

**SURVEY AND DOCUMENTATION OF WILD VARIETIES OF CROP  
PLANTS IN NATIONAL PARK AND SANCTUARIES OF UPPER WESTERN  
GHATS**

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**Gene Campaign,  
New Delhi.**



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WESTERN GHATS**

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**(S.M. Nadaf)**

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## INTRODUCTION

India is one of the twelve mega-biodiversity centres of the world and also an important centre of origin of agri-biodiversity. Indian centre is well known for its rich diversity (320 spp.) and about 166 species of cultivated plants have originated in this centre. In India, Western Ghats (one of the 25 hotspots of biodiversity around the world.) harbour some wild variety relatives of crop plants. To tap this wild germplasm of crop plants from the point of view of food and nutritional security and to develop conservation strategies, a survey was carried out in the reserves (one National Park and five Sanctuaries) of Upper W. Ghats of Maharashtra.

The need to conserve crop germplasm was recognized first by the well-known Russian geneticist Vavilov in 1926. The collection and conservation of genetic resources has been undertaken throughout the world since 1960 and particularly so since the formation of International Bureau of Plant Genetic Resources (IBPGR) which stimulates germplasm collection worldwide and also promotes research to evolve efficient methods for long term conservation (Jackson and Ford-Lloyd, 1991).

Brush (1991) reported four categories of crop germplasm. First of them is 'Wild Crop Relatives'.

**Wild crop relatives** : Conservation of wild crop relatives may be accomplished by establishing biological reserves (Genetic Reserves). One good example is *Oryza officinalis* which was found on a hilltop stream near Trichur, in Kerala. Due to illicit breeding and human disturbance the population was destroyed. Thus preserving these ecological niches is advantageous and can be combined by establishing genetic reserves. Ecological and plant biogeographical research on wild population is necessary to establish and monitor genetic reserves for conservation of wild relatives ( Kulkarni, Kumbhojkar and Khedkar, 1998 ).

Following genera of crop plants were selected for study of their wild relatives.

<b>Crop Type</b>	<b>Genus</b>	<b>Family</b>
Legumes or Pulses	<i>Cajanus, Canavalia, Paracalyx</i> and <i>Vigna</i>	Fabaceae
Cereals	<i>Oryza</i>	Poaceae
Vegetable s	<i>Abelmoschus,</i> <i>Cucumis, Luffa, Momordica, Trichosanthes</i> and <i>Solanum</i>	Malvaceae Cucurbitaceae Solanaceae
Oilseeds	<i>Sesamum</i>	Pedaliaceae

And the following six reserve areas (one National Park and five Sancturies) were selected as the area of study:

1. Kalsubai Harishchandragadh Sanctuary
2. Nandur Madhmeshwar Sanctuary
3. Sanjay Gandhi National Park
4. Phansad Sanctuary
5. Bhimashankar Sanctuary and
6. Karnala Sanctuary

These Western Ghats forests, because of their geographical location and rather stale geographical history, are well known for their rich endemic flora. (Subramaniyan, 1986).



## METHODOLOGY

First of all a list of the wild varieties of selected crop plants was prepared by referring to all of the available literature. Then it was confirmed by scrutinizing the herbarium specimens of different herbaria, BSI (Botanical Survey of India), W. Circle, (ARI) Agharkar Research Institute, Pune and ADS (Academy of Development Science) Kashele (Raigad). Later, tours were conducted during 1999 to 2000 to concerned reserves (National Park and Sanctuaries) of Upper W. Ghats for collecting specimens and field information of these species. During different tours in different seasons, ecological observations such as distribution, ecological habitat, population ecology i.e. aggregation, interdependencies among individuals and various factors like soil type and climatic conditions governing such processes, apparent status within reserve area, behaviour or response of species to the changing habitat, association and associated vegetation pattern, threats to the species and biological potentiality of species were made. Thereafter, these plants were processed properly for herbarium specimens.

1 For quantitative ecological studies, quadrat method was adopted. Quadrats of 1 x 1 m were placed randomly at different localities within reserve areas and at different sites like plateaus, hill slopes, near streams, water reservoirs, cultivated fields and grasslands. Then quantitative values for population characteristics like frequency, density and abundance were calculated by putting the values from tabulated data into the following formulae.

1. Frequency :

It is the number of sampling units ( as % ) in which a particular species occurs. It is calculated by following formula-

$$\text{Frequency (\%)} = \frac{\text{Total number of quadrats in which the species has occurred}}{\text{Total number of quadrats studied.}} \times 100$$

2 Density : It is number of individuals of the species in any unit area. It is calculated as follows

$$\text{Density (/ unit area)} = \frac{\text{Total number of individuals of the species}}{\text{Total number of quadrats studied.}}$$

3 Abundance : It is the number of individuals of any species per sampling unit of occurrence.

It is calculated by following formula

$$\text{Abundance} = \frac{\text{Total number of individuals of the species.}}{\text{Total number of quadrats in which the species has occurred.}}$$

In the survey report, all the families are arranged according to Bentham and Hooker's (1862 – 1883) system of classification But genera, species and infraspecific taxa are arranged alphabetically which seems more convenient to follow. Nomenclature of each species has been checked and updated. Citation of the correct name, basionyms and synonyms are given along with reference to original publications (wherever possible), district and state floras. After citation the parameters included are vernacular names (if available), distribution, description, flowering and fruiting period, ecological habitat, population structure, dispersion pattern and the associated vegetation pattern. Threats to the species, notes and several photographs have also been provided. Along with this, associated farming system and landrace diversity was also studied.

# I KALSUBAI HARISHCHANDRAGADH SANCTUARY

Established	:	1986,
Location	:	Tal. Akole, Dist. Ahmednagar,
Area	:	361.8 km <sup>2</sup> ,
Height	:	1654 m (Max.)
Avg. temperature	:	22 <sup>o</sup> C,
“ rainfall	:	635 mm,
“ humidity	:	Less than 60%,
Type of forest	:	Tropical semi-evergreen forest
Distance from Pune	:	222 km .

## Wild varieties of crop plants recorded within Sanctuary area

- 1 *Abelmoschus manihot* ssp. *tetraphyllus* var. *megaspermus*,
- 2 *Cajanus lineatus*,
- 3 *C. sericeus*,
- 4 *Canavalia cathartica*,
- 5 *Paracalyx scariosus*,
- 6 *Vigna dalzelliana*,
- 7 *V. khandalensis*,
- 8 *V. sublobata*,
- 9 *V. vexillata* var. *sepiaria*,
- 10 *V. vexillata* var. *vexillata*,
- 11 *Cucumis melo*,
- 12 *C. setosus*,
- 13 *Momordica dioica*,
- 14 *Trichisanthes tricuspidata*,
- 15 *Solanum anguivi*,
- 16 *S. giganteum* and
- 17 *Oryza rufipogon*.

## Associated farming system

Shifting cultivation : This is a slash and burn system, which follows a regeneration cycle. Several operations and rituals are involved including land selection, clearing and burning, worship and sacrifice, sowing, weeding, protection, harvesting, threshing and merry making. This type of traditional and primitive form of agriculture is adopted by native agrarian tribes like Mahadeokolis and Thakars. Most of the hill shops of sanctuary area are run by these tribes. They cultivate various crops on hill slopes by shifting cultivation. Hill slopes of this sanctuary at Ghatghar, Ratangad, Bari, Pachnai and Thakarwadi areas are under cultivation.

## Main crops and Native land race diversity

Mahadeokolis and Thakars cultivate land races of different crops especially of rice in their small land holdings. Rice is the main crop of this region. Some land race

varieties of rice are still available like Raibhog, Khadkya, Kolpi and Jini. Along with Rice other kharif crops are also under cultivation.

*Eleusine coracana* (L.) Gaertn. (Nagali), *Panicum sumatrense* Roth. ex Roem. (Wari), *P. millaere* Lamk (Sawa) and in oil seeds, *Guizotia abyssinica* Cass. (Khurasni).

Very few irrigated localities (Thakarwadi & Bari) have improved varieties of rabi crops like *Triticum vulgare* Vill (Wheat), *Cicer arietinum* L. (Gram) & *Dolichos lablab* L. (Wall)

### Irrigation system

For irrigation these agrarian tribes depend on natural water sources like monsoon rains during kharif season and rivulets, streams, and waterfall during rabi season. At Thakarwadi rabi crops are irrigated by rivulets.

***Abelmoschus manihot* (L.) Medik** Malv.46.1787. *Hibiscus manihot* L. Sp. Pl. 696.1753.

Borssum Waalkes (Blumea 14:97-99.1966) recognised two subspecies viz. ssp. *manihot* which includes all cultivated forms and ssp. *tetraphyllus* (Roxb. ex Horn.) Borss. which includes wild forms.

ssp. *tetraphyllus* (Roxb. ex Horn.) Borss. in Blumea 14:97.1966. *Hibiscus tetraphyllus* Roxb. ex Horn. Hort. Hafn. 661.1815; Cooke, Fl. Pres. Bombay 1:118. 1958 (Repr.).

### Key to the varieties

1. Epicalyx segments densely clothed with soft hairs; seeds reniform.  
----- *pungens*
2. Epicalyx segments hispid along margins with stiff hairs. Seeds almost globose.
  - i. Epicalyx caduceus, small, segments 4 - 6, ovate, lanceolate, distantly arranged, seeds 4-5mm across  
  
----- *megaspermus*
  - ii. Epicalyx persistent, segments 4, large, broadly ovate, overlapping; seeds ca 3mm across  
----- *tetraphyllus*

**1 var. *megaspermus*** Hemadri in Bull. Bot. Surv. India 11:338 (1971) 1972; Singh et Karthik, Fl. Maharashtra St. 1:293.2000 *Abelmoschus manihot* (L.) Medik. ssp. *tetraphyllus* (Roxb. ex Horn.) Borss. Pradhan et. Singh, Fl. Ahmednagar Dt. 113.1999.'Ran Bhendi'.

Herbarium specimen number : 35 & 41.

## **Distribution**

Bhandardhara dam, Thakarwadi, Kadgoop, Ratanwadi, Alanggad and Ratanwadi.

## **Description**

Annual, erect hairy herbs, 60-70 cm long; stem unbranched, sparsely haired, hairs stiff. Leaves 5-7 lobed or angled, scabrous, with short stiff hairs, margin dentate, 6.2-9.3 x 8.5-11.9cm; stipules lanceolate, stiff bristles on margins. Flowers axillary, solitary and subracemose towards branch endings. Epicalyx segments 4-6, small, caduceous and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple centre, petals 5. Capsules 5- angled, hispid, 3.5-4 x 2-3 cm. Seeds globose, concentrically striated, sparsely hairy and greenish brown in colour.

Fls. & Frts.: September – November.

## **Morphological Variations**

- i. Locality : Kumshet (Near Kadgoop); here the following variations were recorded- leaf shape was irregular(chordate) and they showed irregular lobing, irregular petal length, change in flower size and oozing of mucilage from fruits. Most probably these changes or deformities are due to pest attack or symptoms of some disease as, most of the individuals of this species were found affected by insect bites.
- ii. Locality : Bhandardhara dam; here two individuals were recorded having comparatively more height (78 cm), broader leaves and were densely haired. They were found growing on bund of dam reservoir especially along roadside on moist red soil partially exposed to sunlight. This variation is probably due to availability of favourable environmental conditions.

## **Ecological habitat**

Occasional along the roadsides, waste places and in grasslands. Most of the subpopulations were observed on partially exposed (sunlight) sites along roadsides, banks of water reservoir or streams having damp poor murumy (red) soil. Very few individuals were found growing amidst grasses with lateritic soil. This implies that the species loves partially exposed humid sites having poor, moist red or moist lateritic soil.

## **Population characteristics**

Considerable but small subpopulations were found within (comparatively large, 361.8 km<sup>2</sup>) reserve area i.e. intermediate population was observed. Population characteristics values like density (0.15 / m<sup>2</sup>) and frequency (11.32 %) support the assumption.

Dispersion pattern : Individuals were aggregated into patches with a few interspersed in between i.e. this population exhibits slightly clumped dispersion pattern.

## Associated vegetation pattern

Associated vegetation pattern recorded was of herbaceous type. Found along with *Urena lobata* var. *sinuata*, *Achyranthes aspera*, *Solanum anguivi*, *Triumfetta rhomboidea*, *Cucumis melo*, *Abutilon indicum*, *Solanum anguivi*, *Caesulia axillaris*, *Indigofera linifolia* and *Edipta prostrata*.

## Threats to genetic diversity

Pest attack : Almost all individuals at all localities were found severely affected by insect bites. Larvae of the insects especially of small black beetles feed on leaves, shoot apex and unopened flower buds. This causes chlorosis in leaves and deformities in petals and reproductive organs. As compared to neighbouring plants, this species is more susceptible to insect bites. Also, deformities in reproductive organs ultimately affect the natality rate.

**Note** : Though having densely glandular (pungent) hairy habit, the species was found to be quite susceptible to insect bites wherever it occurred.

**2 *Cajanus lineatus*** (Wight & Arn.) Van der Masen in Agri, Univ. Wageningen Papers 85(4):129, f.13 (1985) 1986; Pradhan et Singh, Fl. Ahmednagar Dt. 178.1999; Singh et Karthik. Fl. Maharashtra St. 1:613.2000. *Atylosia lineata* Wight & Arn. Prodr. 258.1834; Cooke, Fl. Pres. Bombay 1:408.1958 (Repr.) 'Rantur'.  
*Herbarium Specimen number.* : 9,12,25,26,29 & 31

## Distribution

Bhandardhara dam, Kalsubai, Terungen, Ratangad, Ghatghar, Alanggad, Harishchandragadh, Pachnal and Kadgoop.

## Description

Perennial, erect woody scandent shrubs or undershrubs; 0.75 to 2 m. in length; stem much branched, woody and glabrous at base while herbaceous and densely silky hairy at apex. Leaves 3-foliolate, petioles pubescent; stipules long, linear, acute, hairy when young, becoming nearly glabrous when mature, 3-nerved and conspicuous, 1.9-3.2 x 0.9-1.3 cm. Flowers axillary, solitary or in pairs in racemes, pedicels long, hairy, calyx short, hairy. Corolla yellow. Pods oblong, acute at both ends, depressed between seeds, brownish silky hairy, seeds 2-3 with conspicuously divided strophiole, brownish black.

Fls. & Frts. : February – April.

## Morphological Variations

Some remarkable morphological variations were recorded at the following localities:

Locality : Pachnai; here 2 individuals were recorded attaining height of ca 2.7m with stem girth 18 cm and 20 cm respectively which is approximately double the general range of height and girth found in other individuals of this species. This individual variation can be accounted for by the fact that the plants in question were protected from grazing and so greater height and stem girth may be due to interspecific competition to get more sunlight.

Locality : Harishchandragadh; here stunted growth (ht. Upto 70 cm) and comparatively small leafsize (1.7-2.7 x 0.5-1.2cm.) was recorded in 3 mature individuals growing on extremely dry, black ,rocky substratum.

Besides this, other morphological characters were similar to that mentioned in the general description.

### **Ecological habitat**

Common on plateaus, hill slopes and barren fields. Large profusely growing subpopulations were observed on top of the hillocks and extended plateaus (Harishchandragadh and Thakarwadi), whereas only few sparse subpopulations were recorded on barren fields along hill slopes which had been left to fallow. Few individuals were seen growing on extremely dry black rocky substratum where inter-specific competition is very less. Species strongly favours open (fully sunlight exposed) sites with dry red or lateritic soil at higher altitudes.

### **Population characteristics**

Considerable subpopulations were recorded and found in abundance wherever it occurred. Comparatively large population characteristics values of density (0.43 / m<sup>2</sup>), frequency (18.86%) and abundance (2.3) reveal the nature of population and its good extent of occurrence within the reserve area.

**Dispersion pattern :** Individuals were aggregated into patches with a small number of them interspersed in between. This means that populations of this species exhibit slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation recorded was of shrubby type and the species associated included *Solanum anguivi*, *S. gigantium*, *Clerodendron cerratum*, *Woodfordia floribunda*, *Carissa congesta*, *Lantana camara* var. *aculeata*, *Paracalyx scariosus*, *Euphorbia ligularia* and *Flemingia strobilifera*.

### **Threats to the genetic diversity**

i) Overgrazing: At most of the localities, herbaceous stem apex and branch endings were found grazed by cattle and wild herbivorous animals like rabbits and deer as their faecal matter was found in the areas occupied by the species. According to the natives this species is the favourite fodder of their cattle.

Forest fires: At a few localities, immature individuals were found affected by forest fires. Due to its dense glandular habit the species catches fire immediately.

Notes:

- i. The species is quite sturdy and is adapted to extremely dry and open habitats. It is usually found in association with the succulent species *Euphorbia ligularia*.
- ii. Two different ecads were recorded at Pachnai and Harishchandragadh

**3 *Cajanus sericeus*** (Ben.ex.Bak.) Van der Masen in Agri. Univ. Wageningen pap. 85(4):195, f.28, t.11, (1985) 1986; Singh, Fl. Ahmednagar Dt. 179.1999; Singh et Karthik, Maharashtra St. 1:614.2000. *Atylosia sericea* Benth.ex Baker in Hook f. Fl. Brit. India 2:213.1876; Cooke, Fl. Pres. Bombay 1:408.1958(Repr.) 'Turati'.  
*Herbarium specimen number* : 7 & 8.

