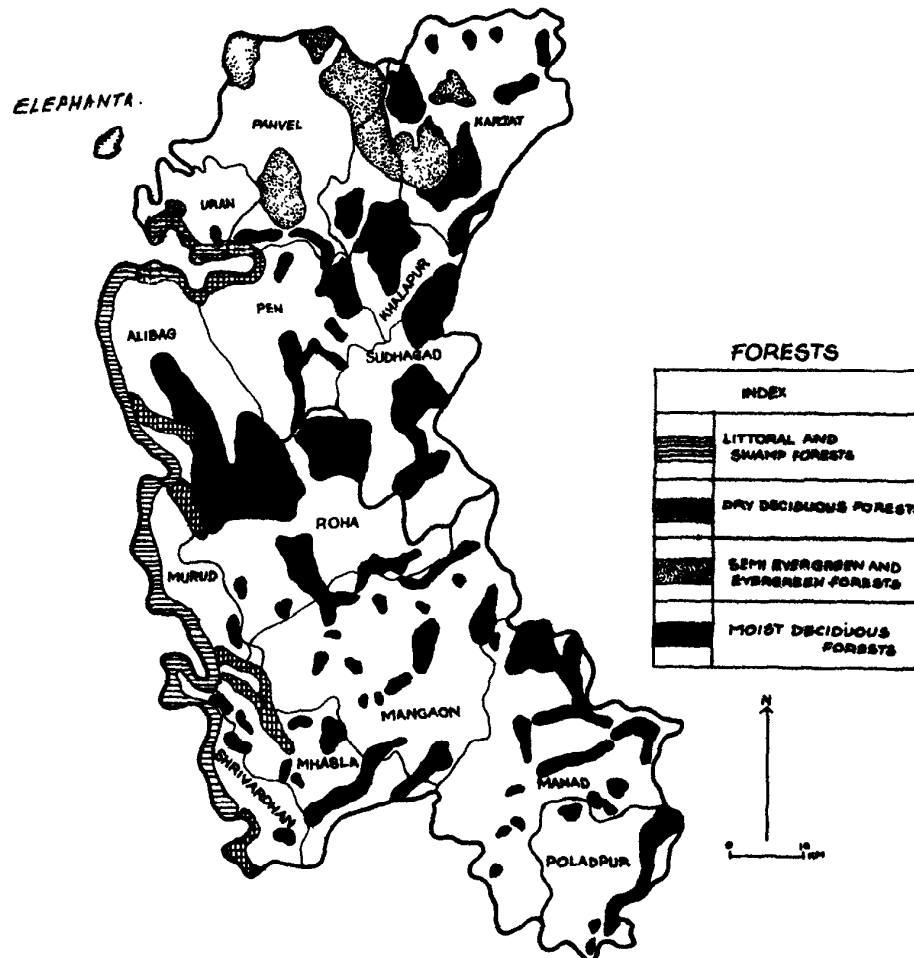
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RAIGAD DIST. (KOLABA)



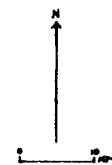
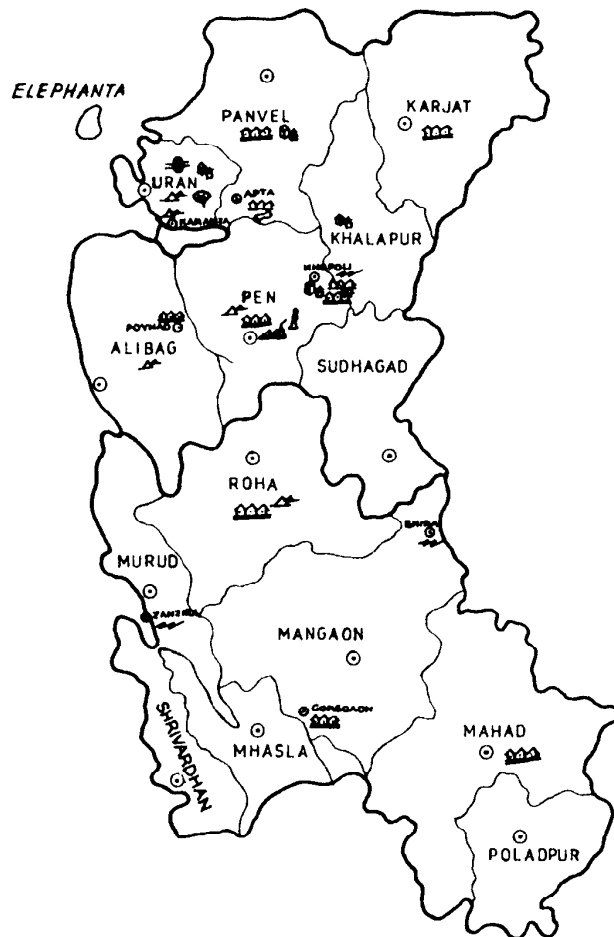
Map-1. Showing Location, Ranges, Forts, Rivers, Sanctuaries etc. in Raigad district (Maharashtra State).

RAIGAD DIST. (KOLABA)



Map-2. Vegetation types observed in different parts of the Raigad district (Maharashtra State).

RAIGAD DIST. (KOLABA)

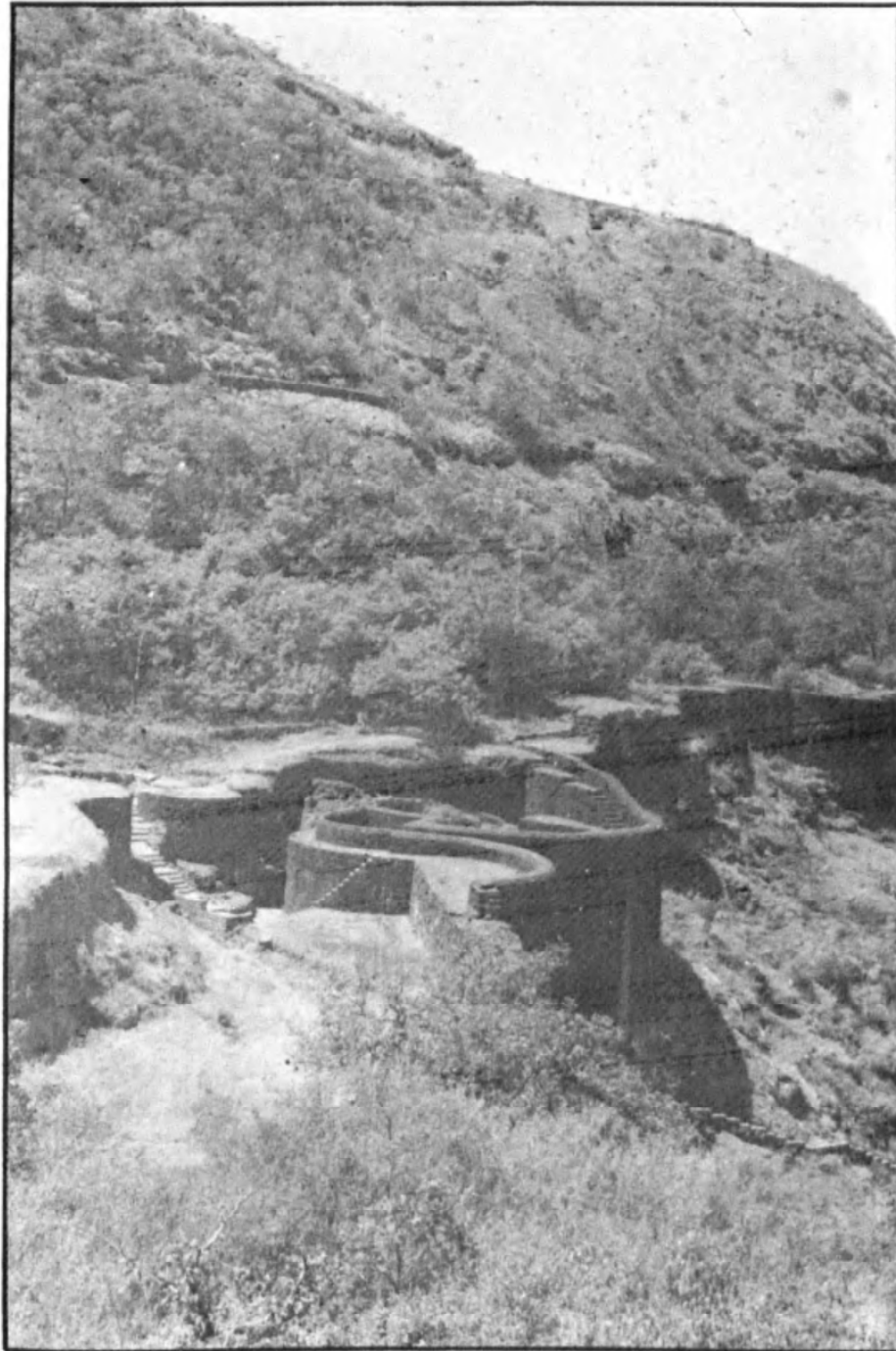


INDUSTRIES

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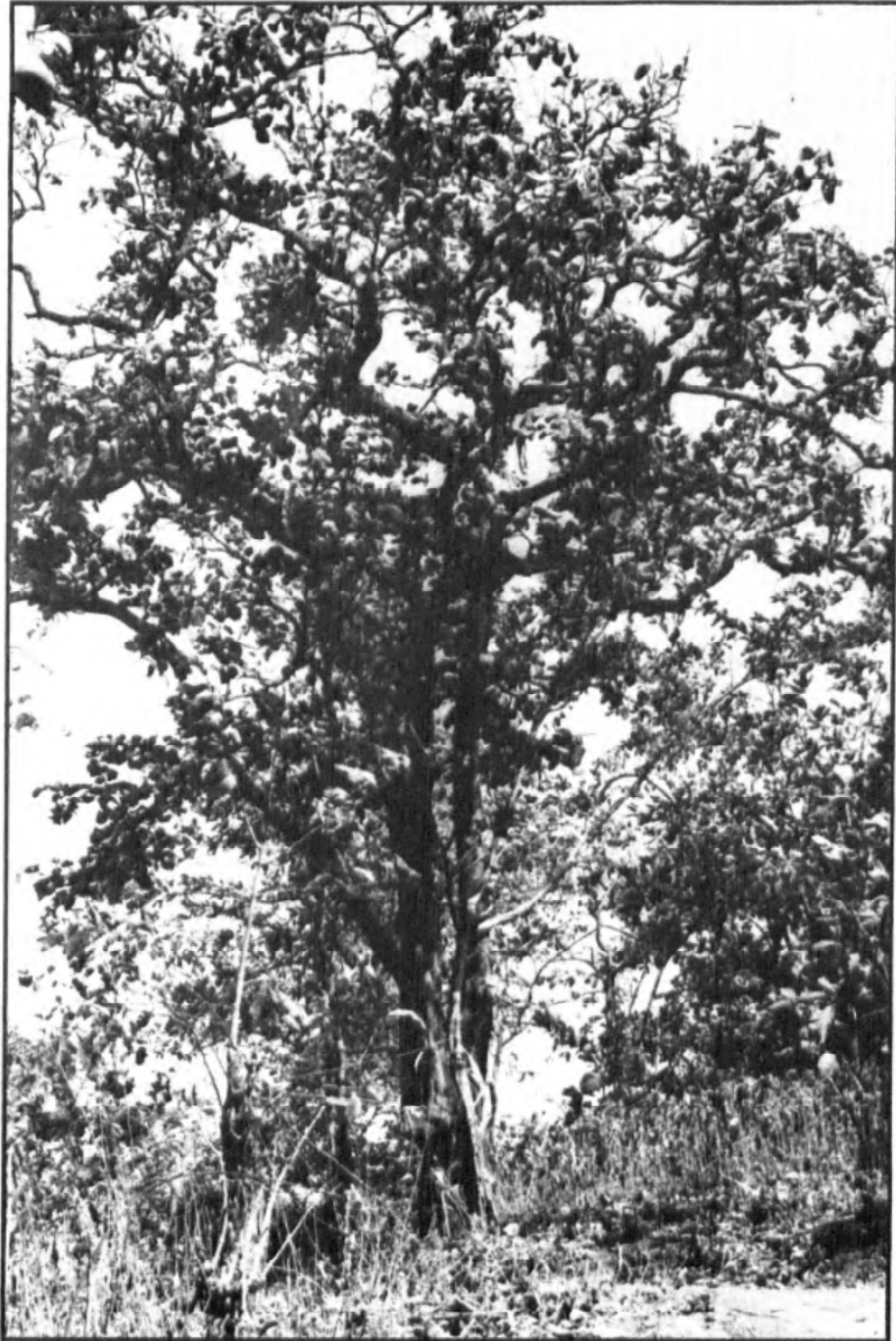
Map- 3. Industries located in Raigad district (Maharashtra State).