### **Distribution**

Kalsubai and Bhandardhara.

### **Description**

Annual undershrubs; 0.75 to 1.75 m in length; stems much grooved, with silky hairs; scarcely branched, herbaceous and greenish white in colour. Leaves 3-foliolate, subdigitate; petioles long, pubescent; stipules long, filiform, pubescent. Leaflets 3, sessile, with dense silky pubescence, prominently 3-nerved from base, 1.8-4.6 x 0.40.6cm. Flowers axillary, solitary or paired without a common peduncle; pedicels short. Calyx, softly silky; teeth triangular, acute, as long as the tube. Corolla yellow, nearly glabrous, petals small. Pods linear – oblong, turgid, oblique at the apex, depressed between the seeds, densely silky. Seeds 2-3, subcylindric, compressed smooth with a divided strophiole, greenish brown.

Fls. & Frts. : October – November.

### **Morphological variations**

Certain variations were recorded at the following localities: Bari (Kalsubai), here growing along the hill slope of Kalsubai (Highest peak of Maharashtra, height 1654m) one individual was recorded attaining a height of 2.75m which is one meter more than the general range of height found in the individuals of this species.

Locality : Bhandardhara; here a few individuals were recorded having comparatively less height and smaller leaf size. They grew on stiff rocky bund of dam, very near to the minimum water level of reservoir i.e, here the species adapted itself to quite different habitat with moist rocky substratum at comparatively low altitude.

Besides these, other morphological characters were similar to that mentioned in general description.

### **Ecological habitat**

Few along the hill slopes and on barren fields. Found only at higher altitudes, especially on old barren fields (shifting cultivation) along hill slopes. Species favours partially sunlight exposed sites having medium (nutrient deficient) red or lateritic soil and with less competing plant species. The only exception of a different site was that with moist murummy soil or rocky substratum near water level of reservoir at Bhandardhara dam.



### Population Characteristics

Fragmented population was recorded as very few subpopulations(2) were seen within a considerably large area (361.8 km<sup>2</sup>). Density (0.07 / m<sup>2</sup>) and frequency (3.77 %) values of population also reveal its fragmented nature.

Dispersion Pattern : Individuals were found aggregated into dense patches at the previously mentioned localities i.e., population of this species exhibits extremely clumped dispersion pattern within the reserve area.

### Associated vegetation pattern

Associated vegetation recorded was of shrubby type. Found associated with *Crotalaria leptostachya*, *Crotalaria stocksii*, *Dalbergia malbarica*, *D. pinnata* var. *pinnata* and shrubby species like *Woodfordia floribunda*, *Lantana camara* var. *aculeata*, *Carissa congesta*, *Clerodendron serratum*, *Thespecia lampas*, *Solanum anguivi*, *Cajanus lineatus*.

### Threats to the genetic diversity

- i Shifting cultivation : This species is suffering due to various operations of shifting cultivation like cleaning and burning of herbaceous and shrubby species for nutrient supply (*Rap*) and dumping of earth (soil and stones) on hill slopes.
- ii Overgrazing : According to natives, this second species of *Cajanus* is also one of the favourite fodders of their cattle. Its herbaceous habit attracts the cattles. This region is famous for one local race of cow (Dangi), best suited to the environmental conditions (humid climate and hilly tracts) prevailing here.
- iii Loss of habitat : Clearing of land for shifting cultivation and illegal felling (deforestation) of trees causes destruction of its habitat.

**Note** : Rare, endemic to Western Peninsula, Lakshminarasimhan & Sharma, 1991, Pradhan & Singh, 1999.

**4 *Canavalia cathartica*** Thou. In Desv. J. Bot. 1:81.1813 ('*C catharticus*'); Singh et Karthik, Fl. Maharashtra St. 1:616.2000. *C. Stocksii* Dalz et Gibbs, Cooke, Fl. Pres. Bombay 1:397.1958 (Repr.) *C. africana* Dunn., Pradhan et Singh, Fl. Ahmednagar Dist. 179.1999. '*Abai*'.

*Herbarium specimen number*: 48 & 49.

### Distribution

Bari (Kalsubai), Ghatghar and near Randha fall.

### Description

Annual twiners; stems branched, very long, terete, smooth. Leaves large; petioles 8-9.5 cm long, stipules very small oblong, obtuse. Leaflets trifoliate, thin, the terminal rhomboid obovate 6-8x4-5.5cm the laterals broadly ovate, 5.5-6.5 x 3.5-4cm, reticulately veined; the 2-3 basal nerves opposite, conspicuous; petioles 0.4-0.6 cm long, hairy (brownish); stipules lanceolate, small. Flowers several, in axillary racemes, penduncle 28-30cm long; pedicels short; bracteoles elliptic oblong, veined, ca 1cm, covering the flowering buds. Calyx veined, glabrous; teeth shorter than the

tube, upper broad, notched, lower deltoid, ciliate. Corolla bluish purple, veined. Pods turgid, glabrous, 13-14 cm long; beaked; seeds 10-12, oblong, glabrous, brownish.

Fls. & Frts. : September – December.

### **Morphological variations**

Locality : Randha fall; here comparatively bigger leaflets and pods were recorded in an individual. Its range of leaflets size is 10-11 x 7-8 cm (middle lobe), 7-8 x 5.5-6cm (lateral lobes) and its pods are ca 16cm. long. Also, its flowers have lilac-coloured petals. This individual is probably an ecad of this species, however, its remaining morphological characters like hairiness, petiole and peduncle length, spread (growth habit), number of leaflets were similar to that mentioned in the description for respective subpopulations at different localities.

### **Ecological habitat**

Few on hill slopes and along roadsides. Individuals were seen growing (twining over the shrubs and small trees) along extreme slopes of rivulets or streams having much eroded red or murumy soil especially at protected sites, partially exposed to sunlight. The species favours protected sites along rivulets and ghats (short roads on hill slopes).

### **Population characteristics**

Fragmented populations were seen within the sanctuary. Individuals were found dispersed over distant localities within the large (361.8 km<sup>2</sup>) reserve area. Density (0.03/m<sup>2</sup>), frequency (3.77 %) and abundance (1) values of population reveal the same fragmented nature of this species.

Dispersion pattern: Individuals of this species were found randomly dispersed i.e. population exhibits random dispersion pattern within the area of study.

### **Associated vegetation pattern**

Found associated with shrubby species like *Carissa congesta*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Pongamia pinnata* and *Zizyphus mauritiana* and tree species like *Mangifera indica*, *Terminalia tomentosa*, *T. chebula* and *Ixora bracheata* i.e. associated vegetation pattern is of shrubby type.

### **Threats to the genetic diversity**

Exploitation of roots and bark: Roots and bark are used medicinally for killing intestinal worms by the natives, however, exploitation of roots causes extinction of individual from its genepool.

**Note:** i. Immature pods are bitter and poisonous, leading to insanity after eating.

ii. Apparently endemic and very rare plant. (Cooke, 1958); A rare plant (Pradhan et al., 1999 and Singh et al., 2000)

**5 *Paracalyx scariosus*** (Roxb.) Ali in Univ. Studies, Karachi 5(3) : 95.1968; Pradhan et al., Singh, Fl. Ahmednagar Dt. 202.1999; Singh et al., Karthik, Fl. Maharashtra St. 1:727.2000. *Cylista scariosa* Roxb. Pl. Cor. 1:64, t.92.1798; Cooke, Fl. Pres. Bombay 1:412.1958 (Repr.). 'Baraware'.  
*Herbarium specimen number.*: 27, 28 & 30.

### **Distribution**

Kalsubai, Harishchandragadh, Ghatghar, Randha, Ratangad, Alanggad, Terungan, Bhandardhara dam, Kadgoop and Kamshet.

### **Description**

Extensive twiners; stems and branches finely downy, grey pubescent, angular. Leaves trifoliolate; leaf rachis prolonged 8-10 mm between the insertion of the lateral leaflets and the stipules of the terminal one; petioles 5-5.5 cm long, downy; stipules small, triangular, acute, downy. Leaflets clothed with soft velvety pubescence above, densely downy and prominently reticulately veined beneath, base subcordate; the terminal rhomboid-ovate, 6.5 –13 x 4.5-7 cm, the laterals obliquely ovate, coriaceous 8-11 x 4.5-6 cm; petioles short, densely pubescent, stipules short, subulate; pubescent. Flowers in copious axillary peduncled racemes; pedicels very short, downy; bracts large, ovate, caduceous. Calyx 3.5 x 3cm., persistent; tube downy; lower lip broad, boat-shaped, conspicuously veined, creamy white. Corolla yellow, concealed in the (scarious) calyx. Pods small, oblique, downy, enclosed in calyx, pubescent, seed 1, black, reniform, tubercled.

Fls. & Frts. : November – April.

### **Morphological variations**

Locality : Randha fall, here very early flowering (November 18,2000) was recorded in one healthy individual growing along tar-roadside, having comparatively large leaflet size ( ca 6.5-14 x 4-7.5 cm in terminal or middle leaflet and ca 8–13 x 4.5-6 cm in lateral leaflets). Flowering period recorded in other individuals was January to April within this reserve area. This individual was probably an ecad of this species.

Besides this, remaining morphological characters like spread (growth habit), hairiness, leaf size, colour of the petals and sepals were similar to that mentioned in the general description for respective subpopulations.

### **Ecological habitat**

Common on hill slopes, hillocks and plateaus, especially at open shrubby vegetation sites. Individuals were found growing on much eroded red or murumy (weathered rock) dry soil twining over (spreading on top) the shrubs. The species strictly favours bright sunlight and spreading habit among shrubby vegetation only.

### **Population characteristics**

Intermediate population was recorded but the individuals were found in abundance wherever the species occurred. Population characteristics values of frequency (16.98%), density (0.18 / m<sup>2</sup>) and abundance (0.18) also reveal the same nature of population.

Dispersion pattern : Individuals were found aggregated into patches with very few individuals interspersed in between i.e., population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

According to ecological habitat of this species, associated vegetation is of shrubby type. Found strongly associated with *Carissa congesta*, *Lantana camara* var. *aculeata*, *Meyna laxiflora*, *Cajanus lineatus* and *Euphorbia nivulia*.

### Threats of the diversity

- i. Stem cutting : At almost all localities some dried up individuals were found. Tribal women cut down the wiry stem and mature branches for binding their bundles of firewood.
- ii. Exploitation of roots : Roots of this species are exploited by native tribes for its medicinal application. Fresh root juice is used as a remedy for stomach disorders. Species is suffering from these two threats.

**Note :** Very sturdy species quite resistant to pest attacks and other diseases.

**6 *Vigna dalzelliana*** (O. Ktze) Verdc. in Kew Bull 24:558.1970; Pradhan et. Singh , Fl. Ahmednagar Dt. 211.1999; Singh et Karthik, Fl. Maharashtra St. 1:761.2000. *Phaseohes dalzellianus* O. Ktze, Rev. Gen. Pl. 202.1891. *P. dalzelli* Cooke, Fl. Pres. Bombay 1:401.1958 (Repr. ed.) .  
*Herbarium specimen number* : 52.

### Distribution

Bhandardhara dam, Kalsubai, Warunghushi, Ghatghar, Kamshet and Ratanwadi.

### Description

Twining and trailing herbs; stems filiform, striate and nearly glabrous. Leaves 3-foliolate; petioles 6-8.5 cm, glabrous; stipules very short, attached above the base. Leaflets 2.5-4-6.5 x 3.5-4.5 cm, membranous, ovate to rhomboid – ovate with tendency to become lobate (the terminal largest, equal sided, laterals inequilateral, all acuminate at apex, sparsely hairy on both surfaces, green above, pale or ash coloured beneath; petioles very short; stipules minute, lanceolate. Flowers small, ca 0.8 cm long in capitate 2-3 flowered racemes; peduncles filiform, 6-7 cm long; pedicels short; bracteoles very small, linear subulate. Calyx short, glabrous or sparsely hairy. Corolla yellow, small. Pods ca 6 cm long, subcylindric, slightly recurved and beaked, quite glabrous. Seeds 8-10, subcylindric, truncate, smooth dark brown.

Flrs. & Frts. : August – October.

### Morphological variations

- i. Locality : All localities; varied leafshape and margin was observed at almost all localities. Ovoid-broadly ovate leaflets, entire to lobed leaflets (1-3 lobes) were seen in the same individual or different individuals of same or different subpopulations.
- ii. Locality : Bhandardhara dam; here a few individuals were recorded having comparatively bigger leaflets, bright green coloured lamina and dark violet coloured stem. They occupied a somewhat different kind of habitat along the dam reservoir i.e. fully sunlight exposed sites lying in between the maximum and minimum water level having brownish alluvial soil and big black stones of bund.

### Ecological habit

Common along the hill slopes amidst grasses. Individuals occupy open sites having red or lateritic soil with little moisture. It means that species favours humid sites with herbaceous vegetation. An exception of a subpopulation was recorded growing on banks of dam(Bhandardhara) reservoir .

### **Population characteristics**

Intermediate population was recorded within sanctuary area, however, found in abundance wherever it occurred. Quantitative values of population characteristics like density (0.11/ m<sup>2</sup>), frequency (9.43 %) and abundance (1.2) also indicate an intermediate structure.

Dispersion pattern: Individuals were aggregated into patches with a few interspersed in between i.e., population exhibits slightly clumped dispersion within reserve area.

### **Associated vegetation pattern**

From ecological habitat it is clear that species favours only herbaceous vegetation and so it was found associated with *Vigna sublobata*, *V. vexillata*, *Cajanus lineatus*, *C. sericeus*, *Paracalyx scariosus*, *Impatiens pulcherima*, *Lucas aspera*, *Indigofera linifolia*, *Caesulia axillaris* and *Eclipta prostrata*.

### **Threats to the diversity**

Individuals were found affected by overgrazing and forest fires but only upto limited extent.

**7 *V. khandalensis*** (Sant.) Raghwan et Wadhwa in Curr. Sci. 41:429.1972; Pradhan et Singh, Fl. Ahmednagar Ddt. 211.1999; Singh et Karthik, Fl. Maharashtra St. 1:761.2000. *Phaseolus khandalensis* Sant in Kew Bull. 1948:276.1948. *P. grandis*. Cooke, Fl. Pres. Bombay 1:400.1958 (Repr.ed.). 'Samara'.

### **Distribution**

Only at Bari (Kalsubai hill).

### **Description**

Erect, annual undershrub, 1.5m high; stem herbaceous, thick, angular, with sparse brownish hairs. Leaves trifoliolate; petioles Ca 7 cm long, stipules large, foliaceous sparsely hairy, attached above the base, obovate, obtuse, cordate at the base, Ca 1.8-3 x 1.2-1.9 cm long. Leaflets variable in shape 5-16.5 cm long, terminal often 3 lobed and as broad as long, laterals frequently 2-lobed with the lower lobe being smaller; with sparse brownish hairs on both sides. Stipules small, ovate. Flowers in condensed racemes; peduncles long upto 30 cm, with brownish hairs, angular; bracts broadly ovate, acute; bracteoles oblong, prominently veined, concealing the flower in bud stage. Calyx hairy, teeth deltoid, small. Corolla yellow, stamens 10; style bearded and stigma capitate. Pods 5x0.4 cm, sub cylindrical, with brownish hairs; seeds 8-10, brownish, subtruncate, with rusty pubescence.

Fls. & Frts. : October.

### **Morphological variations**

Only one individual was seen within reserve area. Morphological variations have not been recorded so far. However, dimensions of parts recorded in this individual are almost equal to the maximum dimensions of plant parts mentioned in earlier references (district, regional and state floras).

### **Ecological habitat**

Found at higher altitudes (1654 m) i.e., extreme slope of Kalsubai hill (highest peak of Maharashtra state). This lone individual was found growing on much eroded dry lateritic soil along bund (edge of the terrace upland) of fields on hill slope. This species may favour open sites with dry eroded soil or a dry murumy (weathered rock) substratum.

### **Population characteristics**

Extremely fragmented population since only one individual was recorded from the large (361.8 Km<sup>2</sup>) reserve area, also comparatively small quantitative values of population characteristics like density (0.01/m<sup>2</sup>), frequency (1.88%) and abundance (1) reveal a similar nature of population and rarity of this species.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Senecio grahami*, *Cucumis setosus*, *Woodfordia fruticosa* and shrubby species like *Ixora bracteata*, *Meyna laxiflora*, *Carissa congesta*, *Clerodendron serratum* and cultivated species *Eleusine coracana*.

### **Threats to the genetic diversity**

Shifting cultivation : This endemic plant species was declared as 'rare' by IUCN Red Data Book of Indian plants in 1992 and its phytogeographical distribution mentioned is restricted to higher ghats in the Sahyadri range and also a very scattered distribution in Ahmednagar, Pune and Satara districts of Maharashtra. However, Kalsubai is considered to be the highest peak of Sahyadri ranges situated in Ahmednagar district of Maharashtra.

One well growing individual was recorded at Bari (Kalsubai) on October 11, 1999 but during second visit (March 9, 1999) this individual was found destroyed by one operation (cleaning and expansion of land) of shifting cultivation.

Loss of habitat : During four visits to this locality it was observed that villagers (local tribe 'Mahadevkolis') residing at the foothills were slowly shifting upwards along hill slope in the search of new sites for cultivation and for protection of their new fields from wild animals. Thus, ecological habitat of this species was found affected by shifting cultivation, deforestation and severe overgrazing.

**Notes :** i This species was found very sturdy and resistant to pest attack and other diseases recorded in other wild species of genus *Vigna*.

ii According to Pradhan and Singh (1999) species is rare in the state where as Singh and Karthikeyan (2000) have mentioned status of the species as 'infrequent' but it was not observed to be so.

**8 *Vigna sublobata* (Roxb.)** Babu et Sharma in Bull. Bot. Surv. India 27:21.1987; Singh et Karthik, Fl. Maharashtra St. 1:763.2000. *Phaseolus sublobatus* Roxb. Fl. India 3:288.1832; Cooke, Fl. Pres. Bombay 1:402.1958 (Repr.) *Vigna radiata* (L.) Wilczek, Pradhan et Singh, Fl. Ahmednagar Dt. 212.1999. '*Halind*'.  
*Herbarium specimen No.:* 1,2 & 3.

### **Distribution**

Kalsubai, Harishchandragadh, Kamshet, Ratangad, Alanggad, Bhandardhara dam, Terungan, Kadgoop and near Lavalikottul.

## Description

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 12-13 cm long, pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8.5 x 5-7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers in condensed racemes with swollen nodes; peduncles 14-15 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 4-6 x 1.2 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – October.

## Morphological variations

Locality : Kalsubai, densely hairy (long hairs ca -0.7 cm) twining individuals (almost all) attaining height upto 1 m and with broad leaflets i.e. which indicates their robust growth were observed. These variations are probably due to favourable climatic conditions.

Locality : Here comparatively small leaflet size, (4.5-6 x 3.5-5 cm), short hairs and somewhat stunted prostrate growth habit was recorded in mature (flowering) individuals growing under the dense shade of shrubs (*Lantana camara* var. *aculeata* and *Meyna laxiflora*). These plants were growing at comparatively lower altitude having eroded blackish soil.

## Ecological habit

Common on hill slopes and a few on plateaus. Almost all subpopulations were recorded along stiff hill slopes. The species strictly prefers partially sunlight exposed sites having dry lateritic or red soil supporting herbaceous or shrubby vegetation.

## Population characteristics

Commonly occurring species, also found in abundance wherever it occurred. Quantitative characters like frequency (16.98 %), density (0.32 /m<sup>2</sup>) and abundance (1.88) also indicate the commonness of population.

Dispersion pattern : Population of this species exhibits slightly clumped dispersion pattern within reserve area.

## Associated vegetation pattern

Found associated with herbaceous species like *Vigna vexillata* var. *sepiaria*, *V. vexillata* var. *vexillata*, *Cajanus sericeus*, *Aerva javanica*, *Celosia argentic*, *Cucumis setosus*, *Senecio grahmi*, *Pinda kokenensis* *Casia auriculata* and shrubby species like *Carvia callosa*, *Nilgiranthes reticulatus*, *Lantana camara* var. *aculeata* and *Meyna laxiflora*.

## Threats to the diversity

The species was found affected by insect bites and forest fires but upto limited extent.

**Notes:** i Very closely allied to *Phaseolus radiatus*, the cultivated Mung, of which it may be the wild form (Cook, 1958).

ii The species was described as 'perennial herb' by Cooke (1958) and Pradhan et Singh (1999), but it was recorded having an annual lifespan (July – October) with flowering and fruiting period being 'September – October'. Contrarily, Singh et Karthik(2000) mention flowering and fruiting period as 'Almost through out the year' .

***Vigna vexillata*** (L.) A. Rich. in.Hist.Fis.Polit Nat. 1:11:191.1845; Pradhan et Singh, Fl. Ahmednagar Dist. 213.1999. *V. capensis* (L.)Walp; Cooke, Fl.Pres. Bombay 1:404.1958 (Repr.)

Key to the varieties,

1. Leaflets larger, ovate-rhomboid lanceolate:
  - i. Flowers pinkish to bluish-purple ..... *vexillata*
  - ii. Flowers, ovate ..... *sepiaria*
2. Leaflets smaller, ovate ..... *stocksii*

**9** var. ***sepiaria*** (Dalz.) Babu & Sharma in Bull.Bot.Surv. India 27:27.1987. *Phaseolus sepiarius* Dalx. in Hook.J. Bot.Kew Gard.Misc. 2:33.1850. '*Halind*'.  
*Herbarium specimen number*

### **Distribution**

Kalsubai hill, and Harishchandragadh.

### **Description**

Annual twiners; roots fusiform; stem herbaceous, pale green, sparsely hairy when mature. Leaves three-foliolate; petioles *ca* 3 cm long, clothed with reddish brown hairs; stipules *ca* 0.5 cm long densely hairy conspicuously nerved, lanceolate, acute. Leaflets 5-7 x 3-4 cm, 3-nerved from the base, ovate (the laterals unequal-sided and subtruncate at the base), sparsely clothed on both sides with short, appressed, reddish brown hairs; petioles very short, hairy. Flowers 2-3, crowded at the ends of axillary peduncles; pedicels very short. Calyx 10-12 cm long, pubescent, nerved; teeth longer than the tube, linear, acute. Corolla purple; standard broad upto 2 cm, auricled, veined; keel obliquely curved, beaked. Pods 8-10 cm long, subterete, straight, clothed when young with brown shiny hairs. Seeds 10-12, subreniform, compressed, brown.

Fls. Frts. : September – October.

### **Morphological variation**

Only 7 individuals were found within *ca* one km<sup>2</sup> area at Kalsubai and 11 individuals were recorded within *ca* 1 km<sup>2</sup> area at Harishchandragadh. Among these individuals remarkable variations were not recorded except for the shape of leaflets and a slight variation in leaflet size which is already mentioned in general description.

### **Ecological habit**

Very few along the stiff hill slope. Individuals were seen growing on much eroded lateritic soil under the shade of shrubs. This species strictly favours humid,



shady sites of higher altitudes with much eroded red soil. One can feel the formation of microclimate at almost all the sites of occurrence.

### Population characteristics

Very few individuals were recorded within comparatively large area (361.8 Km<sup>2</sup>) i.e., fragmented population was observed in this reserve. Population characteristics values of frequency (0.75 %), density (0.09 / m<sup>2</sup>) and abundance (20) also support the assumption made regarding population structure.

### Associated vegetation pattern

As this species is a twiner and favours dense shrubby vegetation, it is found associated with herbaceous species like *Senecio grahmi*, *Impatiens balsamina*, *I. Pulcherima*, *Canavalia cathartica*, *Rungia elegans* and some shrubby species like *Lantana camara* var. *aculeate*, *Carissa congesta*, *Nilgiranthus* sp., *Carvia callosa*, *Meyna laxiflora* and *Ixora rancheta*.

### Threats to the diversity

- i. Exploitation of roots : Fusiform roots are exploited for edible purpose. Tribal children like the sweet milky taste of starchy roots very much. The cause of concern is that exploitation rate is much more than the natality (birth) rate. A few individuals were found dug out during summer season i.e., monsoon season of year 1999. An interesting thing is that the tribal children (cowboys) can identify the dry, leafless wiry stems of this species very sharply.
- ii. Loss of habitat : Ecological habitat of this species was found disturbed due to anthropogenic activities like deforestation, shifting cultivation and development of new residential colonies along hill slopes (e.g. Kalsubai hill).

**Notes :** i. Cooke, 1958 has mentioned lifespan of this species as 'perennial twiner' but, annual (July-October) lifespan was recorded.

ii. The species is endemic to western ghats (Singh et. Karthik, 2000).

iii. Conservation measures taken : Conserved at NBPGR by *Ex-situ* conservation method (NBPGR – Annual report, 1998) but not mentioned specifically which variety is conserved.

**10** var. *vexillata* Singh et Karthik. Fl. Maharashtra St. 1:765.2000. 'Halunda'.  
*Herbarium specimen number* : 10.

### Distribution

Bhandardhara dam, Ghatghar, Kalsubai, Harishchandragadh, Ratnagad, Terungan and Lavali Kotul.

### Description

Annual, trailing or twining herbs; roots fusiform, stem herbaceous, sparsely hairy. Leaves three-foliolate; petioles 5.5 cm long, hairy stipules ca 0.5 cm long,

hairs brownish, nerved, lanceolate. Leaflets 5-10 x 3.5-5 cm, 3 nerved from the base, obovate to lanceolate (the laterals unequal sided) with brownish hairs on both sides, mucronate at apex; petioles very short with brownish hairs. Flowers fragrant, few, in capitate racemes; pedicels very short; calyx pubescent; teeth longer than the tube, linear, acute. Corolla purple; standard broad upto 3 cm, veined; keel obliquely curved, beaked. Stamens 9+1, enclosed in keel petal. Stigma capitate, sugary style bearded. Pods 10-14 cm long, seeds 12-15, brownish, subreniform, compressed.

Flrs. Frts. : September – October.

### **Morphological variations**

Remarkable variations in leaflet size and spread (growth habit) were found at following localities.

Locality : Bhandardhara, here one individual with comparatively larger spread (growth habit) occupying ca 2 m<sup>2</sup> top area and thicker stem was recorded. It twined over *Carissa congesta* growing on bund of the dam reservoir near the maximum water level. This variation is probably due to availability of favourable environmental conditions like sufficient water, sunlight exposure, humidity and protected site as found on top of stiff bund of dam.

Also irregular shape and size was found in a few individuals at different localities, especially development of comparatively smaller or bigger size in one or two leaflets was recorded.

### **Ecological habitat**

Intermediate on plateaus and along the hillocks. Like the var. *sepiaria* this species also favours shady sites in shrubby vegetation but not along the stiff hill slopes. Individuals were found on gray soil or black rocky substratum with scrubby vegetation and sufficient humidity. Also, an exception of two individuals was recorded growing on open wasteland site near the housing complex of natives (Pachnai plateau).

### **Population characteristics**

Considerable subpopulations were seen but the individuals were found growing sparsely (less aggregation) within the area occupied by subpopulations. Good frequency (16.69%) and intermediate abundance (1.11) values indicate an intermediate structure of population.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern with individuals aggregated into patches interspersed with a few individuals.

### **Associated vegetation pattern**

Associated vegetation pattern was of shrubby type. Found associated with herbaceous species like *Pinda kokenensis*, *V. vexillata* var. *sepiaria*, *Senecio grahami*, *Indigofeya linifolia*, *Caesulia axillaris*, *Crotalaria mysorensis* and shrubby species *Carissa congesta*, *Woodfordia fruticosa*, *Cajanus lineatus*, *Lantana camara* var. *aculeata*, *Crotalaria retusa*.

### **Threats to the diversity**

Exploitation of roots : Like the var. *Sepiaria* this plant too is facing the same threats. Its roots are extensively exploited for edible purpose by the natives.

**Notes :** i. More or less both varieties of *V. vexillata* are similar but difference can be seen in growth habit (spread), inflorescence and colour of the flowers. The var. *vexillata* has mostly a semi-erect or trailing habit and a few lilac-coloured flowers in capitate racemes whereas the var. *Sepiaria* predominantly shows a twining habit and has 2-3 bright purple-coloured flowers crowded at the end of inflorescence .

ii. 'Where it is, though not fragrant, called the Indian sweet pea', (T. Cook, 1958) but very fragrant flowers were recorded during the study.

**11 *Cucumis melo* L.** Sp. Pl. 1011.1753; Pradhan et. Singh, Fl. Ahmednagar Dt. 256.1999. *C. trigonus* Roxb, Cooke, Fl. Pres. Bombay 1:569.2.1958 (Repr. ed.). *C. callosus* (Rottl.) Cogn. Naik, Fl. Marathwada 1:401.1998. '*Chibadu*'.  
*Herbarium specimen number* : 5,6,43 & 45.

### **Distribution**

Ghatghar, Bhandardhara, Thakarwadi, Lavali Kotul, Ratanwadi and Kamshet.

### **Description**

Annual, scabrid, twining or trailing monoecious herbs. Stem slender, angled, rough with short, rigid hairs. Tendrils simple. Leaves suborbicular in outline, 5-7 x 4-7 cm, scabrid on both surfaces, cordate at the base, dentate, 5-7 lobed, lobes ovate to obovate; petioles slender, scabrid, 5-7 cm long. Male flowers solitary or in clusters. Calyx tube campanulate, hairy, teeth very short. Corolla yellow ca 1 cm; sparsely pubescent. Appendage of the connective very short. Female flowers : peduncles 2-3 cm long, densely hairy. Ovary hairy. Fruits subglobose or trigonous, 5x 3.5 cm, longitudinally variegated with 10 green stripes, deciduous glandular bristles, pale yellow when ripe. Seed many, whitish with bitter pulp.

Fls. & Frts. : Septembr – November.

### **Morphological variations**

Localities : Kamshet, Lavali Kotul and Bhandardhara; at all these localities individuals were found growing profusely and spreading over the shrubs and small trees, occupying more than 7 m<sup>2</sup> top area with comparatively thicker and much branched stems. Some trailing individuals were also recorded from wastelands near housing colonies of natives especially at Thakarwadi, Ghatghar and Ratanwadi. These trailing plants had less branched stems and fewer number of fruits.

### **Ecological habitat**

Occasional on wastelands, along wastelands and hedges of fields. Almost all individuals were found in exposed locations trailing or twining over the top of shrubs especially on wastelands and along roadsides. Species strictly favours bright sunlight exposure and less fertile compact moist soil.

### **Population characteristics**

Few subpopulations were found, mostly at restricted sites (waste places) within the large reserve area (361.8 km<sup>2</sup>). Frequency (7.54 %), density (0.07 /m<sup>2</sup>) and abundance (1) values of population indicate a sparse population structure.

Dispersion pattern : Individuals were found aggregated into patches at different localities interspersed with nearly no individuals i.e. this population exhibits extremely clumped dispersion.

### **Associated vegetation pattern**

Found along with herbaceous species like *Cassia auriculata*, *Abelmoschus manihot* ssp. *tetraphyllus* var. *megaspermus*, *Solena amplexicaulis*, *Alternanthera pungens*, *Croton bomdplandianus*, *Justicia micrantha* and shrubby species like *Lantana camara* var. *aculeata*, *Carissa congesta*, *Meyna laxiflora* and *Zizyphus glaberrima*.

### **Threats to the diversity**

The plant is not edible due to its scabrid habit and bitter 'fruits', and so it is free from all kinds of threats.

**Note:** Found well naturalized within forest area but doubtful about status of the species i.e. whether semidomesticated weedy crop relative or wild variety, because of its weedy appearance and occurrence on wastelands. According to regional floras and state flora status of the species is 'Weed'.

**12 C. setosus** Cogn. In DC. Monogr. 3: 491.1881; Lakshminarasimhan et Sharma, Fl. Nasik Dt. 226.1991; Naik, Fl. Marathwada 1:403.1998. 'Mekk'.  
*Herbarium specimen number: 46 & 47.*

### **Distribution**

Kalsubai, Bhandardhara, Thakarwadi, Ratanwadi and Pachnai.

### **Description**

Annual, trailing monoecious herbs; stem slender, hispid, weak, 2.5m long. Tendrils hirsute. Leaves broadly ovate, young leaves triangular or slightly trilobed, cordate at base 5-6.5 x 5-7.3 cm, denticulate, hispid on both surfaces. Male flowers fasciculate or subsolitary; peduncles filiform, 7-12 cm long. Calyx tube campanulate, villous hispid, small; teeth subulate, erect. Corolla yellow, lobes oblong, 0.3 cm. Filaments short, anthers ciliate; appendage of the connective small. Female flowers solitary on short peduncles. Ovary oblong, villous. Fruits oblong, 3-3.5 x 1.2 cm, sparsely long-setose, longitudinally variegated with 10 white stripes. Seeds numerous with sour pulp.

Flrs. & Frts. : August – October.

### **Morphological variations**

Locality : Kalsubai, here comparatively less spread (growth habit) was recorded in one individual growing on bund of field along stiff hill slope very near to *Vigna khandalensis*. This individual attained a trailing stem length of 1 m and showed less branching. However, at other localities like Bhandardhara and Ratanwadi nicely branched individuals attaining lengths upto 2-2.5m and area about 1 m<sup>2</sup> were found in dense herbaceous vegetation or grassland on plains and barren lands near the residential colonies of natives.

Variations in first individual (i.e., at Kalsubai) were probably environmentally induced as the individual grew on much eroded dry lateritic soil supporting sparse herbaceous vegetation i.e., different ecological habitat results in 'ecad' formation in this individual.

### **Ecological habitat**

Few in grassland, on plains and barren land. Almost all individuals were found growing in grasslands or herbaceous vegetation with partially shady humid sites i.e. species strictly favours humid shady sites with dense herbaceous vegetation and trailing spreading habit on dwarf herbs (height upto 50-60 cm).