PLATE 1



Vegetation on Raigad fort :
**Bridelia retusa, Ficus racemosa, Mangifera indica, Memecylon
umbellatum, Syzygium cumini etc.**

PLATE 2



Vegetation in sacred groves :
Bauhinia foveolata, Bridelia retusa, Ficus arnottiana etc.

Endemic, Rare and noteworthy plants



(a)



(b)



(c)



(d)

- a) **Gnetum ula** Brongn. ('Umbli') : Mahan forest, Alibag.
- b) **Flacourtia montana** Grah. ('Atki') : Matheran.
- c) **Tetrameles nudiflora** R. Br. ('Bondsra', 'Ranbhend') : Lohiwat forest, Mhasla.
- d) **Hyphaene dichotoma** (Wight) Furtado ('Sindhi') : Nagaon beach, Alibag.

Endemic, Rare and noteworthy plants



(a)



(b)



(c)



(d)

- a) ***Justicia santapaui*** Bennet : Pangloli forests, Mhasla.
- b) ***Smithia sensitiva*** Ait. var. ***flava*** (Dalz. ex Prain) T. Cooke : Mirya dongar, Pen.
- c) ***Ixora brachiata*** Roxb. ('Lokhandi') : Matheran.
- d) ***Ficus callosa*** Willd. ('Garud') : Masadi forests, Roha.

Plants with economic/medicinal value



(a)



(b)



(c)



(d)

- a) **Eragrostis tenella** P. Beauv. ex R. & S. ('Woya').
- b) **Wrightia tinctoria** (Roxb.) R. Br. ('Kuda').
- c) **Euphorbia neriifolia** L. ('Nurang').
- d) **Terminalia bellirica** (Gaertn.) Roxb. ('Beheda').

Plants with economic/medicinal value



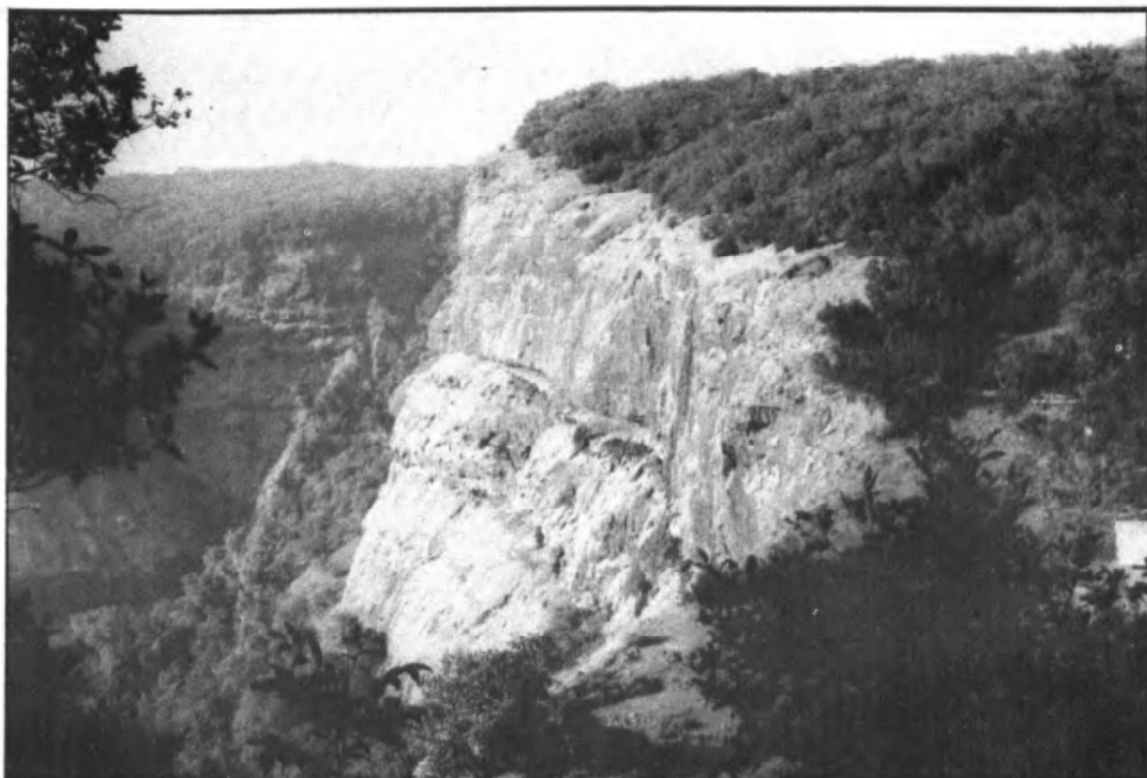
▲(b) ▼(d)



▲(a) ▼(c)



- a) *Gloriosa superba* L. ('*Bachnag*').
- b) *Calycopteris floribunda* (Roxb.) Poir. ('*Ukshi*').
- c) *Rhizophora mucronata* Lam. ('*Kandel*').
- d) *Heterophragma quadriloculare* (Roxb.) K. Schum. ('*Varas*').



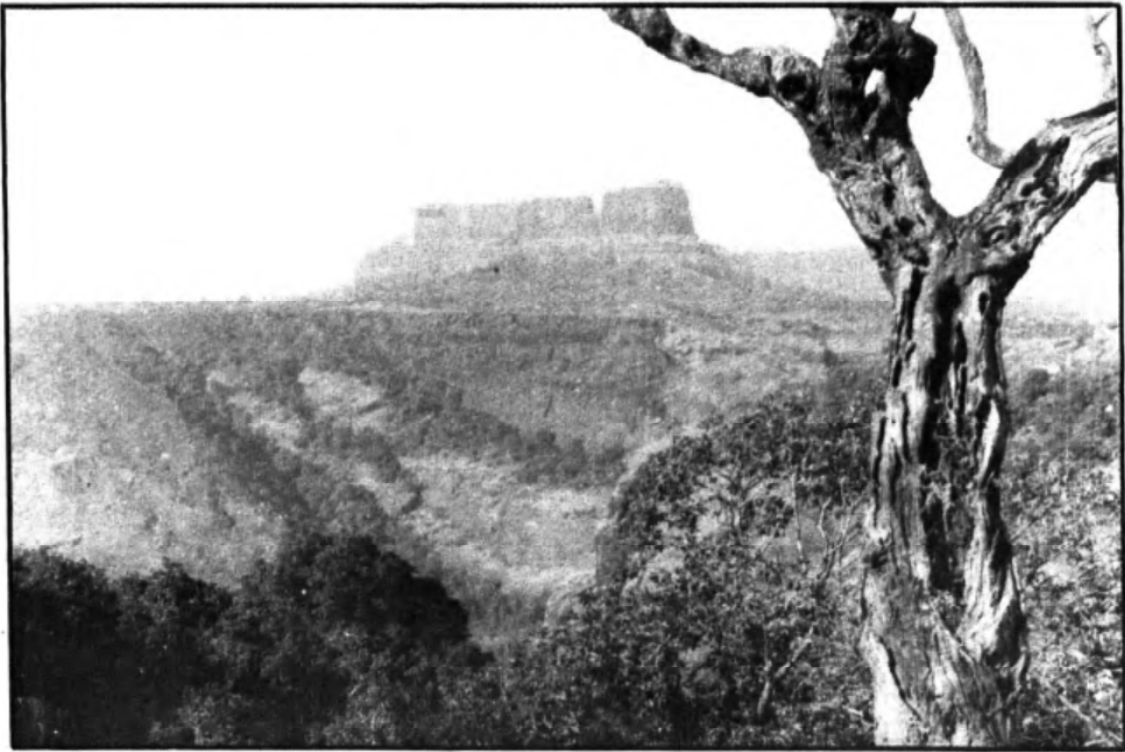
a. Hill top vegetation : Matheran.

Ficus racemosa, Memecylon umbellatum, Olea dioica, Syzygium cumini, Carallia brachiata, Carvia callosa etc.

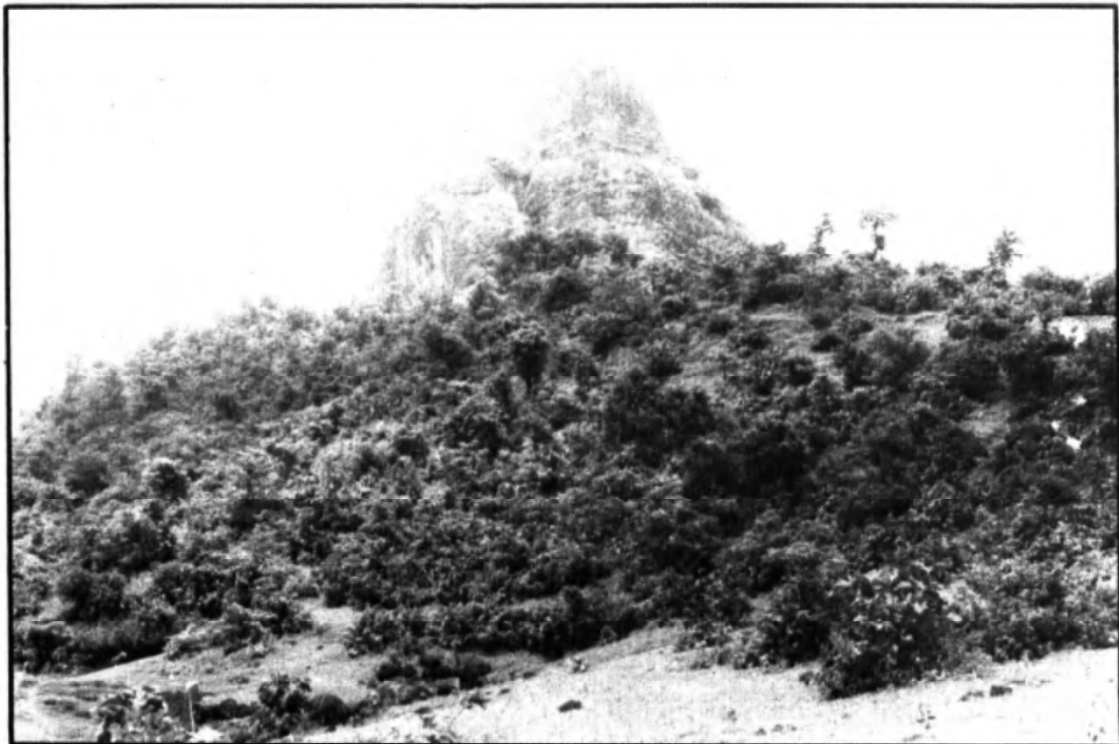


b. Moist deciduous forests : Gheramanik Gad (Panvel).