### **Population characteristics**

Sparse population was observed within sanctuary area. Quantitative characteristics values of frequency(9.43%), density (0.07/m<sup>2</sup>) and abundance (0.08) also support the assumption made about the structure of the population.

Dispersion pattern : Individuals of this species were found randomly distributed within reserve area i.e. population exhibits random dispersion pattern.

### **Associated vegetation pattern**

As mentioned earlier, species favours only herbaceous vegetation and so it was found associated with *Celotia argenta*, *Cassia auriacata*, *Vigna sublobata*, *V. vexillata* var. *vexillata*, *V. dalzelliana*, *Senecio grahami*, *Clerodendron serratum*, *Solena amplexicaulis*, *Tribulus terrestris* and *Thespesia lampas*.

### **Threats to the genetic diversity**

Habitat fragmentation : Patchwork of habitat fragments was observed. Overgrazing, shifting cultivation, developmental activities like road construction, canals (Ghatghar Hydroelectric Project), forest fire, development of new residential colonies by shifting cultivators (Kalsubai hill), all these activities collectively result in habitat fragmentation.

### **Exploitation of fruits**

Small fruits are edible and consumed by natives for their sour taste.

**Note :** This species is endemic to Maharashtra (Naik, 1998).

**13 *Momordica dioica*** Roxb. ex. Willd., Sp. Pl. 4: 605.1805; Cooke, Fl. Pres. Bombay 1:563.1958 (Repr.); Pradhan et Singh, Fl. Ahmednagar Dt. 259.1999. '*Kartoli*'.

*Herbarium specimen number:* 11.

### **Distribution**

Ghatghar, Alanggad, Ratangad and Pachnai (Harishchandragadh).

### **Description**

Annual, dioecious twiners with tuberous roots; stem slender, branched, furrowed, glabrous and shining. Tendrils simple, striate, elongate, glabrous. Leaves broadly ovate in outline, cordate at base, 3-5 lobed, margins denticulate, 4-9.5 x 3.5-

8 cm; petioles 3-4 cm long, channeled above, pubescent, glandular. Male flowers : Peduncle solitary 1-flowered, 14-15 cm long, slender, angled, bract cucullate, orbicular-reniform, strongly nerved. Calyx lobes distant, 0.5-1 cm long, linear lanceolate. Corolla yellow 3-3.5 cm long. Female flowers : peduncles nearly equal to the male inflorescence, bracts small. Ovary clothed with long soft papillae. Fruits 7-8 x 2.5-3 cm, ovoid, shortly beaked, densely echinate with soft spines. Seeds many, broadly ovoid, irregularly corrugated, enclosed in red pulp.

Flrs. & Frts. : July – October.

### **Morphological variations**

Ghatghar : here late flowering (17<sup>th</sup> October) was recorded in only one well growing male individual whereas end of flowering period on other male individuals and mature fruits (fruiting period) in female plants at same and other localities.

Besides this, variation in leaf shape (roundish to broadly ovate) was found in a few individuals growing at different localities.

### **Ecological habitat**

Occasional on plains and along hill slopes. Almost all individuals were found twining over the top of shrubs at exposed places. The species strictly favours fully exposed (sunlight) sites i.e. bright sunlight, compact soil and sparse shrubby vegetation .

### **Population characteristics**

Few individuals were recorded at restricted sites i.e. sparse population was found within the large reserve area (361.8 km<sup>2</sup>). Comparatively small population characteristics values of frequency (5.66%) and density (0.09 / m<sup>2</sup>) indicate a similar structure of population.

Dispersion pattern : Individuals were found aggregated into patches interspersed with a few individuals i.e., population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

The species loves to grow among sparse shrubby vegetation and so it was found associated with *Carissa congesta*, *Lantana camara* var. *aculeate*, *Acacia chandra*, *Meyna laxiflora*, *Woodfordia floribunda*, *Solanum giganteous*, *Cajanus lineatus* , *Memecylon umbellatum* and *Gnidia glauca*.

### **Threats to the diversity**

- i Overexploitation of fruits and roots : Immature fruits are collected on a large scale to prepare delicious and nutritive fruit vegetable while tuberous roots are exploited for their medicinal value as a remedy for piles and fevers in children.
- ii Loss of habitat : To meet their need of fire wood, tribal women prefer wood of tall shrubs or small trees because it is easier for them to cut down the shrubs, however, clearing of shrubby vegetation for this purpose results in loss of the plant's habitat. In this manner one nicely developed subpopulation was found depleted from Ghatghar.

**Notes:** i. Pradhan et Singh (Fl. Ahmednagar DT. 1999) have mentioned status of this plant as 'frequent' but only intermediate and definitely not frequent population was recorded.

ii. Species have very nutritive fruits and so a nice biological potential exists.

iii. Originated in the tropics of old world and India is considered to be an important centre of genetic diversity for bitter gourd. (Sirohi, 1991).

**14 *Trichosanthes tricuspidata*** Laur., Fl. Cochinch. 2:589.1790; Lakshminarasimhan et Sharma, Fl. Nasik Dt. 231.1991; Pradhan et Singh 261.1999. *T. Palmata* Roxb., Cooke, Fl. Pres. Bombay 1:560.1958/ (Repr.). 'Dolephuti'.

*Herbarium specimen number* : 33,34,36 & 37.

### **Distribution**

Kadgoop, Ratangad, Kamshet and Ghatghar.

### **Description**

Perennial, huge twiners; stems robust, woody below, branched, grooved, older parts light gray with scabrous spots, the younger parts smooth, green. Tendrils long, pinkish-brown, trifid. Leaves 9-14 x 8-10 cm, variable, palmate, 3-5 circular glands scattered along lower side, glabrous, base cordate, margin more or less dentate; petioles 8- cm long, glabrous. Male flowers in axillary 5-10 flowered racemes 7-8 cm long; pedicel thick, short; bracts 2.5-3 cm long, pale green, many nerved, fringed; dotted with glandular spots. Calyx tube 5-6 cm long, pubescent, longitudinally striate. Corolla creamy white, petals wedge shaped, fringed exceeding the calyx tube, 6-7 cm long. Filaments slightly hairy. Female flowers axillary, solitary; peduncles 2 cm long. Fruit 3 cm in diameter, globose, red when ripe, pericarp thick, orange streaks inconspicuous. Seeds numerous, ellipsoid, smooth with greenish pulp.

Flrs. & Frts. : July – October.

### **Morphological variations**

Locality : Ratangad, here comparatively large leaf size, about 10-15.9 x 9-13.2 cm., was recorded in 3 robust individuals found growing on a huge Mango tree where as maximum leaf size mentioned in recent literature is 10.5 – 13.5 x 9-13 cm.

Locality : Ghatghar and Kamshet, at these places two mature (fruiting) individuals were seen growing on shrubs and small trees whereas most of the other individuals were found twining over the tall trees.

### **Ecological habitat**

Occasional along roadsides. Most of the individuals were found twining over the huge trees of climax community (tree canopy) in hilly tracts. Species favours shady, humid microclimatic conditions especially in climax community.

### **Population characteristics**

Few sparsely growing subpopulations were found within large (361.8 km<sup>2</sup>) reserve area. Comparatively small quantitative characteristics values of density (0.09 / m<sup>2</sup>) and abundance (1) indicate a sparse population structure.

Dispersion pattern : Individuals of this species were found randomly distributed within reserve area i.e. population exhibits random distribution pattern.

### **Associated vegetation pattern**

Species favours climax community i.e., canopy vegetation and so found associated with tall shrubby species like *Carissa congesta*, *Meyna laxiflora*, *Acacia chundra* and tree species like *Terminalia chebula*, *Memecylon umbelatum*, *Lagerstroemia parviflora* and *L. floxreginae*.

### Threats to the diversity

i Exploitation of fruits : Unripe fruits are used as a remedy in certain diseases of cattle and as an antidote for snake - bites in human being, whereas attractive scarlet red coloured ripe fruits are used for decoration of house by tribals.

**Note:** Climatic conditions and diverse tree canopy similar to the Bhimashankar sanctuary where status of this species is 'Common'.

**15 *Solanum aguivi* Lam. Tab.**, 2:23.1794; Lakshminarasimhan et Sharma, fl. Nasik Dt. 336.1991; Pradhan et Singh, Fl. Ahmednagar Dt. 389.1999. *S.indicum* auct.non L. 1753; Cooke, Fl. Pres. Bombay 2:336.1958 (Repr.) '*Katheringani*'.  
*Herbarium specimen number* : 4,42 & 50.

### Distribution

Kalsubai, Ghatghar, Harishchandragadh, Thakarwadi, Ratangad, Alanggad, Laval Kotul, Kadgoop and Randha fall.

### Description

Biennial undershrubs, 60-70 cm, very prickly; pricks large, with long compressed base, sharp; stem stout, woody at base while purple and herbaceous at apex; covered with whitish stellate hairs. Leaves 7-10x 3-6cm, ovate in outline, elliptic-oblong acute subentire or with a few larger triangular-ovate subacute lobes, sparsely prickly on nerves, clothed above with simple whitish hairs whereas covered below with small stellate hairs; leaf base cordate, often unequal sided; petioles 3-3.5 cm long, hairy. Flowers in extra- axillary racemose cymes; peduncles short; pedicels 1-1.3 cm long, hairy. Calyx hairy; teeth triangular, very small. Corolla 2 x 2.5 cm, pale-purple, clothed with purple hairs; lobes small, deltoid, acute. Anther lobe oblong, lanceolate bright yellow with apical pore. Ovary sparsely hairy. Style curved at the apex. Berries globose, 0.7-0.8 cm across, bright reddish yellow when ripe, glabrous. Seeds, spherical, minutely pitted, flat, numerous.

Fls. Drts. : August – October.

### Morphological variations

Locality : Ghatghar, Alanggad and Ratangad, at all these localities flowering or fruiting was not seen in a few individuals having much stout stem and height upto 50-65 cm whereas at other localities of occurrence flowering and fruiting was observed in individuals of similar height, in the month of October.

Exact reason for uncommon behaviour in previously mentioned individuals was not found but it may be due to immature stage i.e. age less than one year or due to photosensitivity of these individuals as they were found growing under dense shade of shrubs and trees.

### Ecological habitat

Occasional in wastelands and along roadsides. Individuals were found on open sites near housing complexes, temples, dam wall and along roadsides having



compact dry nutrient deficient red soil and less intraspecific competition. Also, a few individuals were seen growing on partially shady sites along roadsides. Species prefers open sites having dry, nutrient deficient soil.

### **Population characteristics**

Intermediate population was observed within sanctuary area. Quantitative values of population characteristics like frequency (13.20 %), density (0.10 / m<sup>2</sup>) and abundance (1.42) indicate the same.

Dispersion pattern : Population exhibits random dispersion pattern.

### **Associated vegetation pattern**

As species prefers wasteland sites as its ecological habitat, it was found associated with herbaceous species like *Abutilon indicum*, *Solanum indicum*, *Achyranthes aspera*, *Croton bomplandianus*, *Alternanthera pungens*, *Justicia micriantha* and a few shrubby species like *Calotropis procera* var. *hamiltonii*, *Woodfordia subfruticosa* and *Lantana camara* var. *aculeata*.

### **Threats to the genetic diversity**

Exploitation of fruits : Immature fruits are collected as fruit vegetable by natives but only upto limited extent.

**16 *S. giganteum* Jacq.** Collect. 4:125.1790; Cooke, Fl. Pres. Bombay 2:336.1958 (Repr.); Pradhan et Singh, Fl. Ahmednagar Dt. 390.1999. '*Chichurdi*'.  
*Herbarium specimen number* : 38 & 44.

### **Distribution**

Ghatghar, Harishchandragadh and Ratangadh.

### **Description**

Perennial much branched tall shrubs, 1.87 – 2.30 m. long, armed with broadly triangular prickles which are yellow towards the apex and usually tomentose at the base; young branches, inflorescence, and underside of leaves clothed with dense close white stellate tomentum. Leaves 9-17x5-9cm, oblong-lanceolate, acute entire, glabrous above when mature, base tapering into the petiole, often unequal-sided main nerves 10-12, conspicuous on upper cymes; peduncles stooping, 3 cm long; pedicels very short. Calyx hairy, teeth triangular and thick. Corolla bluish-purple, deeply divided, lobes lanceolate, hairy outside. Ovary glabrous; style glabrous. Berry Ca 1 cm across, red when ripe. Seeds many, small, flat, brownish and slightly muriculate.

Flrs & Frts. : Octobr – March.

### **Morphological variations**

Locality : Ghatghar, here one tall, profusely branched individual was recorded attaining a height of 2.30 m with its long woody branches extending upto 1m.

Also, all individuals were seen in flowering condition in the month of October and November (October 13, 99 and November 07, 2000) whereas T. Cooke, 1958, has mentioned flowering period 'January – March' from locality Harishchandragadh i.e. much early flowering period.

### **Ecological habitat**

Infrequent on plateaus and hill slopes. Almost all individuals were seen growing on compact lateritic soil or much eroded murumy red soil with black stones supporting dense shrubby vegetation with feeling of humid climate. Individuals were found covered (protected) with profusely growing shrubs. Species strictly favours shrubby vegetation as associated vegetation and microclimatic conditions.

### **Population characteristics**

Sparse population was recorded. Comparatively small population characteristics values of frequency (5.66%), density (0.05 / m<sup>2</sup>) and abundance (1) also indicate a similar structure (sparse) of population within reserve area. Dispersion pattern : Individuals were found aggregated into patches with almost no individuals interspersed in between i.e., population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found almost associated with shrubby species like *Carissa congesta*, *Lantana camara* var. *aculeata*, *Woodfordia fruticosa*, *Meyna laxiflora*, *Cajanus lineatus*, *Nilgiranthes reticulatus* and *Flemingia strobilifera*.

### **Threats to the genetic diversity**

Habitat fragmentation: Uncontrolled deforestation, socio-economic developments (Ghatghar Hydroelectric project, tourist spots, and road construction), shifting cultivation, overgrazing, forest fires and human disturbances, collectively all these activities control the formation of microclimatic conditions.

Exploitation of fruits: Unripe fruits collected as fruit vegetable on a large scale by native tribal communities (Mahadevkolis and Thakars). Also, this activity restricts the migration of individuals and over production.

**Note :** Found only at higher altitude and sensitive to its ecological habitat.

**17 *Oryza rufipogon*** Griff, Notul. 3:5.1851; Sharma and Shastri in Ind. J. Genet. Pt. Breed. 25 (2):157.1965; Bor et Taylor, Gras. India, Burm & Ceylon 605.1973 (Rper.); Duistermaat in Blumea 32:170.1987; Lakshminarashimhan, Fl. Maharashtra (Monocot) 545:1996; Naik, Fl. Marathwada 613.1998. '*Devbhat*'.  
*Herbarium specimen number* : 53 & 54.

### **Distribution**

Pimpalgaon moar.

### **Description**

Annual herbs upto 1.5 m. long; rooting at nodes. Stem herbaceous, submerged under water. Leaves 30-40 cm. long, ligulate, ligules lanceolate 1.3-2.1cm. Spikelets in panicles; spikelets caduceus, awns 8-11 cm long, reddish brown when immature, denticulate. Grains Ca 0.7 cm. long, ellipsoid – oblong, starchy, very similar to the grains of cultivated rice species.

Fls. & Frts. : October – December.

### **Morphological variations**

Much variation in length (height) of stem and awn of grain was observed i.e., many individuals of the same population were found with varying lengths from 0.80 to 1.5m as submerged in water and with 6-10 cm long mature spikelets.

### **Ecological habitat**

Only along water reservoir (backwaters of dam), comparatively at lower altitude especially on margin of sanctuary. All individuals were found submerged in water along maximum water level of reservoir and harboured in between maximum and minimum water level. The species strictly prefers submerged growth in the standing reservoir water i.e., rooted floating stage of hydrosere.

### **Population characteristics**

Found abundant but recorded at a single locality only. A patch (ca 1km) of profusely growing individuals was observed along water reservoir near the boundary of sanctuary area. Quantitative values of population characteristics recorded were :-frequency (3.77 % ), density (0.39 / m<sup>2</sup>) and abundance (10.5). Dispersion pattern : Population exhibits regular random dispersion pattern.

### **Associated vegetation pattern**

Found associated with marshy plants like *Phyla nodiflora*, *Ipomoea aquatica*, *I. eriocarpa*, *Chyranthes aspera*, *Asteracantha longifolia*, *Rungia elegans*, *Coix aquatica*, *Hygrophila polysperma*, *Rotala varticillaris*, *Caesulia axillaries* and *Limnophila heterophylla*.

### **Threats to the genetic diversity**

Habitat destruction : Habitat formation of this species is directly dependent on storage of water in reservoir as recorded along maximum water level. Water level decreases with supply of water from reservoir to irrigation channels causing destruction of habitat.

Cultivation : During rabi season, local people cultivate the banks (land between maximum and minimum water level). Nutrient- rich alluvial soil of this land is very conducive for the growth of rabi crops especially leafy and fruit vegetables. In this way decrease in water level during kharif season and cultivation practices (cleaning and burning of marshy plants) in rabi season cause habitat destruction and destruction of complete plant from its extent of occurrence.

**Notes** : i. Mentioned as 'weed' in previous references but doubtfully wild.

ii. Considered to be most closely related to the cultivated species *O. sativa*. Also, hybridizes freely with cultivated rice. (Bor ex Taylor, 1973.).

iii. Grains(spikelets) are collected by Katkaris(native tribal community) and cooked as food(rice).

**Table No.: 1 Quantitative studies of Kalsubai Harishchandragadh Sanctuary**

Name of the plant species		Number of quadrates studied																		
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19
1	<i>Abelmoschus manihot</i> ssp. <i>Tetraphyllus</i> var. <i>megaspermus</i>	-	-	1	-	-	-	-	2	-	1	1	-	-	-	1	-	-	-	-
2	<i>Cajanus lineatus</i>	2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3	-	1
3	<i>C. sericeus</i>	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	<i>Canavalia cathartica</i>	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
5	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
6	<i>Vigna dalzelliana</i>	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
7	<i>V. khandalensis</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	<i>V. sublobata</i>	-	2	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-
9	<i>V. vexillata</i> var. <i>sepiaria</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	1
11	<i>Cucumis melo</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
12	<i>C. setosus</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	<i>Momordica dioica</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
14	<i>Trichosanthes</i> <i>tricuspidata</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
15	<i>Solanum anguivi</i>	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
16	<i>S. giganteum</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
17	<i>Oryza rufipogon</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Name of the plant species	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37
1	<i>Abelmoschus manihot</i> ssp. <i>Tetraphyllus</i> var. <i>megaspermus</i>	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-
2	<i>Cajanus lineatus</i>	-	-	-	-	2	-	-	-	-	-	2	-	-	-	3	-	-	-
3	<i>C. sericeus</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	<i>Canavalia cathartica</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
5	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
6	<i>Vigna dalzelliana</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
7	<i>V. khandalensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	<i>V. sublobata</i>	2	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-
9	<i>V. vexillata</i> var. <i>sepiaria</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1
10	<i>V. vexillata</i> var. <i>vexillata</i>	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-
11	<i>Cucumis melo</i>	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	<i>C. setosus</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	<i>Momordica dioica</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
14	<i>Trichosanthes tricuspidata</i>	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-
15	<i>Solanum anguivi</i>	-	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	1	-
16	<i>S. giganteum</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
17	<i>Oryza rufipogon</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Name of the plant species	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q	I
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	06	08
2	<i>Cajanus lineatus</i>	-	-	-	-	3	2	-	3	-	-	-	-	-	-	-	-	10	23
3	<i>C. sericeus</i>	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	02	04
4	<i>Canavalia cathartica</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	02	02
5	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	04	06
6	<i>Vigna dalzelliana</i>	-	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	05	06
7	<i>V. khandalensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	01
8	<i>V. sublobata</i>	-	-	3	-	-	-	-	-	1	-	-	-	2	-	-	-	09	17
9	<i>V. vexillata</i> var. <i>sepiaria</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04	05
10	<i>V. vexillata</i> var. <i>vexillata</i>	-	1	-	-	-	-	-	-	-	1	-	-	-	1	-	-	09	10
11	<i>Cucumis melo</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	04	04
12	<i>C. setosus</i>	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	05	04
13	<i>Momordica dioica</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	03	05
14	<i>Trichosanthes</i> <i>tricuspidata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	05	05
15	<i>Solanum anguivi</i>	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	07	10
16	<i>S. giganteum</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	03	03
17	<i>Oryza rufipogon</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	8	02	21

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	11.32	0.15	1.3
<i>Cajanus lineatus</i>	18.86	0.43	2.3
<i>C. sericeus</i>	3.77	0.07	2
<i>Canavalia cathartica</i>	3.77	0.03	1
<i>Paracalyx scariosus</i>	16.98	0.18	1.11
<i>Vigna dalzelliana</i>	9.43	0.11	1.2
<i>V. khandalensis</i>	1.88	0.01	1
<i>V. sublobata</i>	16.98	0.32	1.88
<i>V. vexillata</i> var. <i>sepiaria</i>	0.75	0.09	1.20
<i>V. vexillata</i> var. <i>vexillata</i>	16.69	0.18	1.11
<i>Cucumis melo</i>	7.54	0.07	1
<i>Cucumis setosus</i>	9.43	0.07	0.8
<i>Momordica dioica</i>	5.66	0.09	1.66
<i>Trichosanthes tricuspidata</i>	9.43	0.09	1
<i>Solanum anguivi</i>	13.20	0.10	1.42
<i>S. giganteum</i>	5.66	0.05	1
<i>Oryza rufipogon</i>	3.77	0.39	10.5

## II NANDUR MADHMESHWAR SANCTUARY

Established	:	1986,
Location	:	Tal. Niphad, Dist. Nashik,
Area	:	100.1 km <sup>2</sup> ,
Avg. temperature	:	17°C,
“ rainfall	:	608 – 635 mm,
“ humidity	:	Less than 60%,
Type of forest	:	Scanty vegetation along riverbanks
Distance from Pune	:	162 km .

### Wild varieties of crop plants recorded within Sanctuary area

- 1 *Canavalia gladiata*,
- 2 *V. trilobata* var. *pusilla*,
- 3 *Vigna trilobata* var. *trilobata*,
- 4 *Cucumis melo* and
- 5 *Solanum virginianum*.

### Associated farming system

Commercial / modern agricultural practise: In modern agricultural system, the practise is to grow a few crops on large plots (farms) usually for commercial purpose. It is essentially a type of monocropping involving high inputs of fertilizers, insecticides, pesticides and irrigation water to get maximum possible yield. Usually improved cultivars and hybrid varieties are planted. By and large, areas under cultivation have cultivars with a narrow genetic base suited to specialized conditions of high inputs and this imposes high environmental risks. About 65.70% land of the sanctuary area is under cultivation where modern agricultural system is practised.

River Godavari passes through center of this reserve area. Nutrient rich soil of river bank and lift irrigation system (Installed at Madhmeshwar dam) support the farming in this region. Well flourishing farms are found at Kothule, Karanjaon and Manjargaon within reserve area.

### Main crops and Native land race diversity

Native farmers cultivate hybrid and improved varieties of different crops like *Saccharum officinarum* L. (Sugercane) and *Oryza sativa* L. (Paddy) during kharif season and *Triticum vulgare* (wheat), *Cicer arietinum* (Gram), *Glycine max* (Soyabean), *Dolichos lablab* (Wall) and other leafy and fruit vegetables during rabi season. Orchard vineyards are also found developed at some localities like Kothule, Karanjaon and Katargaon

Native land race diversity

Due to use of improved cultivars and hybrid varieties, land race varieties have got depleted from this region e.g. 'Anabeshahi' a well known land race variety of Grape is now not under cultivation at any of the localities of this region.



### **Irrigation system**

A bund is constructed on river Godavari at Khangaonhadi, and a shallow reservoir is developed as wetland Bird Sanctuary. Two (left and right) irrigation channels have been developed at reservoir to irrigate the adjoining area (cultivated land) while native land is irrigated by lift irrigation system.

1 ***Canavalia gladiata*** (Jacq.) DC. Prodr. 2:404.1825 Singh et Kathik, Fl. Maharashtra St.616.2000. *Dolichos gladiatus* Jacq.Coll.Bot 2:276.1788 non DC 1825. 'Pathadi'.

### **Distribution**

Katargaon

### **Description**

Twiners, stout, lignose. Stem and branches glabrous. Leaves 3.5-9.6x2.4-5 cm; stipules triangular, deciduous. Leaflets thin, ovate, glabrous, petioles short; stipules very short, caduceous. Flowers in axillary racemes. Calyx short, faintly pubescent, upper lip notched. Corolla pale lilac. Pods 10-12 cm long, turgid, slightly incurved, shortly pointed, glabrous. Seeds brown, 8-10.

Flrs. & Frts. : October – December.

### **Morphological variations**

Only 2 individuals were recorded and remarkable variations were not seen.

### **Ecological habitat**

Few on hedges along roadsides. Individuals were found twining over (spreading on top) the tall shrubs along roadside having poor grey coarse soil.

### **Population characteristics**

Only 2 individuals were recorded from comparatively large (100.1km<sup>2</sup>) reserve area i.e., species has fragmented population. Comparatively small quantitative characteristics values of frequency (10 %), density (0.1 / m<sup>2</sup>) and abundance (1) also indicate a similar structure of population.

Dispersion pattern: These 2 individuals were found growing at distant places but on the same side of the road.

### **Associated vegetation pattern**

Found twining over *Lantana camara* and *Pedilanthus tithymaloides*.

### **Threats to the genetic diversity**

Exploitation of pods :Unripe pods are sliced and cooked as vegetable.

**Note** : In previous references (regional and state floras) reported as twiners on hedges near villages.

***Vigna trilobata*** (L.) Verdc. In Taxon 17:172.1968; Lakshminarasimhan et Sharma, Fl. Nasik Dt. 186.1991; *Dolichos trilobus* L., Cooke, Fl. Pres. Bombay 1:401.1958 (Repr.)

Key to the varieties :

Wild plants; leaflets 3-lobed; lobes often broad near apex.  
Stipules large, foliaceous; lobes  
of leaflets obovate, obtuse or rounded; pods glabrous..... *trilobata*.

Stipules small, not foliaceous; lobes of leaflets  
spathulate-acute; pods appressed. Pubescent ..... *pusilla*.

**2 var. *pusilla*** Nai et Pokle in J. Econ. Tax. Bot. 7:670 (1985) 1986; Naik, Fl. Marathwada 1:315.1998; Singh et Karthik, Fl. Maharashtra St. 1:764.2000. 'Junglimuth'.

*Herbarium specimen number: 13,15 & 17.*

### **Distribution**

Khangaonthadi, Kothure, Bhendali, Manjargaon and Katargaon.

### **Description**

Annual prostrate herbs; branched stem with trailing length upto 1.75m, wiry, slender, sparsely hairy; stipules foliaceous, variable in length 0.7-1.3 cm, ovate-oblong, subacute, ciliate. Leaflets 2-2.7 x 1.8-2.4 cm, usually as broad as long, commonly 3 lobed (the middle lobe the largest and oblong, broadly spathulate, obtuse, the lateral lobes oblong or more or less spathulate), membranous, with sparse pinkish silky hairs; petioles very short, hairy. Flowers in axillary subcapitate few flowered racemes; peduncles 22-25 cm long, grooved, sparsely hairy; pedicels short; bracts ovate, deciduous; bracteoles linear-lanceolate, ciliate, deciduous. Calyx nerved, sparsely hairy. Corolla yellow; keel coiled. Stamens 9+1. Style hairy; stigma capitate. Pods sparsely hairy. Seed 6-8, brownish.

Fls. & Frts. : October – November.

### **Morphological variations**

Localities: Kothure and Manjargaon; here a few ecads (environmentally induced variations/ habitat forms) were recorded growing on moist red alluvial soil of barren fields (Galepere) along the banks of river Narmada. They had dusty brown coloured habit, conspicuously long rough hairs on leafmargins and comparatively short trailing length, about 30-50 cm i.e., stunted forms. These adaptations are probably due to habitat degradation by continuous cultivation practices like weeding and burning.

### **Ecological habitat**

Occasional along banks of river. Species strictly favours open sites having moist alluvial red soil, especially wastelands and barren fields along banks of river.

### **Population characteristics**

Intermediate population with considerable individual number was observed within sanctuary area. Frequency (20%) , density (0.7 / m<sup>2</sup>) and abundance (3.5) values of quantitative studies also reveal an intermediate structure of population.

Dispersion pattern: Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Vigna trilobata* var. *pusilla*, *Cucumis melo*, *Leucas aspera*, *Saccharum officinarum*, *Crotalaria sericea* and *Justicia micrantha*.

### **Threats to the genetic diversity**

Loss of habitat : Government of Maharashtra has given a tract of land along riverbanks locally called 'Galepere' (a substratum between maximum and minimum water levels of river basin) for cultivation. This galepere having moist, nutrient- rich red alluvial soil is available for cultivation during rabi season, however, cultivation practices on this land results in destruction of habitat and threatens this species.

Overgrazing : According to local farmers this species is the favourite fodder of their cattle. Cattle are attracted by its lush green habit i.e., shiny green leaves and herbaceous trailing stem.

**Note** : 'Common' in Nasik district (Lakshminarasimhan et Sharma, 1991) but recorded as 'occasional' in this region during the study.

**3 var. *trilobata***, Naik, Fl. Marathwada 1:315.1998; Singh et Karthik., 1:763.2000. 'Junglimuth'.

### **Distribution**

Khangaonthadi, Manjargaon, Kothure, Katargaon and near dam wall.

### **Description**

Annual trailing herbs; stem branched from woody rootstock with trailing length 20-35 cm, thin, wiry, slender, glabrous. Leaves 3-foliolate, petioles 1.2 – 1.5 cm long, grooved; stipules short, green, ovate-acute, hairy, veined. Leaflets 1-1.4 x 0.8 – 1.2 cm, deeply trilobed (the middle lobe spatulate, lateral lobes spatulate with subacute apex, hairy on both sides.), membranous; petioles very short, hairy. Flowers in axillary subcapitate racemes; peduncles 3-7.5 cm long, angled; pedicels very short; bracts small, deciduous. Calyx small, nerved. Corolla yellow, keel coiled. Stamens 9+!. Style bearded; stigma capitate. Pods small about 2-3.5 cm, turgid, sparsely hairy, beaked; seeds 4-5.

### **Morphological variations**

Locality : Khangaonthadi; here some 25 ecads (habitat forms) were recorded growing on extremely open hillock having dry limestone or dull white murumy soil. Profusely branched stem at woody rootstock, stunted growth (trailing length upto 20 cm) and comparatively small leaflet size (0.8 – 1cm) and pod size (upto 2 cm) was observed in these ecads. These adaptations are probably due to unfavourable or extreme habitat conditions.

### **Ecological habitat**

Occasional along bunds of fields and on wastelands. Almost all individuals were found growing on compact blakish soil of bunds or murumy or eroded grey soil of wastelands with sparse ground vegetation. Species prefers fully sunlight exposed sites having little intraspecific competition.

### **Population characteristics**

Intermediate population was observed. Population characteristics values of frequency (40%), density (0.8 / m<sup>2</sup>) and abundance (2) also reveal an intermediate structure of population within the reserve area.

Dispersion pattern : Individuals were found aggregated into patches interspersed with a few individuals i.e., population exhibits clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Vigna trilobata* var. *trilobata*, *Cucumis melo*, *Leucas aspera* and *Amaranthus polygamus*.

### **Threats to the genetic diversity**

At present the species is free from any kind of threats.

**Note** : i. very sturdy species coping well the extreme conditions like nutrient deficiency and drought.

ii. Species may have a good biological potential.

**4 *Cucumis melo* L.** Sp.Pl. 1011.1753; Lashminarsimhan et Sharma, Fl. Nasik Dt. 226.1991. *C. trigonus* Roxb., Cooke, Fl. Pres. Bombay 1:569.1958 (Repr.) *C. callosus* (Rotll.) Cogn. Naik, Fl. Marathwada 1:401.1998. '*Shendad*'.

### **Distribution**

Kothure, Manjargaon, Bhendali and Khangaonthadi.

### **Description**

Annual, scabrid, monoecious twiners or trailing herbs; stems slender, angled, rough with rigid hairs. Leaves suborbicular in outline, cordate, 5-7.8 x 4.5-7.5 cm; scabrid on both surfaces, hispid on nerves beneath, 4-5 angled, dentate margin; petioles slender, striate, scabrid. Male flowers : peduncles slender, axillary in small cluster. Calyx campanulate, hairy. Corolla yellow, pubescent. Female flowers : Peduncles slender, axillary, solitary, ovary hairy. Fruits ellipsoid or obovoid, yellowish green with 10 white longitudinal stripes, pale yellow when ripe with bitter pulp. Seeds white, numerous.

Fls. & Frts. : September – November.

### **Morphological variation**

Locality : Kothure; here two individuals were recorded growing on barren field of Galepere, very near to ecads of *V. trilobata* var. *trilobata* and with similar variations i.e. stunted growth (trailing length upto 1 m), dusty brown coloured habit, comparatively small leaflet size (4-6.1 x 3.7-5 cm) and less leaf number i.e., developmental stunted forms adapted to disturbed ecological habitat.

### **Ecological habitat**

Few in wastelands and on fencing of kitchen gardens. Species favours fully sunlight exposed sites and wastelands lying near housing complexes.

### **Population characteristics**

Sparse population was observed within the reserve area. Quantitative values viz. frequency (10 %), density (0.3 / m<sup>2</sup>) and abundance (1.5) of population also indicate a sparse structure of population.

Dispersion pattern: Individuals were found randomly distributed within the sanctuary area, therefore, population exhibits random dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Vigana trilobata* var. *trilobata*, *V. trilobata* var. *pusilla*, *Amaranthus polygamus*, *Alternanthera pungens* and shrubby species like *Lantana camara*, *Acacia nilotica* and *Pedilanthus tithymaloides*.

### **Threats to the genetic diversity**

At present this plant is free from any kind of threats.