Ficus racemosa, Pongamia pinnata, Sageraea laurifolia etc.



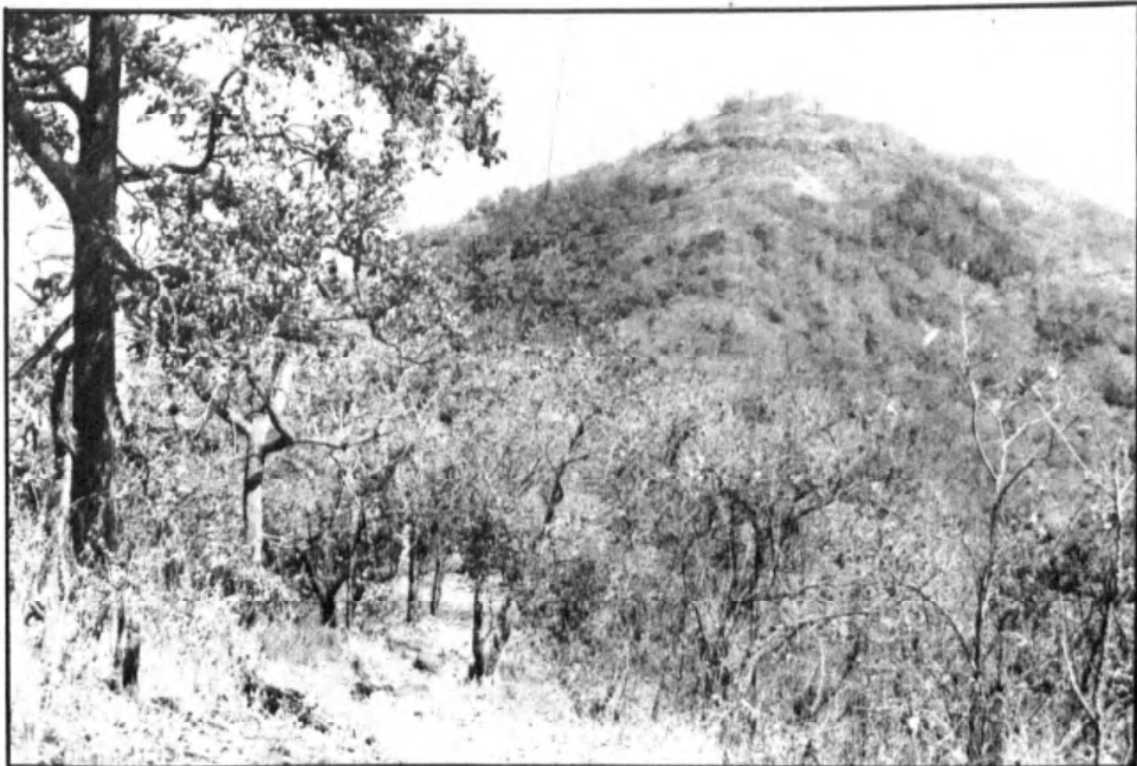
a. Vegetation on Sudhagad fort :
***Bridelia retusa*, *Ficus arnottiana*, *Mangifera indica* etc.**



b. Moist deciduous forests : Sarasgad (Pali).
***Bombax ceiba*, *Bridelia retusa*, *Heterophragma quadriloculare*,
Terminalia spp., *Wrightia tinctoria* etc.**



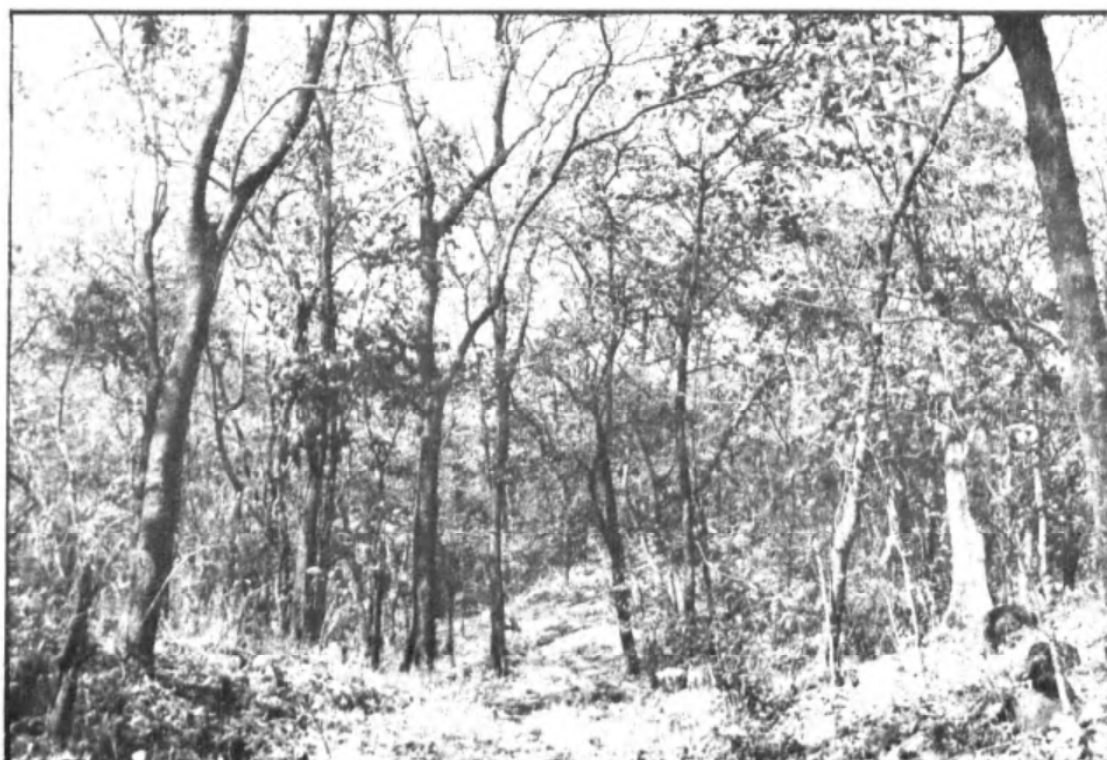
a. Vegetation in Karnala Bird Sanctuary.
Anogeissus latifolia, Flacourtia indica, Lannea coromandelica etc.



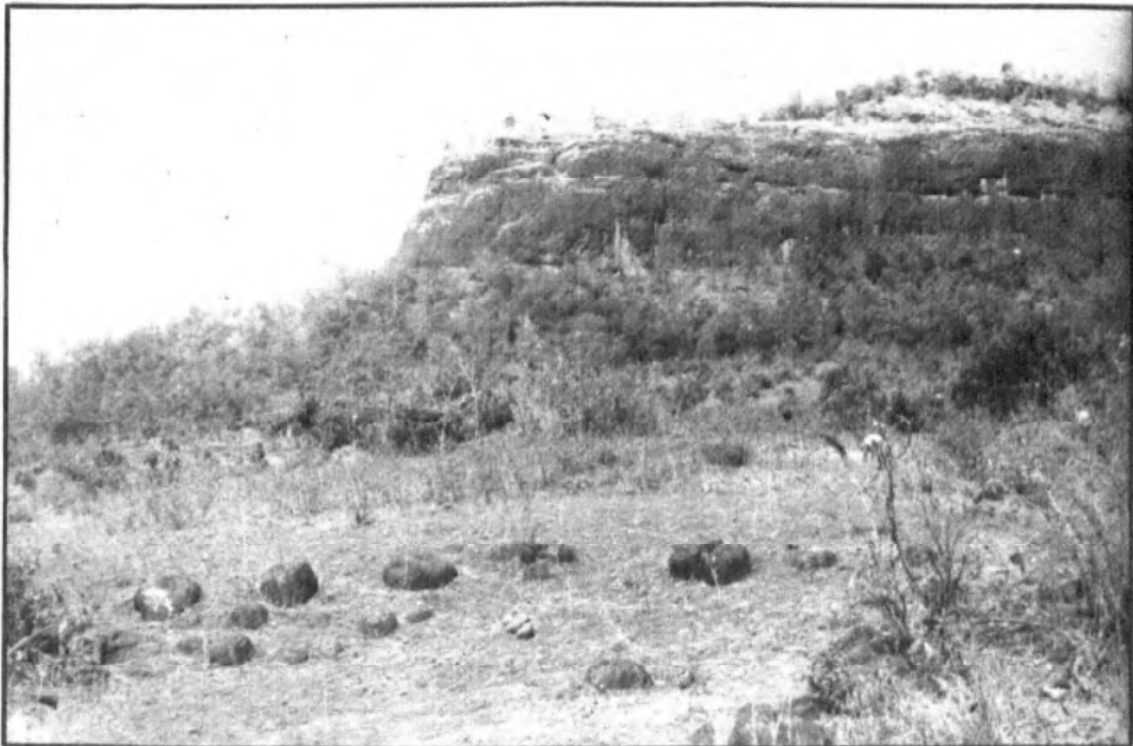
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Dillenia pentagyna, Ficus racemosa, Trema orientalis, Urena lobata, Woodfordia fruticosa, xylicarpa etc.



a. Charlotte lake, Matheran. *Memecylon umbellatum*, *Olea dioica*, *Syzygium cumini*, *Carallia brachiata* etc.



b. Moist deciduous forests : *Mirya dongar*, Pen. *Anogeissus latifolia*, *Tectona grandis*, *Terminalia crenulata*, *Albizia lebbek*, *Erinocarpus* sp., *Woodfordia fruticosa*.



a. Dry deciduous forests : Chavni forests, Pen. General view of *Bauhinia foveolata*, *Bridelia retusa*, *Cassia fistula*, *Erythrina variegata*, *Garuga pinnata*, *Tectona grandis*, *Terminalia crenulata* etc.



b. Mangroves : Around Elephanta island. In foreground *Sonneratia apetala* with vertical roots (Pneumatophores).



a. Riparian flora : Sanegaon, Roha.
Homonoia riparia, **Rotala** spp., **Tamarix** sp., **Vitex negundo** etc.



b. Riparian flora : General view near 'Pej' river, Karjat.
Pure community of **Tamarix ericoides** associated with a few **Argemone mexicana**.

INTRODUCTION

The need for a comprehensive flora of Raigad (Kolaba) district in Maharashtra state was long felt. Nairne (1894) in his book 'The flowering plants of Western India' had cited localities of *ca* 60 species from Raigad district and *ca* 300 species without precise locality simply mentioned as 'Konkan' a place which stretches from Bombay to Goa. Similarly, Cooke (1901-08) also had recorded *ca* 375 species from Raigad district in his 'Flora of Bombay Presidency : Blatter & McCann (1926-35, 1935) have mentioned *ca* 70 plants from Raigad district in their articles on Revision of Flora of Bombay Presidency' and a few grasses from Raigad district in their "Bombay Grasses". Besides, a few others such as Birdwood (1886) enumerated *ca* 205 flowering and *ca* 22 non-flowering species from Matheran. Woodrow (1895) had written some botanical notes on 'vegetation between Pune to Nagothana' based on his journey in 1894. R.R. Chaudhari (1951-52) gave a list of common trees, shrubs, herbs climbers etc., in forest working plan of Kolaba district. A revised Gazetteer of Kolaba district was published in 1964 by Govt. of Maharashtra (Ed. P. Setu Madhav Rao).

After reorganisation of the Botanical Survey of India in 1956, several officers have undertaken botanical exploration in Maharashtra and published some accounts on regional flora (Puri & Jain 1959, 1960; Puri & Mahajan 1960; Billore & Hemadri 1969; Venkata Reddy 1970; Malhotra & Moorthy 1974; Karthikeyan *et al.* 1981; Deshpande & Singh, 1986). Some of them included plants collected from Raigad district, in Konkan (Jain 1959) and W. India (Raghavan & Singh 1983). Similarly from Agharkar Research Institute (Formerly MACS) Pune, Vartak (1981, 1983) has mentioned some plants from Raigad district in this articles on 'Wild edible plants of Maharashtra & Goa' and 'Endemic plants from sacred groves of W. Maharashtra respectively.