**5 *Solanum virginianum*** L. Sp. Pl. 187.1753; Pradhan et Singh, Fl. Ahmednagar Dt. 391.1999. *S. surattense* Burm.f. , Lakshminarasimhan et Sharma, Fl. Nasik Dt. 337.1991. *S. xanthocarpum* Schrad. Et Wendl, Cooke, Fl. Pres. Bombay 2:335.1958 (Repr. ed.). '*Bhuiringani*'.

### **Distribution**

Beghar vasahat near Kothure.

### **Description**

Very prickly, diffuse, prostrate herbs, woody at the base; stem somewhat zigzag; much branched, the younger ones clothed with dense stellate hairs; prickles compressed, straight, yellow, glabrous and shining, exceeding 1 cm in length. Leaves 16-20 x 3.7-4.5 cm; laterate, attenuate at base, acute at apex, prickly and with stellate hairs; petioles 2-3 cm long, with stellate hairs and prickly. Flowers in extra-axillary, few flowerd (sometimes single flower) racemes; peduncles short; pedicels short, curved, hairy. Calyx 0.7-1.2 cm long, linear lanceolate, acute, hairy outside. Corolla pale violet, lobes deltoid, hairy outside. Filaments short, anthers lanceolate, opening by small apical pores, yellowish orange coloured. Ovary ovoid; style glabrous. Berries globose, glabrous, white with green veins, surrounded by enlarged calyx. Seeds numerous, compressed, spherical and minutely rugose.

Flrs. & Frts. : December – February.

### **Morphological variations**

Some remarkable characters were recorded in one quite mature individual, like much woody stem at the base, dark green leaves with milky white veins, leaves upto 20 cm long, prickles very shining and upto 1 cm long and considerable (ca 50 cm<sup>2</sup>) area was occupied by this individual. All these characters are much more prominent than that in other individuals of the same population or individuals found at Karnala Sanctuary.

### **Ecological habitat**

Few on bunds of fields (developed on barren plains nearby villages). Individuals were recorded on dry, eroded murumy soil of bunds which are fully exposed to sunlight.

### **Population characteristics**

Only 4 individuals were found on the boundary of reserve area, besides this, there is no occurrence of the species anywhere within the sanctuary area. Comparatively small quantitative values of density (0.1 / m<sup>2</sup>) and frequency (5%) indicate the fragmented structure of population.

Dispersion pattern : These 4 individuals were randomly distributed within the area (ca 5 m<sup>2</sup>) occupied by the population .

### **Associated vegetation pattern**

Found growing along with weedy plants viz. *Parthenium hysterophorus*, *Cynodon dactylon*, *Xanthium strumarium* and *Achyranthes aspera*.

### **Threats to the genetic diversity**

Weeding : As they grow on bunds of cultivated fields, they face the threat of uprooting and burning.

**Note :** In District and regional floras (Flora of Nasik, Raigad, Ahmednagar Dt. and Marathwada) ecological habitat is mentioned as 'along bunds and on waste places' and treated as a weedy plant.

Locality : Borimal; pale lilac coloured flowers were observed in one individual twining over the tall shrubs. This variation is probably environmentally induced i.e. due to individual being fully exposed to bright sunlight.

**Table No. 2 Quantitative studies of Nandur Madhmeshwar Sanctuary**

Name of the plant species		Number of quadrats studied											
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
1	<i>Canavalia gladiata</i>	-	-	-	-	-	-	-	-	-	-	-	-
2	<i>Vigna trilobata var. pusilla</i>	7	-	3	-	-	-	-	-	2	-	-	-
3	<i>V. trilobata var. trilobata</i>	-	2	-	1	3	-	-	-	-	-	2	1
4	<i>Cucumis melo</i>	-	-	-	-	-	-	1	-	-	-	-	-
5	<i>Solanum virginianum</i>	-	-	-	-	-	-	-	-	-	-	-	-

Continued ....

		Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q	I
1	<i>Canavalia gladiata</i>	-	-	-	-	-	1	1	-	02	02
2	<i>Vigna trilobata var. pusilla</i>	-	-	-	2	-	-	-	-	04	14
3	<i>V. trilobata var. trilobata</i>	2	-	2	-	3	-	-	-	08	16
4	<i>Cucumis melo</i>	-	2	-	-	-	-	-	-	02	03
5	<i>Solanum virginianum</i>	-	-	-	-	-	-	-	2	01	02

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Canavalia gladiata</i>	10	0.1	1
<i>Vigna trilobata var. pusilla</i>	20	0.7	3.5
<i>V. trilobata var. trilobata</i>	40	0.8	2
<i>Cucumis melo</i>	10	0.3	1.5
<i>Solanum virginianum</i>	5	0.1	2



### III SANJAY GANDHI NATIONAL PARK

Established	:	1980,
Location	:	Borivali, Dist.-Thane,
Area	:	104 km <sup>2</sup> ,
Height	:	30 m – 468 m.,
Avg. temperature	:	27° C (Max 35°C & min 15°C),
“ rainfall	:	2500 mm,
“ humidity	:	60% (80% in monsoon),
Type of forest	:	Southern tropical semievergreen forest,
Distance from Pune	:	182 km .

#### Wild Crop relatives recorded within National Park area.

- 1 *Abelmoschus manihot* ssp. *tetraphyllus* var. *megaspermus*,
- 2 *A. manihot* ssp. *tetraphyllus* var. *tetraphyllus*,
- 3 *A. manihot* ssp. *tetraphyllus* var. *pungens*,
- 4 *Cajanus scarabaeoides*,
- 5 *Canavalia africana*,
- 6 *Vigna dalzelliana*,
- 7 *V. sublobata*,
- 8 *V. vexillata* var. *vexillata*,
- 9 *Cucumis melo*,
- 10 *Luffa acutangula*
- 11 *Momordica dioica*,
- 12 *Solanum anguivi* and
- 13 *Sesamum mulayanum*

#### Associated farming system

##### *Subsistence agriculture*

Most of the National Park area is well preserved except for some land under cultivation at Patonapada and Saibangoda. Subsistence agricultural system is practiced at Patonapada. It is a traditional form of agriculture done in small landholdings (plots) often with mixed cropping of various crops required by the farmers for their own use. Most crops are of multipurpose type. Seed harvested is also used for the next sowing, which is the best source of landrace diversity adapted to local conditions of moisture, stress, disease / pest attack, etc.

##### **Main crops and native landrace diversity**

At Patonapada native tribal communities like Mahadeokolis and Warlis cultivate various crops in their small landholdings like, *Oryza Sativa* L. (Paddy), and *Panicum sumatrense* Roth. ex Roem. (Wari). Cultivation is practised during the kharif season only.

Orchard : Date palm, banana and guava are planted in orchards at Saibangoda.

Native land race diversity : Jiri, a well known land race variety of rice is still under cultivation in this region and also in some other parts of Thane district.

## **Irrigation system**

For irrigation, cultivators of Patonapada depend on natural water source like, monsoon rains during kharif season (land is under rain feed condition). Orchards at Saibangoda are irrigated by pumped water from the nearby water reservoir of Vihar lake.

**1 *Abelmoschus manihot* (L.) Medik ssp. *tetraphyllus* (Roxb. ex Horn.) Borss. var. *megaspermus* Hemadri. 'Ranbhendi'.**

## **Distribution**

Chunapada, Potonapada, Vihar Lake, near Tulas Lake, Meera and Chena beat.

## **Description**

Annual, erect hairy herbs, 40-70 cm; stem unbranched with sparse stiff hairs. Leaves 5.7-8.2 x 6-7.3 cm, lobed or angled, scabrous, with short stiff hairs, dentate margin 6.2-9.3 x 8.5-11.9; stipules lanceolate, stiff bristles on margins. Flowers axillary, solitary and subracemose towards branch endings. Epicalyx segments 4-6, small, caduceous and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple center, petals 5. Capsules 5- angled, hispid, 3.5-4 x 2-3 cm. Seeds globose, concentrically striate, sparsely hairy and greenish brown. Fruits 3-4 cm long.

Fls. & Frts.: September – November.

## **Morphological variations**

Locality : Vihar lake; two dwarf individuals were recorded on rocky bund of Vihar lake. These fruiting individuals were 40-55 cm high with comparatively smaller leaves about 5.7-7 x 6-6.3 cm. and had 3 cm long capsules and a comparatively sparse hairy habit.

Locality : Patonapada; Like in other reserves here also change in shape of leaves, flowers and fruits was recorded due to deformities resulting from pest attack.

## **Ecological habitat**

Occasional along bunds of reservoir and on plateaus. Most of the subpopulations were found near water reservoir especially on waste places which were fully exposed to the sunlight and had moist gravelly soil. Very few individuals were recorded on fine red soil partially exposed to the sunlight, amidst grasses on plateaus. Species prefers wastelands having a humid substratum

## **Population characteristics**

Few subpopulations with few number of individuals were recorded within comparatively large (104 km<sup>2</sup>) area. Quantitative values of population characteristics like frequency (11.11 %), density (0.14 / m<sup>2</sup>) and abundance (1.33) reveal a sparse population structure.

Dispersion pattern : Individuals were aggregated into patches interspersed with a few number of individuals i.e., population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation recorded was of sparse herbaceous type like *Tribulus terrestris*, *Heteropogon contortus*, *Celosia argentea*, *Justicia prostrata*, *Solanum anguivi* and *Cajanus scarabaeoides*.

### **Threats to the genetic diversity**

- i. Habitat degradation; individuals growing along water reservoir (of Vihar lake) were found affected by trampling activity and other regular human disturbances like encroachment by housing colonies within reserve area. For their everyday needs like bathing, clothing and cleaning of housewares, local people use the water of reservoir illegally. This continuous disturbance leads to habitat degradation and loss of the associated vegetation pattern. Some individuals were found affected by these disturbances.
- ii. Pest attack : Like in other reservoirs here also individuals were found affected by insect bites.

**Note :** Occurrence of species in a somewhat different climate (optimum temperature, humidity and rainfall i.e. typical coastal climate) than that in other reserves at higher altitudes with microclimatic conditions, indicates the degree of plasticity of species to withstand different climates.

**2 A. manihot** (L.) Medik. ssp. **tetraphyllus** (Roxb. ex Horn.) var. **pungens** (Roxb.) Hochr. in Candollea 2:87.1924; Almeida, Fl. Maharashtra 1:98.1996; Naik, Fl. Marathwada 1:32.1998. *Hibiscus pungens* Roxb. Fl. India 3:213.1832. 'Ran Benda'.

### **Distribution**

Chunapada only.

### **Description**

Erect tall undershrubs, 2-2.0 m; stem branched, nearly glabrous, slender, thick, shining greenish brown, branches sparsely bristly with scattered black dots. Leaves shining dark green, ovate-suborbicular, broad, hispid on lower side, 11-16 x 14-17 cm. long; stipules lanceolate, 1.5-2 cm long, often 3-lobed. Flowers axillary, solitary or in terminal racemes, peduncle long upto 20 cm, thick; pedicels 2.5 cm long, stout; bracteoles 2-3 cm long, hirsute. Calyx 4-5 cm long, 3-toothed at apex, hirsute. Corolla yellow with purple base, petals obovate, 4-8 cm long. Capsules ovoid-oblong, 5-6 cm long, beaked, densely bristly. Seeds reniform globose, dark brown with hairy concentric rings.

Flrs. & Frts. : September – December.

### **Morphological variations**

Locality : Chunapada; only variation in height 2-2.70 m was recorded. More variations were not found. The species was recorded growing at a single locality only.

In Maharashtra, this species is reported from two localities only:-Bombay (Fl. Maharashtra, 1996) and Nanded (Fl. Marathwada, 1998) by above authors, however, during documentation studies it was also recorded growing at Chunapada

within Sanjay Gandhi National Park, very near to the locality reported by Almeida i.e. Bombay (Mumbai).

### **Ecological habitat**

Few on gravelly soil along rivulet (Tulsi nala), under the dense shade of tall trees and especially near residential colony of natives (Chunapada) with semblance of somewhat microclimatic conditions.

### **Population characteristics**

Only 16 individuals were recorded in population (only at Chunapada) within comparatively large (104 km<sup>2</sup>) area i.e. fragmented population was seen. Comparatively small quantitative values of population characteristics like frequency (11.11 %), density (0.14 /m<sup>2</sup>) and abundance (1.33) also support the assumption made about structure (i.e., fragmented) of population.

Dispersion pattern : These 16 individuals were found compactly aggregated within ca 12 m<sup>2</sup> area forming a patch. Population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation pattern recorded was of tall herbaceous type. The species was found growing along with *Heteropogon contortus*, *Crotalaria retusa*, *Hibiscus vitifolius* and *Molachra capitata* under the shade of tree species like *Ixora nigricans* and *Pterocarpus marsupium*.

### **Threats to the genetic diversity**

- i. Exploitation of roots : According to one native, roots are beneficial in wound healing.
- ii. Habitat degradation : Chunapada is situated very near to the Tulasi nala for the need of water by natives. But the road approaching this village exactly passes through the population of this species, therefore, habitat of this species has become fragmented due to trampling activity. Trampling activity threatens the species by degrading its habitat.

**Note** : i. Rare, under the shade of trees in hill forests (Almeida, 1996 and Naik, 1998)

ii. Although having only sparse hairy habit it was found to be quite resistant to pest attack as compared with the other two wild varieties of *Abelmoschus manihot* ssp. *tetraphyllus*. The species may have a good biological potential.

**3 A. manihot** (L.) Medik. ssp. **tetraphyllus** (Roxb. ex Horn.) var. **tetraphyllus** Singh et Karthik, Fl. Maharashtra 1:291.2000 '*Bhurbhendi*'.

### **Description**

Kanheri road, Yaoor road, Ghodbunder, Sasunavaghar beat, Sai bangoda and Recreation and Botanical sector.

## **Description**

A large annual erect hairy plant, 1.5-1.75 m high; stems with small scattered prickles. Leaves 6-15 x 4-10 cm, scabrid with short stiff hairs, cordate, serrate, acutely angled, palmately 5-7 lobed; usually acuminate; petioles long upto 6-10 cm long, prickly. Stipules very short, linear lanceolate, bristly on margins. Pedicels 2-2.5 cm long, axillary, solitary, prickly. Epicalyx segments 4, large, persistent, broadly ovate, overlapping. Calyx softly villous, sepals connate at the tip. Corolla yellow with purple base. Capsules 4 cm long, ovoid, 5-angled, hispid, cuspidate. Seeds globose, faintly pubescent.

Flrs. & Frts. : October – December.

## **Morphological variations**

Locality : Sasunavaghar beat and Ghodbunder; at both these localities divided lobes was recorded in leaves. Lobes were further subdivided into small lanceolate parts in leaves of the same individual.

Locality : Ghodbunder and Saibangoda; here scarlet coloured spots were seen on leaves which were quite conspicuous and changed into brown colour in older leaves. These individuals were found along hillocks fully exposed to the sunlight. It is very difficult to conclude whether these are diseased or signs of some ecological variation in leaves.

Locality:Saibangoda and Sasunavaghar beat; here comparatively large, bright yellow coloured flowers and comparatively taller individuals (difference in height ca 25 cm) were observed than the individuals recorded along roadsides (Yaor road, Kanheri road). Individuals recorded at these localities were found on hillocks fully exposed to the sunlight where as the subpopulations at Yaor road and Kanheri road developed along roadside under the partial shade of tall trees.

## **Ecological habitat**

Common along roadsides and on small hillocks. Individuals growing along roadsides were found under the partial shade of tall trees whereas individuals recorded on hillocks were fully exposed to the sunlight and grew amidst shrubby vegetation. However from morphological variations (healthy individuals growing at Saibangoda and Sasunavaghar) it is clear that species prefers open sites having murumy red soil supporting sparse herbaceous and shrubby vegetation.

## **Population characteristics**

Considerable subpopulations with considerable number of individuals were recorded within sanctuary area. Comparatively large population characteristics values of frequency (11.11 %), density (0.25 m<sup>2</sup>) and abundance (2.33) also reveal its commonness and an intermediate population structure.

Dispersion pattern : Individuals were found aggregated into patches interspersed with a very few number of individuals i.e., population exhibits extremely clumped dispersion pattern.

## **Associated vegetation pattern**

Associated vegetation pattern recorded was of tall herbaceous and shrubby types. The species was found strongly associated with Malvaceae members viz. *Abutilon indicum*, *Malachra capitata*, *Hibiscus vitifolius* and *Urena lobata*. It also

grew along with *Sesamum mulayanum*, *Heteropogon contortus* and shrubby species like *Ixora bracheata* and *Zizyphus mauritiana*.

### **Threats to the genetic diversity**

Exploitation of roots : According to natives(Varalis), root extract called 'Vaidya' is beneficial in jaundice. But exploitation for this medicinal purpose is only upto limited extent.

**4 *Cajanus scarabaeoides*** (L.) du-Petit – Thours in Dcit. Sci.Nat.6:617.1817 ('Cajanus scarabaeoides'); van der Masen in Agric. Univ. Wageningen Papers 85(4):183, 189, f.27. (1985) 1986. *Dolichos scarabaeoides* L. Sp. Pl. 726.1753. *Atylosia scarabaeoides* (L.) Benth., Cooke, Fl. Pres. Bombay 1:409.1958(Repr.) 'Rantur'.  
*Herbarium specimen number* : 18 & 19.

### **Distribution**

Chunapada, Patonapada, Saibangoda and Sasunavaghar beat.

### **Description**

Annual herbaceous twiners; stem and branches slender, striate, clothed with pubescence. Leaves 3-foliolate; petioles long, clothed with brown pubescence; stipules small, triangular, acute. Leaflets small 2-5.4 x 1-2.7 cm, sub-coriaceous, elliptic to obovate, subacute, sparsely pubescent above, densely brown pubescent and reticulately veined beneath; petioles very short. Flowers pedicelled, solitary or few in axillary (densely pubescent peduncle) racemes; pedicels long, densely hairy. Calyx short, fulvous pubescent; teeth linear. Corolla brownish yellow. Pods, straight, apiculate, clothed with long soft brownish hairs, glandular, with deep obliquely transverse lines between the seeds. Seeds 4-6, ellipsoid, black, smooth.

Frs. & Frts. : September – December.

### **Morphological variations**

Locality : Patonapada and Sasunavaghar; at both these localities a few fruiting individuals were recorded growing along roadside amidst herbaceous vegetation having very less spread (growth habit) i.e. less branched stem whereas individuals (fruiting) recorded at Chundapada had good spread with much branched stems intermingling to form a fine network. This variation is probably because individuals growing at Patonapada did not have support (as twining over shrubs) and protection which could be seen in individuals at Chunapada.

### **Ecological habitat**

Occasional on plateaus and plains. Almost all subpopulations were found developing on compact, fine red soil partially or fully exposed to the sunlight and supporting a sparse herbaceous vegetation followed by shrubby vegetation cover resulting into formation of microclimate. Species prefers fine red soil and a cover of shrubby vegetation with microclimatic conditions.

### **Population characteristics**

Few subpopulations with a few number of individuals were found within large reserve area (104 km<sup>2</sup>). Quantitative characteristics values of population viz.

frequency (18.50 %), density (0.20 / m<sup>2</sup>) and abundance (1.6) also reveal an intermediate structure of population.

Dispersion pattern : Individuals were found aggregated into sparse patches interspersed with a few number of individuals, therefore, population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

From description of morphological variations it is clear that species prefers association with herbaceous followed by shrubby vegetation. Found associated with *Cassia glauca*, *Smithia conferta*, *Lavandula bipinnata*, *Senecio grahmi* and shrubby species like *Zizyphus glaberrima* and *Ixora bracheata*.

### **Threats to the genetic diversity**

- i. Habitat degradation : Uncontrolled interference by human beings can be seen within National Park area like encroachment of land on plateau for construction of farm houses (Yaor plateau), irresponsible firing of ground flora (Saibangoda), tourism (Kanheri caves), illegal cultivation practices (Patonapada), deforestation and development of different sets for film shooting at filmcity and surrounding area (Vihar lake). The human interference is very real (as very near to the metropolitan city of Mumbai) and a very careless preservation and maintenance effort by Department of forest is doing the harm. All these activities are responsible for degradation of habitat of this species which grows on plateaus and plains.
- ii. Exploitation of pods : Pods are edible and consumed by tribal (Varali) children but only upto limited extent.

**5 *Canavalia africana*** Dunn in Pipers & Dunn, Bull. Misc. inf. Kew 1922:135.1992; Pradhan et Singh, Fl. Ahmednagar Dt. 179.1999. Singh et Karthik, Fl. Maharashtra St. 615.2000. *C. ensiformis* (L.) Dc., Cooke, Fl. Pres. Bombay 1:397.1958 (Repr.) 'Aba'.

*Herbarium specimen number :*

### **Discription**

Kushi Beat, Tumanipada, Sasunavaghar and Ghodbunder.

### **Description**

stout perennial twiners; stems and branches glabrous. Leaves 3-foliolate, 9.7x3.2 - 6.4 cm; petioles 7-8 cm long, glabrous; stipules triangular, deciduous. Leaflets obovate – oblong, rounded at base, shortly acuminate at apex, glabrous on both surfaces; petioles very short; stipules very short, subulate, caduceus. Flowers in lax, axillary racemes; pedicels very short, usually in pairs. Corolla pale lilac and sometimes whitish. Pods 16-17 cm long, slightly incurved, glabrous. Seeds 8-10, 2-2.5 cm long, glabrous, oblong-elliptic.

Flrs. & Frts. : October – December.

### **Morphological variations**

- i. Locality : Kushi Beat; here one dense subpopulation was seen with almost all its individuals in flowering stage. These individuals had very prominent (broad) and bright liliac coloured flowers visible from ca 0.5 km whereas at other localities

pale lilac or whitish flowers were recorded on same and next day within reserve area.

- ii. Locality : Sasunavaghar and Ghodbunder; here a few large subpopulations having many individuals forming a belt (aggregated patch) amidst sparse shrubby vegetation was recorded along north-western boundry of the reserve. Individuals in these subpopulations were healthy and profusely growing with considerable number of flowers and pods whereas at other localities (Tumanipada -situated towards interior of reserve) very few individuals (3) were recorded .

### **Ecological habitat**

From morphological variations it is clear that species prefers sparse shrubby vegetation of relatively disturbed places (as occurs near Mumbai – Ahmedabad National Highway passing along north-western boundry of reserve area) as its ecological habitat and avoids dense tree canopy vegetaton or climax community developed towards interior of reserve. These disturbed boundry areas have poor whitish soil and also much eroded substratum at Ghodbunder.

### **Population characteristics**

Found in abundance wherever it occurred but recorded at a few localities only. Quantitative characteristics values of population viz. frequency (11.11 %), density (0.14/ m<sup>2</sup>) and abundance (1.12) reveal an intermediate structure of population within the reserve area.

Dispersion pattern : Individuals were found aggregated into dense patches with very few individuals interspersed in between i.e., population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation pattern recorded was of shrubby type like *Carissa congesta*, *Lantana camara var. aculeate*, *Acacia chundra* and *Maytenus emarginata*.

### **Threats to the genetic diversion**

Recorded at boundary areas i.e., near urban habitations (Meera and Dahiser), therefore, species faces very less threat of exploitation of pods (fruits) as vegetable and roots for medicinal purpose.

## **6 *Vigna dalzelliana* (O.tze.) Verdc. 'Halandi'.**

### **Distribution**

Kanheri hills, Patonapada, Saibangoda and Mulund beat.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex. densely hairy. Leaves trifoliolate; petioles 5.2-7.3 cm long pubesent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 4 - 6.2 x 3 – 4.2 cm (terminal larger and ovate to rhomboid ovate, the lateral ovate, acute, inequilateral with truncate base), all acute, silky hairy on both sides, conspicuously three nerved from the base; petiolules short, hairy; stipels linear. Flowers 1 cm, in condensed racemes with swollen nodes; peduncles 14-15 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous,



teeth deffoid. Carolla 1.5-2 cm long, yellow. Pods 7.2 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, ablong with truncate ends.

Fls. & Frts. : September – October.

### **Morphological variations**

i. Locality : Kanheri hills; here few individuals were seen growing on extremely rocky substratum very near to the base of rain fall under partial shade and with feeling of coolness (low temperature). These individuals had pale green but comparatively bright coloured (indication of healthiness) leaves and very bright yellow coloured flowers.

ii. Locality : Saibangoda; few suberect individuals with less spread (growth spread) were found on gravelly soil of bank of Vihar lake with much lobed leaflets.

Besides these variations, entire to lobed leaflets and ovate to obovate leaf shape was recorded at almost all the localities.

### **Ecological habitat**

Occasional on plateaus. Almost all subpopulations (3) were found on plateaus. Individuals grew amidst grassland and herbaceous vegetation having compact lateritic soil exposed fully to the sunlight.

### **Population characteristics**

Very few subpopulations (3) with sparsely growing individuals were recorded within comparatively very small (4.48 km<sup>2</sup>) reserve area. However, quantitative values of population characteristics like frequency (11.11 %), density (0.11 / m<sup>2</sup>) and abundance (1) reveal an intermediate structure of population

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Heteropogon contortus*, *Alysicarpus vaginalis*, *Vigna dalzelliana* and *Lavandula bipinnata*.

### **Threats to the genetic diversity**

Because of good management, preservation and protection efforts the species is free from any kind of threats which are found in other reserves.

**7 *Vigna sublobata*** (Roxb.) Babu et Sharma '*Halunda*'.

### **Distribution**

Kanheri hills, Patonapada, Saibangoda, Kashi, Yaor plateau and Mulund beat.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 7-9.7 cm long, pubescent; stipules 1.3-2 cm long, ovate, acute, ciliate, hairy; leaflets 5.3 –8

x 4 –6.7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers 1 cm, in condensed racemes with swollen nodes; peduncles 12-15 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 5-7 x 1.3 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – October.

### **Morphological variations**

Locality : Kanheri hills; here few individuals were seen twining over the shrubs attaining height upto the 70-80 cm with very broad leaves and very long shining brown hairy habit, whereas at other localities, most of the individuals were found along hill slopes amidst grasses with trailing habit. Twining growth habit adapted by habitat forms (ecads) of Kanheri hills near to the water fall for which road approaching to is passing through the area occupied by the subpopulation.

Also, at other localities variable shape of leaves from lanceolate to broadly ovate and acute to acuminate leaves were found in same or different individuals.

### **Ecological habitat**

Common on plateaus and along hill slopes. Species prefers open (sunlight exposed) hill slopes and plateaus having eroded red soil supporting herbaceous vegetation. An exception of individuals was recorded at Kanheri where they grew along roadside under the partial shade of canopy vegetation.

### **Population characteristics**

Found abundantly wherever it occurred but subpopulations were found at restricted sites only within the extent of occurrence, therefore, intermediate population was observed. Population characteristics values viz. frequency (14.81%), density (0.20 / m<sup>2</sup>) and abundance (1.70) also support the assumption and reveal the commonness of species within reserve area.

Dispersion pattern : Population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species viz. *Heteropogon contortus*, *Tribulus terrestris*, *Vigna vexillata*, *Desmodium laxiflorus* and *Alysicarpus vaginalis*.

### **Threats to the genetic diversity**

As found growing amidst grasses and herbs the plant faces threats from ground-fires and trampling activity due to increasing tourism and human interferences.

**Note** : Species recorded only at southern region of reserve whereas northern part of reserve is drifted by Vasai creek (estuary) and due to this a thick mangrove forest has developed in this part.

**8 *Vigna vexillata* (L.) Rich. var. *vexillata* Singh et Karthik. ' *Bhurmulī* .**

## **Distribution**

Saibangoda, Patonapada, Kanheri beat, Tulsi beat, Chunapada and Kashi beat.

## **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 12-13 cm long pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8.5 x 5-7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, silky hairy on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers in condensed racemes with swollen nodes; peduncles 14-15 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 4-6 x 1.2 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – October.

## **Morphological variations**

Locality : Saibangoda; here one subpopulation with its constituents trailing along bank of Vihar lake had each individual occupying less area than that occupied by twining and suberect individuals growing amongst shrubby vegetation at other localities.

Also, difference in colour of petals i.e., shades of liliac colour and variable number of pods from 1-4 at the end of peduncle was observed at all localities.

Occurrence of these ecads were recorded probably due to change in environmental conditions i.e. typical coastal climatic conditions (optimum rainfall, humidity and high temperature) that of favourable microclimatic conditions at higher altitude (Kalsubai–Harishchandragadh and Bhimashankar).

## **Ecological habitat**

Occasional along plateaus, on hill slopes and banks of reservoirs. Species favours compact red soil and gravelly soil exposed to the sunlight and supporting a sparse shrubby vegetation.

## **Population characteristics**

Few subpopulations with few number of individuals were recorded at most places. The individual number was small at almost all sampling sites. Population characteristics value of frequency (11.11 %), density (0.11/m<sup>2</sup>) and abundance (1) also reveal an intermediate structure of population.

Dispersion pattern : Subpopulations were found uniformly distributed over the extent of occurrence of species, however, individuals were aggregated into patches interspersed with a few number of individuals i.e., population exhibits slightly clumped dispersion pattern.

## **Associated vegetation pattern**

Found growing along with *Cajanus scarabaeoides*, *Tribulus terrestris*, *Solanum anguivi*, *Alysicarpus vaginalis*, *Despnodium laxiflorum* and shrubby species like *Ixora bracheata*, *Carissa congesta* and *Meyna laxiflora*.

### **Threats to the genetic diversity**

Exploitation of roots : Roots are exploited for edible purpose. This species is threatened by human activities in all the reserves where it occurs.

### **9 *Cucumis melo* L. 'Kharoti'**

#### **Distribution**

Mulund beat, Kanheri, Chunapada, Kashi beat and Patonapada.

#### **Description**

Annual, erect hairy herbs, 60-70cm. long; stem unbranched, sparsely hairy, hairs stiff. Leaves 3.5-7 x 5-8 cm, lobed or angled, scabrous, with short stiff hairs, dentate margin 6-8.7x 7.5-11, stipules lanceolate, stiff bristles on margins. Flowers axillary, solitary and subracemose towards branch endings. Epicalyx segments 4-6, small, caduceous and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple centre, petals 5. Capsules 5- angled, hispid, 3.5-4 x 2-3 cm. Seeds globose, concentrically striate, sparsely hairy and greenish brown, fruits ca 6 x 4 cm.

Fls. & Frts.: September – November.

#### **Morphological variations**

Locality : Chunapada and Kanheri caves; At Chunapada, individuals were found twining over the top of shrubs whereas at Kanheri a few individuals were seen scrambling up the rocky wall.

Locality : Mulund; here much green variegated fruits were seen i.e., immature fruits developed on profusely growing individuals whereas at other localities like Patonapada, Kashi beat, Kanheri and Chunapada ripe (yellow) fruits were recorded.

#### **Ecological habitat**

Occasional on waste places. All subpopulations were found growing on waste places lying near residential colonies, along roadsides and near rivulets. Species strongly favours very poor grey soil of disturbed places exposed to bright or partial sunlight .

#### **Population characteristics**

Found in abundance wherever it occurred but subpopulations were found at a few localities only ( since waste places are few in number due to dense climax community vegetation throughout the reserve area). So only a sparse population was recorded within reserve area. Population characteristics values of frequency (7.40 %), density (0.07 /m<sup>2</sup>) and abundance (1) also reveal a similar population structure. Dispersion pattern : Individuals were found aggregated into dense patches with a very few number of individuals interspersed in between i.e., population exhibits extremely clumped dispersion pattern.

#### **Associated vegetation pattern**

Found associated with *Achyranthes aspera*, *Croton bonplandianus*, *Alternanthera pungens* and *Justicia micrantha*.

### **Threats to the genetic diversity**

Overexploitation of fruits : Fruits are exploited on a large scale (gunny bags) by natives due to the special demand (from urban areas) of fruits for lightening of lamps and as a decorative item during Ganesh festival and Diwali. These seasonal fruits are sold in vegetable markets of Pune and Mumbai at high prices during the above festivals as a part of prey, according to Hindu traditions.

Species is threatened by this commercial exploitation.

### **10 *Luffa acutangula* (L.) Roxb. 'Kadu dodaka'.**

*Herbarium specimen number* : 32 & 40.

### **Distribution**

Chunapada and Patonapada.

### **Description**

Annual, erect hairy herbs, 60-70 cm. long; stem unbranched, sparsely hairy, hairs stiff. Leaves 3-5.5 x 3.7-8 cm., lobed or angled, scabrous, with short stiff hairs, dentate margin 6-8.7 x 7.5-11 cm., stipules lanceolate, stiff bristles on margins; Flowers 3-3.4 cm, axillary, solitary and subracemose towards branch endings. Fruits 8-9 x 4-4.4 cm. Epicalyx segments 4-6, small, caduceous and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple centre, petals 5. Capsules 5-angled, hispid, 3.5-4 x 2-3 cm. Seeds globose, concentrically striate, sparsely hairy and greenish brown.

Fls. & Frts.: August – October.

### **Morphological variations**

Locality : Chunapada; here comparatively bigger fruits were seen. Two extensive twiners were recorded at Chunapada having much bigger (9-10 x 5 cm) fruits than the fruit size (8-9 x 4-4.4 cm) recorded at Patonapada.

Locality : Chunapada; Also, both these individuals were found twining over the trees whereas profusely growing individuals forming a network over top of the shrubs was recorded at Patonapada along roadside. Species prefers spreading growth habit, especially over shrubs or tall herbs, but individuals were recorded at Patonapada along roadside. Species prefers spreading growth habit especially over shrubs or tall herbs but individuals recorded at Chunapada is only an exception which is probably due to absence of proper shrubby vegetation.

### **Ecological habitat**

Few on plateaus or plains. Individuals at Patonapada were found growing amidst shrubby vegetation with full exposure of sunlight and having eroded lateritic soil whereas individuals at Chunapada were recorded near residential colony of natives especially on trees.

### **Population characteristics**

Sparse population was seen within considerably large (104 km<sup>2</sup>) area. Only few- 7 (5 at Patonapada and 2 at Chunapada) were recorded and that too at two localities only. Comparatively small quantitative characteristics values of population viz. frequency (7.40 %), density (0.07 / m<sup>2</sup>) and abundance (1) also support the assumption.