Regarding seedless vascular plants or Pteridophytes, a review of literature (Birdwood 1886-87, 1897; Blatter 1909; Blatter & Almeida, 1922, Bir 1977, Nair & Bhargavan 1981; Dixit 1984) and consultation of Regional herbarium, Pune (BSI) reveals insufficient information and only sporadic collections from Raigad district.

A few articles such as Enumeration of wild edible plants from Karnala bird sanctuary (Datar & Vartak 1975); An interesting new species of *Cassia* L. from Kolaba district (Kothari *et al.* 1981); Some noteworthy plants from Raigad district (Kothari & Moorthy 1983); Floristic composition and utility of wild plants from Raigad district (Kothari & Moorthy 1992) and some unpublished thesis like 'Flora of Matheran' (Irani 1962), Flora of Uran (Kuttan 1965), Flora of Karnala Bird sanctuary (Mandavgane 1978), Vegetation and flora of

Kankeshwar hills (Sane 1983) are the only publications pertaining to the Raigad flora. Nevertheless, a comprehensive flora of this district is a long felt need, particularly so, when most of our indigenous flora is being altered due to deforestation activities. Therefore, an attempt has been made here to present a flora of Raigad district, Maharashtra State.

LOCATION, PHYSIOGRAPHY AND DRAINAGE PATTERN (Map - 1)

The Raigad district in Maharashtra state lies between 17° 53' & 19° 08' N. Latitude and 72° 51' and 73° 42' E. Longitude and covers an area of 719,889 Sq. kms. The district is bounded on the west by Arabian sea and on the east, partly by foot hill zone and partly by the water shed of the major Sahyadrian scrap, adjoining Ratnagiri district, on the north by Thane district and on the south the Savitri river which flows along the boundary over a stretch of 30 kms., on the south-east, the Satara district and on the east the Pune district.

Though the district forms an important part of traditional 'Konkan plain', ruggedness and uneven topography are the characteristic physical features. There are several hill ranges stretching out from the main Sahyadri mountains which run almost parallel to the West coast at a distance of 64-80 Kms. In the Westwards 'The main Sahyadrian range sheds several transverse members of subsidiary hills with varying heights to form head-lands or promoterics. They rise in the east to an average elevation of about 600 m. The highest point being 1,367 m on the Nhad-Kedar hill of Western ghats in Dhawla village. These hills are steeply cut and traversed by a network of rivers, rivulets and streams forming many irregular terraces, ravines and valleys. The higher slopes and spurs of these hills are with dense forests.

Many rivers and streams originate in the Sahyadris and flow westwards to the Arabian sea. The chief rivers are the Ulhas with its main tributaries Posheri, Chilar and Pej in Karjat range, the Patalganga and its tributaries Balganga and Bhogeshwari in Panvel and Pen ranges, the 'Amba' in Nagothana range, the Kundalika in Roha range, the Savitri with its tributary 'Kal' in Mangaon and Mahad ranges. The Patalganga joins in South to South-West in a stretch of about 32 Kms, the Dharmatar Creek. Here hilly topography persists but river valley is broader and merges into tidal flat of Dharamatar Creek. Hot water springs 'Unhere' are also found near Sav village in Dasgaon, Mahad range.

Hills : The chief hills of the district are of Shayadris, the N.E. boundaries of the district; the Sahyadrian range is crossed by several passes or ghats beginning from Bhimashankar ghat (N.E.) to Parghat (South); Varandh ghat joining Mahad and Bhor, useful for wheeled traffic.

Besides, hill ranges, west of Panvel is Karnala (468 m), Ratangad (540 m), Mirya dongar (330 m), South of Pen is Sarasgad (407 m) and west of Alibag are more prominent elevations in the northern portion of the district. In the southern half, Talagad (300 m), the famous Raigad (855 m) and Mangalgad are detached outliers from the main Sahyadris. Matheran with its highest Panorama point (760 m), is situated in N.E. part of the district near Neral.

GEOLOGY AND SOIL

The geology of entire district consists of dark coloured volcanic lava flows and laterites. Approximately 80 to 100 million years ago, the lava flows were poured out of the long and narrow fissures in the earth's crust, at the close of Mesozoic Era. These are spread out in the form of horizontal sheets or beds and constitute the innumerable spur hills and hill ranges; bold, flat topped ridges; lofty peaks and plateaux with impressive cliffs. The hill ranges and plateaux form a part of the famous western ghats. In plains and valleys, the lava flows occur below thin blankets of soil of variable thickness.

In plateau basalts the lava forms dominant 'basaltic composition' since the basaltic lava covers an extensive region in the Deccan and frequently present 'step-like' appearance to the hills and ridges which are commonly termed as 'Deccan traps'. The 'traps' attain a thickness of 750 to 810 m, around Matheran and Raigad plateaux respectively.

The basalts are composed of abundant labradorite, feldspar, enstatite, augite and interstitial glass. Magnetite is the most common accessory mineral, though at times 'Olivine' is also present. The basalts are dark grey to grey and bluish-grey in colour and are hard, compact, tough and fine to medium grained in texture.

Next to this is found the comparatively softer amygdular and scoriaceous traps, purple to greyish in colour, usually showing rounded and elongated or tubular cavities and geode with infillings of secondary minerals like calcite, zeolites, a variety of secondary quartz like agate, jasper, chalcedony etc. these generally occupy the lower portions of the ridges and slopes and usually in the valleys and plains. Associated with this acid lava flows are also found represented by light coloured trachyte, rhyolite etc. Tufaceous beds, volcanic ash etc. are also noticed at places in the district. A 'Red clayey bed' often termed as 'Red bole' is also noticeable in some places.

Sandwiched between the above two traps, flows, thin beds of grey to dark-grey and dirty green, argillaceous and calcareous shales or clays and friable sand-stones usually occur. No such beds have been reported so far from the district. These are known as the inter-trappean

beds, representing sediments deposited in shallow lakes during the quiescent periods of volcanic eruptions which are, however, not reported in the cliffs.

Beds of 'Laterites', usually formed by the mechanical and chemical disintegration brought about by the atmospheric agencies on the underlying traps cap, the several peaks and lofty ridges are present in the district. They are found at places in the lower regions also. The beds vary in thickness from 5-50 feet or more. The rocks are usually mottled, reddish or yellowish-brown in colour and show vermicular and tubular cavities often stained with dark-brown, ferruginous solution. The rocks are soft and show bright colours when freshly cut but become very hard and dull on exposure to atmosphere. The outer surface of the beds, present dark to dirty-brown coloured rugged and pitted appearance. Examples are Western Ghats, Geramanek gad, Mirya-dongar, Sukeli, Sarasgad, Kankeshwar hill and Raigad.

Soil : The traps on weathering give rise to a greyish to dirty green friable 'murum' which on decomposition and decay yield a rich and fertile, reddish-brown to coffee-brown and black soil. The laterite on disintegration gives rise to a dusty reddish to reddish-brown soil.

The soils of the district fall under 6 categories viz. 1. the forest soils, 2. varkas soils, 3. rice soils, 4. Khar soils, 5. coastal alluvial soils and 6. laterite soils. Of these, forest soils are not put to cultivation but yield valuable forest produce like teak, hirda, beheda, pepper etc. Varkas soils located just below the forest soils are poor in organic matter and nitrogen and are suitable for the growth of millets. Rice soils occupy the largest area of the district. Khar soils situated on the flat levelled land near the creeks are being brought under reclamation, best suited for garden crops eg. Areca nut, coconut etc. Coastal alluvial soils all along the coasts and laterite soils are observed among the Sahyadri ranges in the traps rock, mainly at Matheran and Poladpur suitable for valuable species of evergreen and semievergreen types.

CLIMATE

The climate is similar to that of the west coast of India with plentiful and regular seasonal rainfall, oppressive weather in the hot months and high humidity throughout the year. The summer season from March to May is followed by the south-west monsoon from June to September-October and November forms the post-monsoon or the retreating monsoon season. The period from December to February is the cold season.

The average annual rainfall for the district as a whole is 2500 mm. The rainfall increases rapidly from the coast towards the Western

Ghats on the eastern border of the district. In the coastal strip, the annual rainfall decreases from south to north; Uran and Alibag at the north end of the coast get annually 2070 mm and 2080 mm of rain, respectively. Matheran gets about as much as 5160 mm of rain, annually. Nearly 95% of the annual rainfall is received during the south-west monsoon months and rainfall in October forms the major portion of the rest. July receives the heaviest rainfall with 38% of the annual rainfall. The climate is however, generally pleasant from December to March.

VEGETATION TYPES (MAP - 2)

The wide variation in physiography, geology, soil and climate of the district have regulated in various forests types. Based on Champion and Seth (1968), the forests of the district can be broadly classified under the following types.

1. Tropical semi-evergreen to evergreen forests.
2. Tropical moist deciduous forests.
3. Tropical dry deciduous forests.
4. Littoral and swamp forests: a) Riparian. b) Mangrove.

1. Tropical semi-evergreen to evergreen forests : This type of forest is found mainly in hilly regions, particularly in the Western Ghats and some of its spurs such as north of Alibag slopes, Matheran, upper slopes of Dhamni and Mirya dongar, Pen; Parghat and Varandh ghat, Mahad range etc. The forest composition particularly in Matheran and other places shows different stratification as follows.

- i) The plateau forests or top layer is composed of the evergreen species of which *Actinodaphne angustifolia*, *Ficus racemosa*, *Glochidion hohenackeri*, *Mangifera indica*, *Memecylon umbellatum*, *Olea dioica*, *Syzygium cumini* etc. are some important. (Plates 1,2, 7a)
- ii) In the middle layer or terraces below the plateau *Bridelia retusa*, *Careya arborea*, *Heterophragma quadriloculare*, *Lagerstroemia microcarpa*, *Terminalia bellirica* etc. are found.
- iii) The ground layer or the undergrowth consists of *Carissa congesta*, *Carvia callosa*, *Gnidia glauca*, *Leea indica*, *L. macrophylla*, *Pavetta indica*, *Woodfordia fruticosa* etc.

A number of twiners, climbers or lianas are also found in the forests. To mention a few, are *Arbus precatorius*, *Acacia pennata*, *A. rugata*, *Butea superba*, *Cansjera rheedii*, *Celastrus paniculata*, *Combretum ovalifolium*, *Dioscorea spp.*, *Entada rheedei*, *Gnetum ula*, *Mucuna prurita* etc.

Orchids like *Habenaria* spp., *Pecteilis susannae*, *Peristylus lawii*, *P. plantageneus* etc., ferns like *Selaginella delicatula*, *Lygodium flexuosum* etc. mosses like *Funeria* spp., Bryophytes like *Riccia* spp. etc., are frequent particularly in Matheran. Grasses are found usually on steep slopes, edges of the plateau, tops and bases of the cliffs.

The plateau forests in Matheran, are very dense and even congested in places and their most luxurient growth represents the natural climatic climax.

2. Tropical moist deciduous forests : Throughout the district, major part of the forests are of this type, usually found on hill slopes eg. Matheran, Panvel, Karnala birds sanctuary, Mahad, Mhasla, Nagothana, Roha, Raigad, Sudhagad etc. (Plates 7b, 8,9, 10b)

Like evergreen types, here also the vegetation is observed in 3 different storeys or zonations.

- i) Top storey : The chief deciduous species are *Tectona grandis* and its associates like *Acacia catechu*, *Albizia lebbek*, *Bombax ceiba*, *Dalbergia latifolia*, *Pterocarpus marsupium*, *Terminalia paniculata*, *Trewia nudiflora* etc. The preponderance of teak or *Tectona grandis* is overwhelming with 60% or more.
- ii) Middle storey : The species forming middle layer are *Careya arborea*, *Erythrina indica*, *Gmelina arborea*, *Grewia tiliifolia*, *Haldina cordifolia* etc.
- iii) Ground layer : The undergrowth mostly consists of *Carissa congesta*, *Carvia callosa*, *Helicteres isora*, *Holarrhena antidysenterica*, *Wrightia tinctoria* etc.

3. Tropical dry deciduous forests : This type of forests, (Plate 11 a) popularly known as 'Fuel forests' are found especially in Roha division eg. Tharbat forest in Sanegaon round. The forest is characterized by high percentage (ca 60%) of 'Ain' i.e. *Terminalia crenulata* associated with *Bombax ceiba*, *Haldina cordifolia*, *Holoptelia integrifolia*, *Mitragyna parvifolia*, *Pterocarpus marsupium*, *Terminalia chebula* etc.

As a subtype of 'fuel forests' various evergreen patches spread all over the area need special mention. A part of village 'Phansad' in Murud range (area about 903 hectares) consists *Memecylon umbellatum* as principal species associated with *Syzygium cumini*, *Mangifera indica* etc. and other sacred groves known as 'Devrai' or 'Devrath' in Maharashtra located near 'Gani' and 'Vinhere' in Mahad range and 'Ransai' near Karnala are mainly composed of evergreen species such as

Artocarpus heterophyllus, *Ficus* spp., *Gardenia gummifera*, *Mangifera indica* etc. Here the middle and ground layer is nearly the same as described in moist deciduous forests. These pockets in protected localities have alone reached the climax evergreen stage as they are relatively free from adverse biotic influences.

4. Littoral and swamp forests : a) **Riparian flora :** This vegetation type is found along the river banks, river beds on stony, sandy or alluvial habitat in the area. (Plate 12)

Along the sandy soils and stony river banks, plants found are *Capillipedium huegalli*, *Homonoia reparia*, *Indigofera cordifolia*, *Rotala serpyllifolia*, *Rotula aquatica*, *Tamarix ericoides*, *Vitex negundo* etc.

On alluvial soil, number of wetland and marshy plants are met with. They are *Ageratum conyzoides*, *Ammannia baccifera*, *Caesulia axillaris*, *Chenopodium album*, *Typha angustata*, species of *Chrozophora*, *Commelina*, *Cyperus* and *Polygonum*.

b) **Mangrove forests :** The vegetation found along the muddy sea-shores and sandy saline areas observed in the district particularly at Alibag, Dasgaon around in Mahad, Dharamtar creek from Ghosale to Murud, Elephanta island, Rajapuri-Mhasla creek in Janjira-Murud, Revas, Revdanda, Uran etc. fall under this category. The dominant species are *Avicennia marina* var. *acutissima* and *A. officinalis* associated with *Acanthus ilicifolius*, *Aegiceras corniculata*, *Carallia brachiata*, *Rhizophora mucronata*, *Sonneratia* spp. etc. (Plate 11b)

On muddy soil, *Salvadora persica*, *Sesuvium portulacastrum* and *Suaeda monoica* are frequent while on sandy sea-shore *Aeluropus lagopoides*, *Cressa cretica*, *Cyperus bulbosus*, *Hyphaene dichotoma*, *Pandanus tectorius*, *Pedaliium murex*, *Spinifix littoreus*, *Tribulus terrestris* etc., are found.

To arrest soil erosion by high tides and also as wind breakers etc. huge plantations or 'Man made forests' of *Casuarina equisetifolia* have been raised at Nagaon beach in Alibag.

In addition to the plants mentioned in the above forest types a number of hydrophytes, epiphytes, parasites a few insectivorous, plants of Biological interest and pteridophytes area also found in the area and to mention a few of each category are :

i) **Hydrophytes :** In ponds and ditches a number of water plants are found. They are either submerged, floating or in wetlands.

Submerged : *Blyxa echinosperma*, *Ceratophyllum demersum*, *Hydrilla verticillata* etc.

Floating : *Eichhornia crassipes*, *Hygroryza aristata*, *Nymphaea pubescence*, *Nymphoides hydrophylla*, *Pistia stratiotes*, *Trapa natans* etc.

Wet land or marshy plants are similar to riparian flora.

- ii) Epiphytes : There are many epiphytes in the area mostly belonging to the family Orchidaceae, viz. *Acampe ochracea*, *Aerides maculosum*, *Dendrobium* spp. *Eria* spp. *Porpax jerdoniana*, *P. reticulata*, *Rhynchostylis retusa*, *Vanda parviflora* etc.
- iii) Parasites : Two types of parasites met in the area are (a) Root parasites eg. *Aeginetia indica*, *Buchnera hispida*, *Christisonia calcarata*, *Santalum album*, *Sopubia delphinifolia*, *Striga* spp. and (b) Stem parasites eg. *Cassytha filiformis*, *Cuscuta chinensis*, *C. reflexa*, *Dendrophoe falcata*, *Viscum articulatum* etc.
- iv) Insectivorous plants : *Drosera indica* and *Utricularia* spp. are usually met with.
- v) Plants of Biological interest : The branched palm *Hyphaene dichotoma* (Plate 3d) occurs in Nagaon & Revdanda beach in Alibag : *Gnetum ula*, (Plate 3a) a botanically important and interesting Gymnosperm species occurs in the area; *Oroxylum indicum* with its fruits resembling large swords, *Entada rheedei* a liana for its woody fruits and largest seeds, *Radermachera xylocarpa* for its longest, branch like fruits with external warty protruberances are found in Roha division and other places of the district.
- vi) Pteridophytes : These seedless vascular plants are comparatively rich in hilly regions like Kalasgiri in Roha, Karnala fort and Matheran where humidity is high and altitude reaches upto 760 m. Among them 'Sanchrini' or walking ferns like *Adiantum philippense*; silver ferns like *Cheilanthes albomarginata* and *C. farinosa*; epiphytic ferns like *Drynaria quercifolia*, *Microsorium membranaceum*, *Pteris pellucida* and *P. quadriaurita*; terrestrial ferns like *Athyrium hohenackerianum* and *Tectaria macrodonta*; aquatic or semiaquatic ferns like *Ceratopteris thalictroides*, *Marsilea minuta* and climbing Ferns *Lygodium flexuosum* etc. are frequent. The members of a most primitive family, Ophioglossaceae, viz. *Ophioglossum costatum*, *O. nudicaule* and *O. reticulatum* also occur in plains and hilly areas. The fern-allies like *Selaginella delicatula* are found in shady and moist habitats while free floating *Azolla pinnata* in small ditches.

Factors affecting Vegetation : The vegetation of the district is greatly affected by abiotic (ecological) and biotic factors.

Abiotic (Ecological) factors : Forest fires have cleared the forests in some places like "Shriganchari" near Alibag. Due to forest fires or felling, some of the areas have retrogressed from moist or mixed forest to deciduous type (Jain, 1959). Soil erosion also has affected the vegetation in coastal region, especially in Alibag, Murud, Nagaon, Shrivardhan etc. Forest department has now taken steps to prevent erosion by planting *Casuarina equisetifolia* at Nagaon beach etc. and 'teak' plantations in the area cleared by forest-fires. Land-slides in hilly region like Matheran has also affected the vegetation in some parts.

Biotic factors : Various biotic factors like felling, grazing, Industrialization, construction of roads and heavy transport at Mahad-ghat and Varandh-ghat have affected the natural vegetation.

Construction of Railway-line between Neral to Matheran and Trolley-line between Roha to Bhira have also affected the natural vegetation in the area. Similarly, clearing of the natural forests for house building, rehabilitation and for industrial purposes have also affected plant wealth particularly in Mhasla, Roha etc.

Hill stations like Matheran and coastal places like Alibag, Elephanta caves, Murud, Shrivardhan etc. are constantly visited by tourists and this also affected the vegetation.

Over-exploitation of many economic and medicinal plants for commercial purposes have depleted important plants like *Rauvolfia serpentina*, *Santalum album* etc.

Grazing has considerably affected habitat of natural vegetation especially in Roha and other parts of the district.

Industrialization in certain areas eg. Khalapur (Hindustan Organic Chemicals Co.) and Uran (O.N.G.C. project) have created partly water and air pollution in the district. Because of waste chemicals thrown into the Patalganga river by Hindustan Organic Chemicals, water becomes polluted and number of fishes as well as water plants have been depleted. This process is still continued. Similarly, due to O.N.G.C. Project at Uran air, sea-water is also polluted. Perhaps because these reasons, the plants like *Bruguiera cylindrica*, *Tamarix troupii* etc. recorded by Kuttan (1965) could not be located by present authors in recent plant explorations.

Botanical collectors are also responsible to some extent for depletion of certain species. For instance, Matheran hill is visited

botanically by innumerable batches of Research workers, excursion parties from colleges and universities etc. and have greatly disturbed the distribution and depleted some species.

Conservation : To save the plants from all kinds of threats (i.e. ecological and biological), Govt. of India has taken a number of steps such as ban on over export of commercial plants like *Aconitum* and beautiful orchids, under Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES). The Indian Wild life (Protection) Act 1972, is also further amended to include plants in its schedules to restrict or prohibit trade. Certain areas in India are also declared as Biosphere Reserves, National parks and Sanctuaries to protect plants and animals from adverse biotic effects. In Maharashtra state there are 5 National parks, 24 Wild life Sanctuaries and 3 Game reserves. In Raigad district, there are 2 Wild life Sanctuaries, one being Karnala bird Sanctuary and the other Phansad (Panther) wild life Sanctuary. 'Karnala Bird Sanctuary' is located in Panvel range and Phansad (Panther) Wild life Sanctuary in Murud range.

Karnala bird Sanctuary : Karnala or Funnel hill (18° 57' N. Lat. & 73° 07' E. Long.) is a small historic fort in Konkan region having an altitude of 475 m located 62 kms from South of Bombay and 12 Km. from West of Panvel along the Bombay-Goa high way. It covers an area of about 4.48 sq. kms. The peak of the fort is dome shaped and Funnel or centre of the upper part is almost inaccessible. Basal pillar considered to be religious in origin. The Funnel is full of honey bees.

Geologically the soil is rugged terrain of Deccan trappean hills and climate is similar to central coastal areas in W.India. A review of literature (Graham 1839, Dalz. & Gibs. 1861, Cooke 1901-08) suggests that the Karnala forests were not explored for many years. After construction of Bombay-Goa national high-way, a few workers visited the area and published some data (Datar & Vartak 1975, Vartak *et al.* 1985). The area was also intensively explored by present authors during 1976-80 and specimens collected are deposited in BSI.

The forests are of moist deciduous type with a few isolated patches of semi-evergreen species in the ravines. The Karnala flora consists of about 114 plant families, 432 Genera and 642 species. Not only the vegetation but also a large variety of birds ca 152 (Grubh 1982) such as snipes (*Gallinago* spp., *Rhynchaea* spp.), ducks whistling Teal (*Dandrocyna javanica*), partridges (*Ortigonis* spp.), grey quail (*Corturnix communis*), golden & stone plover (*Charadrius* spp., *Edicnemus* spp.), pigeons (*Columba* spp.) etc., and animals such as snakes, python, Deers (*Tetracerus* spp.), Monkeys Vanar & Makad (*Presbytis entellus*, *Macaca radiata*), jackals (*Canis aureus*), Dukkar

(*Sus indicus*), red squirrel (*Sciurus elphinstonei*), Mungus (*Herpestes edwardsi*), Peacock, Lahuri, Harial, Pankombari, Rabbits, Titar etc. provide a great interest to Naturalists. Hence the Govt. of Maharashtra on 4.5. 1968 declared 4.48 sq. Kms. area of Karnala Bird sanctuary as Reserved or protected forests for its beautiful birds and developed a tourist complex with a view to preserve an old culture and traditions of the local tribal people.

Phansad (Panther) Wild life Sanctuary : This is of relatively recent origin, declared on 25-2-1986 with an area of 69.79 sq. kms. Besides Private forests (Avagikrut van) of about 4504.474 hectares and conserved forests of about 903.265 hectares totalling to 5407.739, say roughly 5408 hectares around it.

The type of forest, located 60 kms from Roha is classified as Tropical moist deciduous one. The wild life existing at present is Chitad (Panther), Bibat tiger, Bhekar, Taras, Ran dukkar, Kolhe, Pisora (Makus deer), Mongoose, Makad (Monkey), Pankutra, Sambar etc. (cf. 'Rastriya Udyana Va Abhayaranya Cha Sadya Sthiti Darshak Ahaval' in Marathi by R.N. Indurkar (C.C.F.), M.state, Nagpur, dt- 4-3-1991.

ETHNOBOTANY

The main tribals which are economically, educationally and socially backward are Katkaries or Kathodies, Mahadev kolis, Thakurs etc. known as Adivasis. They are famous for their folk dances.

The Katkaries are known as 'Kathodies' because of their occupation making 'Kath' or catechu, the thickened juice of Khair (*Acacia catechu*). They worship the kanbi village God 'Gamdev' or minor Tiger God such as Muslya, Mhasa, Vetat etc. For their food they usually hunt wild boar or Dukkar or cultivate millets like Sawa (*Panicum miliaceum*) and Nagli (*Eleusine corocana*).

The Thakurs are comparatively advanced than Katkaries. They usually plough the narrow steeps along hills and raise paddy crops during rainy season and also grow plantains and vegetables near their houses. They worship 'Shankar-Parvati' These tribal communities have been always believers and devotees of forest gods. Hence, cutting of any trees or killing of animals in sacred groves or Devrai (Devarth) is tabooed (Vartak 1981). Perhaps vegetation and wild life survives in Devrath near Karnala bird sanctuary and Vinhere for the same reason.

There are number of wild plants used as food, medicine and in cottage industries by the tribal people and the study of this branch is known as 'Ethnobotany'. These plants are discussed in detail under cultivated and other useful plants.

Cultivated and other useful plants: The main food crops cultivated in the district are *Eleusine corocana*, *Oryza sativa*, *Panicum miliaceum* and *Paspalum scrobiculatum* among cereals; *Cajanus cajan*, *Cicer arietinum*, *Pisum sativum*, *Vigna angularis*, *V. radiata* etc. among pulses; *Abelmoscus esculentus*, *Brassica oleracea*, *Colocasia esculenta*, *Ipomoea batatas*, *Raphanus sativus* etc. among vegetables; *Anacardium occidentale*, *Carica papaya* etc. among fruits.

There are many wild plants which are consumed by the local people.

- a) Roots, tubers or rhizomes of many wild plants are eaten raw or boiled. Some examples are : *Asparagus racemosus*, *Ceropegia attenuata*, *Colocasia esculenta*, *Costus speciosus*, *Cyperus bulbosus*, *C. rotundus*, *Dioscorea bulbifera*, *Nelumbo nucifera*, *Nymphoides indicum*, *Tacca pinnatifida*, *Vigna vexillata*.
- b) Leaves or young shoots of wild plants eaten raw or cooked as green vegetables are *Abrus precatorius*, *Casuarina esculenta*, *Chlorophytum tuberosum*, *Clerodendrum serratum*, *Cressa cretica*, *Cyanotis tuberosa*, *Ipomoea aquatica*, *Leea indica*, *Melothria heterophylla*, *Mussaenda frondosa*, *Portulaca oleracea*, *Thunbergia grandiflora*, *Typha angustata* etc.
- c) Buds or flowers of many wild plants are eaten raw or cooked. They are *Bauhinia purpurea*, *Bombax ceiba*, *Buddleja asiatica*, *Dillenia indica* (Fleshy-calyx), *Dioscorea pentaphylla*, *Oroxylum indicum* etc.
- d) Ripe or unripe fruits of many wild plants are eaten raw, cooked or pickled, Such as *Aegle marmelos*, *Capparis zeylanica*, *Carissa congesta*, *Cordia dichotoma*, *Dillenia indica*, *Eragrostis tenella*, (Plate 5a), *Garuga pinnata*, *Jasminum malabaricum*, *Leea crispa*, *Mucuna prurita*, *Phyllanthus officinalis* etc.
- e) Seeds of many wild plants roasted or boiled and eaten. They are *Bauhinia vahlii*, *Entada rheedei*, *Gnetum ula*, *Holoptelia integrifolia*, *Sterculia guttata*, *Vigna umbellata* etc.

There are plants from which delicious beverages or drugs and narcotics are obtained. Fresh sap of *Borassus flabellifer* and *Phoenix sylvestris* provides a good beverage. *Areca catechu* is cultivated for its fruit 'supari' used along with betel leaves as a masticatory. Many tree species like *Erythrina variegata*, *Moringa pterygosperma*, *Phoenix acaulis*, *Sesbania grandiflora* etc. are planted for support of the vines.

There are many species used as condiment and spices. They are *Brassica juncea*, *Coriandrum sativum*, *Garcinia indica*, *Piper nigrum*, *Zanthoxylum rhetsa* etc.

Among oil yielding plants *Azadirachta indica*, *Cocos nucifera*, *Pongamia pinnata*, *Ricinus communis* and *Sesamum indicum* are noteworthy.

For building huts, making brooms, baskets, mats ropes, clothes etc. natural fibre from plants like *Abutilon indicum*, *Bombax ceiba*, *Calotropis gigantea*, *Corchorus capsularis*, *C. olitorius*, *Gossypium herbaceum*, *Helicteres isora*, *Hibiscus cannabinus*, *Kydia calycina*, *Phoenix sylvestris*, *Sida acuta*, *Urena lobata* etc. used.

Major forest products that occur in the district are timber, fire-wood and char-coal. Timber is obtained from *Haldina cordifolia*, *Bambusa arundinacea*, *Dalbergia latifolia*, *Pterocarpus marsupium*, *Tectona grandis*, *Terminalia bellirica*, *T. crenulata* etc.

Minor forest products such as dyes obtained from *Acacia catechu*, *Butea monosperma*, *Cassia fistula*, *Mallotus philippensis*; *Bidi-wrappers* from *Bauhinia racemosa*, *Diospyros melanoxylon*; *Shikakai* pods for hair wash from *Acacia concinna*; leaves for thatching for *Borassus flabellifer*, *Bambusa arundinacea*, *Dendrocalamus strictus*, *Dillenia pentagyna* etc.; Resin and gum from *Acacia nilotica* ssp. *indica*, *Gardenia resinifera*, *Garuga pinnata*, *Sterculia urens* etc. are also of considerable value.

There are many wild plants which are used medicinally either by the local people or commercially by the business men. These are : *Ailanthus triphysa*, *Asparagus racemosus*, *Barleria cristata*, *Calophyllum inophyllum*, *Capparis zeylanica*, *Flaucourtia indica*, *Garcinia indica*, *Helicteres isora*, *Heterophragma quadriloculare*, *Holarrhena antidysenterica*, *Ipomoea aquatica*, *Michelia champaca*, *Nelumbo nucifera*, *Plumbago zeylanica*, *Rauvolfia serpentina*, *Tephrosia purpurea*, *Tinospora cordifolia*, *Vitex negundo*, *Woodfordia fruticosa*, *Xeromphis spinosa* etc.

INDUSTRIES (MAP - 3)

The district was considered as industrially backward upto 1914. Fishing, Timber, Carpentry, Ceramics, Rice pounding and Transport are the major industries which accomodate more than 60 % of persons employed. Among large and small scale industries 'manufacturing of Grinding wheels' is an important industry at Mora (Uran). Among two to four 'Electricity generating units' (Bhira, Bhivpuri, Khopoli, Janjira)., the power system located at Khopoli is one of the largest in South East Asia. As paddy is main crop of the district, 'Rice milling' forms one of its

major industry. About 125 Rice mills in the district are located in Pen, Panvel, Karjat, Mahad, Khopoli, Goregaon, Roha and Poynad. Panvel is the biggest collecting and distributing centre of Rice.

Paper and Paper products: Because of abundant availability of water, electricity, raw materials (Wood pulp, rags, waste paper, straw and hay) and cheap labour, Paper industry units at Khopoli and Apta have been established, which manufacture printing and binding paper and paper boards. Plants used in paper industries are *Ficus racemosa*, *Gnidia glauca*, *Lannea coromandelica*, *Streblus asper* etc.

Chemicals and Pharmaceuticals : Panvel is one of the centres for manufacturing Ayurvedic medicines. The main products of the industry are : Kadha, Asava, Churna, Bhasma, Gutika (Pills) etc. Plants used in Ayurvedic medicines are *Terminalia bellirica*, *T. Chebula*, *Tinospora cordifolia*, *Tribulus terrestris* etc. A pioneer concern of manufacturing Sodium Salicylate, Salicylic acid and Aspirin was started at Khopoli in 1954.

'Hindustan Organic Chemicals' near Patalganga river in Vadgaon area, Khalapur is one of the bigger factories in India where production of chemicals are in lakhs of metric tons per annum.

India's biggest Oil and Natural Gas Commision's Project (ca 1,700 crore rupees) started in 1975-76 and is earning a revenue/profit of Rupees 300 crores per annum is also located at Uran-Pirwad area of Raigad district.

Cotton textiles : A power loom factory was started in 1932 at Uran. It produces mainly Grey long cloth, coating and canvas. Plants used in this industry are *Corchorus* spp., *Gossypium* spp. etc.

Engineering industry : There is a cutlery workshop at 'Pen' which produces Pen-knives, Scissors and similar articles.

Coated fabrics : Adhesive tapes, varnish tapes, packing strips, medical tapes and water proof tapes are produced in small scale industries at 'Khopoli'

Salt making : It is an old industry started at Alibag, Pen and Roha. Now it is expanded at Shewa, Karanja and Uran.

Cottage industries : 'Charcoal making' is one of the oldest industries in which 'Adivasis' and 'Katkaries' are engaged for years. Among cottage industries fishing, wool weaving, leather, bamboo-plaiting, carpentry, smithy, boxes & toy making (from wood of *Erythrina variegata*, *Haldina cordifolia*, *Mitragyna parvifolia*, etc.), Walking sticks (Branches of *Combretum ovalifolium*, *Masea indica*,

Murraya paniculata etc.), Pottery and brick making are main. Pen is famous for making decorative images, idols and statues of different sizes and shapes (particularly of Lord Ganesh) out of Kaolin and plaster of Paris.

SALIENT STATISTICS ON THE FLORA

The present flora mainly deals with flowering plants and includes 1137 species and 36 varieties +40 cultigens belonging to 620 genera spread over in 151 families. The table-1 shows the proportion of monocot-dicot ratio, which is 1: 2.5 and genera to species is nearly 1: 2. Hooker (1904) estimated the ratio between monocot to dicots as 1: 2.3 and genera to species as 1: 7.

Table-I : General Survey

Group	Family	Genera	Species	Varieties	Cultigens
Monocots	22	134	303	8	3
Dicots	128	485	833	31	37
Gymnosperms	1	1	1		
Total	151	620	1,136	39	40

Besides 33 Pteridophytes found in the area are also enumerated in 19 families. A comparison between this sequence and with those given in Hooker's (1904) Flora of British India is given Table-II. The position of Poaceae is first in present flora which is third in Flora of British India. The position of Orchidaceae is first in Flora of British India while it is 8th in present flora. The position of other families too vary in both cases. In present flora Fabaceae, Caesalpiniaceae and Mimosaceae are treated separately while Hooker included them under Leguminosae.

Table-II : The Ten Dominant Families Comparison with Flora of British India

Flora of Raigad	Flora of British India
1. Poaceae	1. Orchidaceae
2. Leguminosae (Fabaceae)	2. Leguminosae
3. Cyperaceae	3. Poaceae
4. Acanthaceae	4. Rubiaceae
5. Asteraceae	5. Euphorbiaceae
6. Euphorbiaceae	7. Acanthaceae
7. Rubiaceae	7. Asteraceae
8. Orchidaceae	8. Cyperaceae
9. Convolvulaceae	9. Lamiaceae
10. Caesalpiniaceae	10. Urticaceae

Floristic analysis : An analysis of the distribution of floristic elements occurring in the area was made to understand the phytogeographical affinity on one hand and to find out the endemic content of the flora on the other.

Being a part of the western ghats in Peninsular India, the flora of Raigad district shows some phytogeographical affinity with Sri Lanka and African floras. A few examples of such an affinity are given below.

Chloroxylon swietenia DC., *Chukrassia tabularis* Juss., *Melothria leiosperma* Cogn., *Soyimida febrifuga* Juss. etc. are a few examples of some common elements which occur in Sri Lanka and in this area. Similarly, some African elements occur in this region are *Alstonia scholaris* R.Br. , *Grewia tiliifolia* Vahl and members of the family capparaceae. Some Malesian elements which occur in this region are in the genera *Macrosolen*, *Pueraria* and *Xantolis* and Arabian elements in genera *Acacia*, *Heliotropium*, *Salvadora* etc. A few species such as *Dicliptera zeylanica* Nees and *Indigofera constricta* are restricted to India and Sri Lanka, *Commelina hasskarlii* C.B.Cl. to India and Bangla Desh while *Cyanotis fasciculata* Schult. with rare and restricted distribution in India, Sri Lanka and Bangla Desh are also met within the Raigad flora.

A notable work to analyse such phytogeographical elements and characteristic flora confined to the Indian sub-continent is done by D. Chatterjee (1940, 1962). He estimated that Himalayas have the largest number of endemics with 3,169 species of dicotyledons and about 1000 species of monocotyledons. Nayar (1980 a,b) mention the total endemic genera in India represents 6.5% of the 2252 genera occurring in India Ahmedullah & Nayar (1987) mention that out of about 15,000 species of Angiosperms 12% are found to be endemic to Peninsular India.

Raghavan & Singh (1983) reported 27 species which are apparently very rare or possibly extinct and not collected since their original type collections. Among them *Bidaria khandalense* (Sant.) Jagtap & Singh has recently been recollected from Raigad district (Kothari & Moorthy, 1983). Similarly, *Achyranthus coynei* Sant., *Canscora concanensis* C.B.Cl. and *Eriocaulon humile* Mold. are also recollected from Matheran in Raigad district (Irani, 1962). *Typhonium bulbiferum* Dalz. confined to Konkan is found in W. ghats, Karnataka, Kerala, Meghalaya etc. (Ahmedullah & Nayar, 1987). *Ischaemum santapau* Bor, earlier reported from Maharashtra is now known from Dangs in Gujarat (Kothari & Hajra, 1983). Of the 93 endemic species reported so far from Maharashtra, 23 species occur in Raigad district. A new species *Cassia kolabensis* Kothari *et al* (1981) also has been discovered from Raigad district, confined at present to Raigad and

Thana districts in Maharashtra. Similarly, species such as *Hoya alexicaca* (N.J. Jacq.) Man., *Iphigenia magnifica* Ansari et Rolla Rao, *Pogonachne racemosa* etc., have been originally described from Raigad district but are now known to occur in other parts of Maharashtra state but not outside, while *Hypoestes lanata* Dalz. has been confined to North western ghats and Konkan at present. Similarly, *Nilgirianthus membranaceous* (Talb.) Brem. known from W. Ghats in Karnataka (cf. Ahmedullah & Nayer, 1987) is now known to be in W.Ghats of Maharashtra also.

According to an estimate of threatened plants committte of IUCN, about 10% of world's flora are under varying degrees of threat (Jain & Sastry 1980). The floristic analysis in the present area revealed that *ca* 114 species of flowering plants out of several hundred endemic species occuring in the flora of India are distributed in Raigad district, facing the same problem either in district, state or country level having restricted distribution. eg. some plants occur with very small populations at present. *Flemingia gracilis* *Bidaria khandalense* etc. are the best examples of rarity in occurence in the district. Similarly plants like *Entada r heedei* *Gnetum ula* and *Hyphaene dichotoma* are becoming rare due to ecological and biotic factors.

A comprehensive list of endemic plants of India having distribution in Raigad district with remarks on their status is given in Table-III based on extensive plant exploration in the area (1976-80) and consultation of literature and herbaria at Pune (BSI), Blatter herbarium, Bombay (BLAT), Northern circle herbarium of Botanical Survey of India, Dehradun (BSD), FRI herbarium, Dehra Dun (DD) and Cental National Herbarium, Howrah (CAL).

Table-III : A list of endemic plants of India having distribution in Raigad district

Name of species	Family	Range of distribution
+ <i>Achyranthes coynei</i> Sant.	Amaranthaceae	Western Ghats (Khandala, Matheran). Extremely rare.
<i>Aerides maculosum</i> Lindl.	Orchidaceae	Peninsular India, W. Ghats, Konkan, Ramdurg, Belgaum, Bellary, Hassan, Deccan & upto Rajashtan.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>Aglaia lawii</i> (Wight) Sald.	Meliaceae	W. Ghats, Konkan, Kanara, Malabar-Tirunelveli.
<i>Ancistrocladus heyneanus</i> Wall. ex Grah.	Ancistrocladaceae	Western Peninsula (Konkan to Travancore).
<i>Aporosa lindleyana</i> (Wight) Baill.	Euphorbiaceae	W.Ghats.
<i>Argyrea sericea</i> Dalz.	Convolvulaceae	W. Ghats, Konkan, Malabar, Nilgiris to Tirunelveli hill.
<i>Arthraxon jubatus</i> Hack.	Poaceae	W. Ghats (Maharashtra).
<i>Asystasia dalzelliana</i> Sant.	Acanthaceae	W. Ghats from S. Kanara, Southwards at low alt.
<i>Atylosia lineata</i> Wight & Arn.	Fabaceae	W.Ghats, Konkan, Karnataka to Travancore.
<i>A. sericea</i> Benth.	Fabaceae	W. Ghats, Konkan, Deccan & E. Ghats, Visakhapatnam hills.
<i>Barleria gibsoni</i> Dalz.	Acanthaceae	Maharashtra, Rajasthan, Andhra Pradesh, Madhya Pradesh, Kerala, Karnataka.
<i>B. prattensis</i> Sant.	Acanthaceae	Western India (Maharashtra, Goa, Rajasthan, Karnataka)
<i>Begonia concanensis</i> A. DC.	Begoniaceae	Maharashtra (Karnala grove in Raigad, Khandesh). Rare.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>+Bidaria khandalense</i> (Sant.) Jagtap & Singh	Asclepiadaceae	Maharashtra (Khandala, Raigad). Extremely rare.
<i>Blepharis asperrima</i> Nees	Acanthaceae	W. Ghats, hills of Karnataka, S. Kanara, Coorg.
<i>Blumea malcolmii</i> (C.B.Cl.) Hook.f.	Asteraceae	W. India, Gujarat, Madhya Pradesh, Bihar, Maharashtra, Karnataka, Tamilnadu.
<i>Bothriochloa concanensis</i> (Hook. f.) Henr.	Poaceae	Maharashtra (Common), Karnataka (Rare).
<i>Calacanthus grandiflorus</i> (Dalz.) Radlk.	Acanthaceae	W. Ghats (Kanara & Mysore in Karnataka). Threatened.
<i>Canarium strictum</i> Roxb.	Burseraceae	W. Ghats, Assam, Sikkim.
<i>Canscora concanensis</i> C.B.Cl.	Gentianaceae	Gujarat & Maharashtra. Rare and Threatened.
<i>C. khandalensis</i> Sant.	Gentianaceae	Maharashtra (Pune, Raigad, Thane).
<i>Carvia callosa</i> (Nees) Brem.	Acanthaceae	Gujarat, W. Ghats of Maharashtra & Karnataka.
<i>Cassia kolabensis</i> Kothari <i>et al.</i>	Caesalpiniaceae	Maharashtra (Raigad, Thane).
<i>+Ceropegia attenuata</i> Hook.	Asclepiadaceae	Western Ghats of Maharashtra, Malwan; Goa; Karnataka, N. Kanara. Threatened.
<i>+ C. oculata</i> Hook.	Asclepiadaceae	W. Peninsula (Goa, N. Kanara, Maharashtra). Threatened.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
+<i>C. vincaefolia</i> Hook.	Asclepiadaceae	Maharashtra (Bombay, Pune, Raigad, Ratnagiri, Satara, Thane). Rare.
+<i>Chlorophytum borivilianum</i> Sant. & Fern.	Liliaceae	Greater Bombay, Borivili, Gujarat, Raigad (Matheran). Rare & Threatened.
<i>C. glaucum</i> Dalz.	Liliaceae	W. Ghats, Konkan, Sahyadri ranges, N. Kanara, Chikmagalur & Mysore. Rare & Threatened.
<i>Christisonia calcarata</i> Wight	Orobanchaceae	Peninsular India (Konkan).
<i>Cissus woodrowii</i> (Stapf ex Cooke) Sant.	Vitaceae	Peninsular India (Konkan)
<i>Clitoria biflora</i> Dalz.	Fabaceae	W. Ghats (Sahyadri ranges), Uttar Pradesh.
+<i>Crotalaria filipes</i> var. <i>trichophora</i> (Benth. ex Baker) Cooke	Fabaceae	W. Ghats (Konkan, Kanara), Bengal, Bihar. Rare & Threatened.
+<i>C. stocksii</i> Benth. ex Baker	Fabaceae	Maharashtra (Igatpuri, Mumbra, Raigad) & Andaman Islands.
<i>Curcuma inodora</i> Blatt.	Zingiberaceae	Western India (Gujarat, Maharashtra).
<i>C. pseudomontana</i> Grah.	Zingiberaceae	W. ghats, Konkan, Chikmagalur, Mysore, Anamalais, Madhya Pradesh.
<i>Cyanotis concanensis</i> Hassk.	Commelinaceae	South-West India.
<i>Dalbergia horrida</i> (Dennst.) Mabb.	Fabaceae	W. Ghats, Konkan, Kanara & Travancore etc.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>Dalzellia zeylanica</i> (Gardn.) Wight var. <i>konkanica</i> (Willis) Janardhanan	Podostemaceae	Peninsular India (Maharashtra: Thane, Raigad), Nilgiri & Malabar hills (S. India).
<i>Delphinium malabaricum</i> (Huth) Munz	Ranunculaceae	W. Ghats (Matheran). Threatened.
<i>Dendrobium barbatulum</i> Lindl.	Orchidaceae	Gujarat, W. Ghats, Konkan, Travancore & Nilgiris.
<i>D. microbulbon</i> A. Rich.	Orchidaceae	Gujarat, W. Ghats, konkan, N. Kanara, Nilgiris, Anamalais. Rare & Threatened.
<i>D. ovatum</i> (Willd.) Kranz.	Orchidaceae	W. Ghats, Konkan, N. Kanara, Belgaum & Hassan.
<i>Dicaelospermum ritchiei</i> C.B.Cl	Cucurbitaceae	Western India (Karnataka, Maharash- tra), Punjab, Tamilnadu.
<i>Entada rheedei</i> Spreng.	Mimosaceae	Himalaya, Assam. W. Peninsula. Threatened.
<i>Eranthemum roseum</i> (Vahl) R. Br.	Acanthaceae	W. Ghats, S. Kanara.
<i>Eria dalzellii</i> Lindl.	Orchidaceae	W. Ghats, Konkan. Hassan, Mysore to Nilgiris.
<i>E. microchilos</i> Lindl.	Orchidaceae	Throughout W. Ghats, Konkan. Travancore & Tamilnadu hills.
+ <i>Erinocarpus nimmonii</i> Grah.	Tiliaceae	W. Ghats (Maharashtra, Kanara). Threatened.
<i>Eriocaulon cuspidatum</i> Dalz.	Eriocaulaceae	W. Ghats, N. Kanara, Shimoga. Rare & Threatened.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>E. diana</i> Fyson var. <i>longibracteatum</i> Fyson	Eriocaulaceae	Gujarat, Maharashtra, Karnataka (South Kanara), Calicut.
+ <i>E. humile</i> Mold.	Eriocaulaceae	Maharashtra (Khandala, Matheran). Vulnerable.
<i>Eriolaena stocksii</i> Hook. f.	Sterculiaceae	Peninsular India (Karnataka, Tamilnadu, Maharashtra). Threatened.
<i>Euphorbia khandalensis</i> Blatt. & Hallb.	Euphorbiaceae	Maharashtra (Khandala, Matheran).
<i>Flacourtia montana</i> Grah.	Flacourtiaceae	Peninsular India (Maharashtra, Karnataka, Tamilnadu). Threatened.
+ <i>Flemingia gracilis</i> (Mukerjee) Ali	Fabaceae	Peninsular India (Pune, Raigad, Kanara). Rare.
+ <i>Frerea indica</i> Daly.	Asclepiadaceae	W. Ghats (Pune, Raigad) Endangered.
<i>Garcinia talbotii</i> Raiz. ex Sant.	Clusiaceae	Peninsular India (S. Kanara, Karnataka, Coimbatore, Tamilnadu).
<i>Geissaspis tenella</i> Benth.	Fabaceae	W. Coast, konkan (Raigad, Thane), Kanara, Karnataka plains.
<i>Gnetum ula</i> Brongn.	Gnetaceae	W. Ghats. Threatened.
<i>Habenaria grandifloriformis</i> Blatt. & McC.	Orchidaceae	W. Ghats, Konkan, hills of Karnataka to Shevaroy of E. Ghats
<i>H. heyneana</i> Lindl	Orchidaceae	W. Ghats, Konkan, throughout Karnataka

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
		hills to Nilgiris, Eastwards to Shevaroy of E. Ghats.
<i>H. longicorniculata</i> Grah.	Orchidaceae	W. Ghats, Konkan, Karnataka hills to Nilgiris.
<i>H. rariflora</i> A. Rich.	Orchidaceae	W. Ghats, Konkan, Kolar, Mysore, Shimoga to Travancore, Nilgiris.
<i>Haplanthodes neilgherryensis</i> (Wight) R.B. Majumdar	Acanthaceae	W. Ghats, hills of Karnataka, (incl. S. Kanara) & Malabar.
<i>H. plumosa</i> (T. Anders.) Panigrahi et Das	Acanthaceae	Throughout W. Ghats.
<i>H. tentaculata</i> (L.) R.B. Majumdar	Acanthaceae	Maharashtra, Goa.
<i>H. verticillata</i> (Roxb.) R.B. Majumdar	Acanthaceae	Deccan, Bellary.
<i>Hemigraphis latebrosa</i> Nees var. <i>heyneana</i> Brem.	Acanthaceae	Peninsular India.
<i>Heterostemma urceolatum</i> Dalz.	Asclepiadaceae	Maharashtra, Karnataka.
<i>Hibiscus talbotii</i> (Rakshit) T.K. Paul et Nayar	Malvaceae	W. Ghats, Konkan to Karnataka.
<i>Hoya alexicaca</i> (N.J. Jacq.) Man.	Asclepiadaceae	Maharashtra (Raigad). Extremely rare.
<i>Hygrophila pinnatifida</i> (Dalz.) Sreem.	Acanthaceae	W. Ghats, Konkan, Kanara, Deccan. Rare & Threatened.
+ <i>Hypoestes lanata</i> Dalz.	Acanthaceae	N. & W. Ghats, Konkan, (Roha in Raigad, Dapoli in Ratnagiri). Rare

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>+Hyphaene dichotoma</i> (White) Furtado	Arecaceae	West coast regions. (Diu, off Saurashtra coast, Goa, Nagaon and Revdanda in Raigad; occasionally cultivated in gardens). Threatened.
<i>Impatiens dalzellii</i> Hook. f. & Thoms.	Balsaminaceae	Western peninsula (Konkan). Threatened.
<i>+Iphigenia magnifica</i> Ansari et Rolla Rao	Liliaceae	Maharashtra (Dhule, Pune, Raigad), Karnataka. Vulnerable.
<i>+Isachne elegans</i> Dalz.	Poaceae	Maharashtra (Pune, Raigad, Satara, Thane).
<i>Ischaemum diplopogon</i> Hook. f.	Poaceae	Western India (Gujarat, Maharashtra).
<i>I. santapaui</i> Bor	Poaceae	Western India (Dangs in Gujarat; Pune, Raigad, Thane in Maharashtra).
<i>Ixora brachiata</i> Roxb.	Rubiaceae	W. Ghats, Konkan, Karnataka & South to Travancore at low alt.
<i>Jasminum malabaricum</i> Wight	Oleaceae	W. Ghats, Konkan, southwards Karnataka to Nilgiris.
<i>Knema attenuata</i> (Hook. f. & Thoms.) Warb.	Myristicaceae	W. Ghats, Konkan, Kanara & Southwards.
<i>Mackenzia integrifolia</i> (Dalz.) Brem.	Acanthaceae	W. Ghats, hills of S. Kanara & Coorg.
<i>Maytenus rothiana</i> (Walp.) Lobreau Callen	Celastraceae	Peninsular India (Maharashtra, Karnataka, Tamilnadu).
<i>Neanotis foetida</i> (Dalz.) W.H.Lewis	Rubiaceae	W. Ghats, Konkan, Kanara.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>N. montholonii</i> (Hook. f.) W.H.Lewis	Rubiaceae	W. Ghats, Konkan, Karnataka, Kanara, Malabar, Kerala, Madhya Pradesh. Rare & Threatened.
<i>N. rheedei</i> (Wall. ex Wight & Arn.) W.H.Lewis.	Rubiaceae	West Cost, W. Ghats, Konkan, Kanara, Karnataka, southwards to Cochin & Anamalais. Rare & Threatened.
<i>Nervilia infundibulifolia</i> Blatt. & McC.	Orchidaceae	Maharashtra: Khandala, Lonavala, Matheran; N. Kanara in Karnataka, Uttar Pradesh (Dehra Dun).
<i>Neuracanthus sphaerostachyus</i> (Nees) Dalz.	Acanthaceae	Gujarat, W. Ghats of Maharashtra & Karnataka (N. Kanara).
<i>Nilgirianthus asper</i> Sant.	Acanthaceae	W. Ghats in Maharashtra, Karnataka, Nilgiris, Anamalais, Travancore hills.
<i>N. heyneanus</i> (Nees) Brem.	Acanthaceae	W.ghats, Maharashtra, Karnataka, Nilgiris, Anamalais, Travancore & Tirunelveli hills.
<i>N. membranaceous</i> (Talb.) Brem.	Acanthaceae	W. Ghats in Maharashtra and Karnataka.
<i>Nothapodytes nimmoniana</i> (Grah.) Mabb.	Icacinaceae	Peninsular India (Maharashtra, Karnataka, Tamilnadu).
<i>Pinda concanense</i> (Dalz.) Mukh. & Const.	Apiaceae	Maharashtra (Pune, Raigad, Satara). Rare.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>Pogonachne racemosa</i> Bor	Poaceae	Maharashtra (Pune, Raigad, Thane).
+ <i>Polyzygus tuberosus</i> Dalz.	Apiaceae	W. Ghats (Kanara, Mysore, Raigad). Rare.
<i>Porpax jerdoniana</i> (Wight) Rolfe	Orchidaceae	W. Ghats, Konkan, hills of Karnataka & Malabar -Travancore.
<i>P. reticulata</i> Lindl.	Orchidaceae	W. Ghats.
<i>Reissantia grahami</i> (Wight) Ding Hou	Hippocrateaceae	Peninsular India (Maharashtra, Karnataka, Kerala.) Rare.
<i>Rhamphicarpa longiflora</i> (Arn.) Benth.	Scrophulariaceae	W. Ghats/ coast, Konkan, Matheran, Mahabaleshwar, Belgaum, N. Kanara to Chikmagalur, Shimoga & S. Kanara.
<i>Sageraea laurifolia</i> Dalz.	Annonaceae	Peninsular India (Malabar, Travancore, Konkan, N. Kanara, Kerala, Tamilnadu).
<i>Senesio bombayensis</i> Balakr.	Asteraceae	Western India (Maharashtra, Mt. Abu in Rajasthan, N. Kanara). Threatened.
<i>S. dalzellii</i> C.B.Cl.	Asteraceae	Bababudan hills, W. Ghats, Konkan to Karnataka. Rare & Threatened.
<i>Striga gesnerioides</i> (Willd.) Vatke var. <i>minor</i> Sant.	Scrophulariaceae	Peninsular India (Maharashtra: Khandala, Ambavane-Mulshi, Matheran). Threatened.
<i>Swertia minor</i> (Griseb.) Knobl.	Gentianaceae	W. Ghats, Konkan to Nilgiris.

A list of endemic plants of India having distribution in Raigad district.

Name of species	Family	Range of distribution
<i>Thelepaepale ixiocephala</i> (Benth.) Brem.	Acanthaceae	W. Ghats, S. Kanara & Tamilnadu.
<i>Tolypanthus lagenifer</i> (Wight) van Tiegh.	Loranthaceae	W. Ghats, Konkan, Kanara, Malabar.
<i>Torenia indica</i> Sald.	Scrophulariaceae	Maharashtra (Bombay, Raigad, Ratnagiri, Thane), Karnataka.
<i>Triplopogon ramosissimus</i> (Hack.) Bor	Poaceae	Peninsular India (Maharashtra).
<i>Typhonium bulbiferum</i> Dalz.	Araceae	W. Ghats, (Konkan & Raigad dist.), Karnataka, Kerala, Meghalaya.
<i>Ventilago bombaiensis</i> Dalz.	Rhamnaceae	Palghat dist., W. Ghats, Chikmagalur, Coorg, N. Kanara, Wynaad.
+ <i>Vigna khandalensis</i> (Sant.) Raghavan et Wadhwa	Fabaceae	W. India (Gujarat, Maharashtra, Karnataka). Threatened.
<i>Zingiber cernuum</i> Dalz.	Zingiberaceae	Peninsular India (Konkan in Maharashtra, Bababudan hills in Karnataka). Rare.
<i>Z. neesatum</i> (Graf) Ramamoorthy	Zingiberaceae	Peninsular India (Maharashtra, Kanara, Travancore).

+Plants published in Red data book of Indian Plants. Vols. I-III.

STYLE OF PRESENTATION

For phanerogams, Bentham and Hooker's system (1862-83) has been followed in the present flora. For splitting the families, in general, Hutchinson's classification (1959) is adopted.