Dispersion pattern : Individuals were found growing close to each other but distance between two subpopulations was great and therefore, population exhibits random dispersion pattern.

### **Associated vegetation pattern**

Found growing along with shrubby species viz. *Nilgiranthus reticulatus*, *Carissa congesta* and tree species like *Ficus amplissima* and *Oroxylum indicum*.

### **Threats to the genetic diversity**

Exploitation of fruits : According to one native (Varli), juice of immature fruits and seed powder is used as an antidote for snake bite but only upto limited extent.

**Note** : Besides exploitation of fruits, exact reason behind sparse population is not apparent.

## **11 *Momordica dioica* Roxb. ex Wild. 'Kantoli'.**

### **Distribution**

Patonapada, Gundgaon and Kushi.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves 6-10.3 x 6.7-9.7 cm, trifoliolate; petioles 12-13 cm long, pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8.5 x 5-7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers in condensed racemes with swollen nodes; peduncles 12-13 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 4-6 x 1.2 cm; linear, cylindric, densely clothed with reddish-brown silky hairs. Seeds 10-12, subquadrate, brown, oblong with truncate ends, fruits 7.3 x 4.1 cm.

Fls. & Frts. : September – October.

### **Morphological variations**

Locality : Gundgaon; here extensively growing male individuals with very broad (6-11 x 5-9 cm) leaves and bright yellow coloured flowers were recorded growing amidst shrubby vegetation. Only few individuals were recorded within reserve area therefore, no other variations were found.

### **Ecological habitat**

Occasional on plateaus and hillocks. Species loves to grow amidst sparsely shrubby vegetation fully exposed to sunlight. Individuals were protected by a cover of shrubs or small trees at almost all places which had a somewhat cool climate i.e., optimum humidity and moist compact eroded substratum or laterite soil.

### **Population characteristics**

Sparse population was recorded within reserve area, as only few subpopulations were found with 1-6 individuals. Comparatively small population characteristics values viz. frequency (7.40 %), density (0.07 / m<sup>2</sup>) and abundance (1) also support the assumption made regarding population structure.

Dispersion pattern : Subpopulations were found dispersed over distant places with or without aggregation of individuals i.e., subpopulations exhibit irregular slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found twining over the shrubs like *Ixora bracheata*, *Meyana laxiflora* and *Carissa congesta*.

### **Threats to the genetic diversity**

Commercial exploitation of fruits : Fruits are said to be very nutritive and good for health. Fruits are collected by natives to feed the demand from vegetable markets of Mumbai. Also, tribal women sell these fruits at the nearby railway stations of Mumbai and Thane districts, as an earning source during monsoon.

**Note** : Fruits of this species were seen on sale in the vegetable markets of different cities of Maharashtra viz. Kolhapur, Pune, Mumbai and Thane. All these localities are situated along Upper W. Ghats of Maharashtra.

## **12 *Solanum anguivi* L. 'Ringan?'**

### **Distribution**

Patonapada, Yaoor road, Chunapada, Kanheri, Saibangoda and Kashi.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy, height 90 cm, Leaves 3.4-11 x 2.9-7 cm, trifoliolate; petioles 12-13 cm long, pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8.5 x 5-7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers in condensed racemes with swollen nodes; peduncles 12-13 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 4-6 x 1.2 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, Seeds 10-12, subquadrate, brown, oblong with truncate ends, fruits 7.3 x 4.1 cm.

Fls. & Frts. : September – December.

### **Morphological variations**

Locality : Patonapada; here one subpopulation with an aggregation of 6 individuals was recorded growing under the dense shade of tall trees amidst the canopy vegetation. Now this is a protected site, an ecological habitat completely different from that occupied by the species in the other reserves. Though growing under shade and on much eroded substratum along dried stream (seasonal flowering monsoon), the individuals have willowy-grey woody stem attaining heights upto 60-

70 cm, considerable number of leaves and shining bright scarlet red berries i.e., healthy morphological habit.

### **Ecological habitat**

Occasional on plains, plateaus and hill slopes. Most of the individuals were found on waste places near residential colonies or roadsides and reservoirs having compact red or dusty white soil exposed to full or partially bright sunlight. Also an exception of a subpopulation was recorded at Patonapada where the individuals grew under dense shade of trees amidst canopy vegetation.

### **Population characteristics**

Intermediate population with considerable number of individuals was recorded within reserve area. Comparatively large population characteristics values of frequency (14.8 %), density (0.82 / m<sup>2</sup>) and abundance (1.5) also reveal the same population structure.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found growing along with herbaceous species like *Cajanus scarabaeoides*, *Indigofera linifolia*, *Haldina cordifolia* and under the shade of *Pongamia pinnata* and *Tectona grandis*.

### **Threats to the genetic diversity**

Fruits of this species are collected in other reserves as fruit vegetable but within this sanctuary such exploitation by natives was not recorded. According to natives, they have no need of such collection because all residential localities are connected by motarable roads and therefore, cultivated vegetatbles are available to them from nearby local markets whereas in other reserves (Kalsubai and Bhimashankar) most of the tribal villages are in remote areas. Therefore, species is free from such kinds of threats.

**13 *Sesamum mulayanum*** Nair. '*Rantil*'.

*Herbarium specimen number* : 39 & 51.

### **Distribution**

Kanheri road, near Saibangoda, Yaoor road, Patonapada, Chunapada, Kashi and Mulund Beat.

### **Description**

Annual prostrate herbs, 1 m long; stem and branches grooved, sparsely hairy with long soft white hairs. Leaves 2.9-6.9 x 2-5.1 cm, elliptic, variously clothed beneath with a white tomentum; petioles 2.5 cm long. Flowers axillary, solitary. Calyx deeply divided, hairy outside; segment linear, strongly ciliate. Corolla lilac with a yellow palate, long, tubular ventriose, minutely pubescent outside. Capsules 3.2-3.5 cm long, scabrous pilose, tetralocular, oblong, compressed, strongly mucronate at the apex. Seeds obovoid, oblong, rugose, black, numerous.

Flrs. & Frts.: September –October.

### **Morphological variations**

Locality : Saibangoda; here a few individuals were seen growing along the bank of Vihar lake. All these individuals grew at distant places from each other within area (ca 25 m<sup>2</sup>) occupied by this subpopulation i.e. absence of aggregation tendency.



However at other localities dense patches with significant number of individuals was recorded within comparatively small area.

### **Ecological habitat**

Occasional along roadsides and in open places. Species prefers open places along roadsides, exposed fully or partially to the sunlight and having moist red soil.

### **Population characteristics**

Sparse population was recorded within reserve area. Found abundant wherever it occurred but seen at restricted localities (roadsides) only. Population characteristics values of frequency (14.81 %), density (0.03 / m<sup>2</sup>) and abundance (3) indicate the aggregation tendency of species and a sparse population structure.

Dispersion pattern : Population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found strongly associated with *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*, *Abutilon indicum*, *Urena lobata*, *Hibiscus vitifolius* and *Cajanus scarabaeoides*.

### **Threats to the genetic diversity**

This species is found affected by anthropogenic activities like those described in threats to the genetic diversity of *Cajanus scarabaeoides*.

**Table No. 3 Quantitative studies of Sanjay Gandhi National Park**

Name of the plant species		Number of quadrats studied														
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-
2	<i>A. manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
3	<i>A. manihot</i> ssp. <i>tetraphyllus</i> var. <i>pungens</i>	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	<i>Cajanus scarabaeoides</i>	-	1	-	-	-	-	-	-	-	2	-	3	-	-	-
5	<i>Canavalia africana</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	<i>Vigna dalzelliana</i>	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-
7	<i>V. sublobata</i>	-	-	-	2	-	-	-	-	2	-	-	-	1	-	-
8	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-
9	<i>Cucumis melo</i>	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
10	<i>Luffa acutangula</i>	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
11	<i>Momordica dioica</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
12	<i>Solanum anguivi</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3
13	<i>Sesamum mulayanum</i>	-	-	-	-	-	-	8	-	-	-	1	-	-	-	-

Continued ...

	Name of the plant species	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q	I
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	1	-	-	-	-	-	-	-	-	-	-	-	03	04
2	<i>A. manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	3	-	2	-	-	-	-	-	-	-	-	-	03	07
3	<i>A. manihot</i> ssp. <i>tetraphyllus</i> var. <i>pungens</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
4	<i>Cajanus scarabaeoides</i>	-	-	-	-	-	2	-	-	-	-	-	-	05	08
5	<i>Canavalia africana</i>	-	-	-	-	-	-	-	2	1	-	-	1	03	04
6	<i>Vigna dalzelliana</i>	-	-	-	-	1	-	-	-	-	-	-	-	03	03
7	<i>V. sublobata</i>	-	-	-	-	2	-	-	-	-	-	-	-	04	07
8	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	-	-	1	-	-	-	-	-	-	03	03
9	<i>Cucumis melo</i>	-	-	-	-	-	-	-	-	-	-	1	-	02	02
10	<i>Luffa acutangula</i>	-	-	-	-	-	-	-	-	-	-	-	-	02	02
11	<i>Momordica dioica</i>	-	-	-	-	-	-	1	-	-	-	-	-	02	02
12	<i>Solanum anguivi</i>	-	-	-	-	-	-	1	-	-	-	1	-	04	06
13	<i>Sesamum malayanum</i>	-	-	1	2	-	-	-	-	-	-	-	-	04	12

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	11.11	0.14	1.33
<i>A. manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	11.11	0.25	2.33
<i>A. pungens</i>	3.70	0.07	2
<i>Cajanus scarabaeoides</i>	18.50	0.20	1.60
<i>Canavalia africana</i>	11.11	0.14	1.33
<i>Vigna dalzelliana</i>	11.11	0.11	1
<i>Vigna sublobata</i>	14.81	0.20	1.70
<i>V. vexillata</i> var. <i>vexillata</i>	11.11	0.11	1
<i>Cucumis melo</i>	7.40	0.07	1
<i>Luffa acutangula</i>	7.40	0.07	1
<i>Momordica dioica</i>	7.40	0.07	1
<i>Solanum anguivi</i>	14.81	0.22	1.5
<i>Sesamum mulayanum</i>	14.81	0.03	3

## IV PHANSAD SANCTURY

Established	:	1986,
Location	:	Tal. Murud, Dist. : Raigad,
Area	:	69.79km <sup>2</sup> ,
Avg. temperature	:	27 <sup>o</sup> C ,
“ rainfall	:	2208 mm – 2537 mm,
“ humidity	:	60-70 %,
Type of forest	:	Tropical moist deciduous forest
Distance from Pune	:	178 km .

### Wild varieties of crop plants recorded within Sanctuary area

- 1 *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*,
- 2 *Cajanus scarabaeoides*,
- 3 *Canavalia africana*,
- 4 *Paracalyx scariosus*,
- 5 *Vigna sublobata*,
- 6 *V. vexillata* var. *vexillata*,
- 7 *Trichosanthes cucumerina*,
- 8 *Solanum anguivi* and
- 9 *Sesamum mulayanum*

### Associated farming system

Home gardening : Home gardening is a component of ethnic agro-ecosystem. It is a traditional form of farming done in small plots very near to residential colonies or backyards of hutments, often involving mixed cropping of various crops (vegetables and fruit trees) required by the tribal family for their day to day needs. Seed harvested is also used for the next sowing. Some home gardens were found at remote localities like Supegaon and Vadghar, lying within sanctuary area.

**Main crops :** Native tribals cultivate different vegetables in their home gardens like *Solanum melongena* (Brinjal), *Capsicum sp.* (Chillies), *Dolichos lablab* (beans) and *Luffa acutangula* (Ridge gourd)

**Orchard:** One large mango orchard has been developed at Supegaon within sanctuary area by the Nawab of Janjira (local royal family) where the local land race varieties of mango are under plantation.

### Irrigation System

As these home gardens and the mango orchard are developed in remote areas, for the need of water they depend on monsoon rains i.e., area is under rain feed condition.

**1 *Abelmoschus manihot*** (L.) Medik. ssp. ***tetraphyllus*** (Roxb. ex Horn.) Borss. var. ***tetraphyllus*** Pradhan et Karthik. '*Ran bhendi*'.

### **Distribution**

Majagaon, Supegaon, Pimpalgaon, Velaste and Kashid

### **Description**

A large annual erect hairy plant, 1-1.25 m high; stems with small scattered prickles. Leaves 5.7 –11.3 x 4 –9.2 cm, scabrid, with short stiff hairs, cordate, serrate, acutely angled, palmately 5-7 lobed; usually acuminate; petioles long upto 6-10 cm, prickly. Stipules very short, linear lanceolate, bristly on margins. Pedicels 2-2.5 cm long, axillary, solitary, prickly. Epicalyx segments 4, large, persistent, broadly ovate, overlapping. Calyx softly villous, sepals connate at the tip. Corolla yellow with purple base. Capsules 3-4 x 2 cm long, ovoid, 5 -angled, hispid, cuspidate. Seeds globose, faintly pubescent.

Frs. & Frts. : October – December.

### **Morphological variations**

Locality :Pimpalgaon; here dense hairy habit was seen in a few individuals (one subpopulation) growing on waste place along roadside. Precisely, these individuals grew amidst grasses near a dried puddle, were rough and stinging to touch and one could feel irritation on touching the stem.

Locality : Majagaon; here,early maturity was recorded. One subpopulation of dried individuals (with fruits) was found exactly on next day (December, 13<sup>th</sup>) observing the green (live) subpopulations at other localities like Pimpalgaon and Velaste within reserve area. These tall dried individuals were found growing along dry stream ( flowing only in monsoon) on extremely dry, eroded murumy red soil along open hill slope. This variation is most probably due to habitat destruction leading to development of drought conditions.

### **Ecological habitat**

Common on waste places and along bunds of fields. Most of the individuals were found along roadside on open (sunlight exposed) sites having moist soil supporting grasses. Species prefers sites like waste places having moist soil.

### **Population characteristics**

Found abundantly wherever it occurred but only at waste places which were few in number i.e., intermediate population structure was recorded. Quantitative values of population characteristics like frequency (18.18%), density (0.31 / m<sup>2</sup> ) and abundance (1.75) also reveal a similar structure of population.

Dispersion pattern : Individuals were aggregated into patches with a very few number of individuals interspersed in between i.e., population exhibits slightly clumped dispersion.

### **Associated vegetation pattern**

As recorded from waste places and bunds, found associated with *Heteropogon contortus*, *Sesamum mulayanum* *Tribulus terrestris*, *Desmodium laxiflorum* and *Malachra capitata*.

### **Threats to the genetic diversity**

Nonpalatable by cattle due to its densely glandular and stinging hairy habit and also its fruits are nonedible. Due to these reasons the species is free from any kinds of threats.

- Note:** i. Found very sensitive to drought conditions.  
ii. Grows well in association with *Sesamum mulayanum*.

**2 *Cajanus scarabaeoides*** (L.) du-Petit – Thours in Dcit. Sci.Nat.6:617.1817 ('Cajanus scarabaeoides'); van der Masen in Agric. Univ. Wageningen Papers 85(4):183, 189, f.27. (1985) 1986. *Dolichos scarabaeoides* L. Sp. Pl. 726.1753. *Atylosia scarabaeoides* (L.) Benth., Cooke, Fl. Pres. Bombay 1:409.1958(Repr.) '*Rantur*'.

### **Distribution**

Chikhalachigan, Vadghar and Velaste.

### **Description**

Annual herbaceous twiners; stem and branches slender, striated, clothed with pubescence. Leaves 3-foliolate; petioles long, clothed with brown pubescence; stipules small, triangular, acute. Leaflets small, 1.6-3.5 x 0.8-2cm, sub-coriaceous, elliptic to obovate, subacute, sparsely pubescent above, densely brown pubescent and reticulately veined beneath; petioles very short. Flowers pedicelled, solitary or a few in axillary (densely pubescent peduncle) racemes; pedicels long, densely hairy. Calyx short, fulvous pubescent; teeth linear. Corolla brownish yellow. Pods straight, apiculate, clothed with long soft brownish hairs, glandular, with deep obliquely transverse lines between the seeds. Seeds 4-6, ellipsoid, black, smooth.

Flrs. & Frts. : September – December.

### **Morphological variations**

Locality : Chikhalachi gan; here stunted growth was observed in the individuals. These individuals had trailing stems only about 60 cm long, pale green leaves and very short petioles whereas at other localities dark green leaves on well spreading twining (high upto 1 m) and trailing individuals occupying area ca 75 cm<sup>2</sup> was observed.

Locality : Vadghar; late fruiting was observed in few individuals growing on plateau along roadside that of in other individuals shattering of fruits i.e. completion of fruiting period.

### **Ecological habitat**

Occasional on plateaus and hill slopes. Individuals grow on compact, red soil partially exposed to sunlight and supporting a sparse shrubby vegetation offering a somewhat microclimatic (humid) atmosphere. Species favours microclimatic habitat.

### **Population characteristics**

Only a small number of individuals in a few subpopulations were found within (68.79km<sup>2</sup>) reserve area i.e., species had a sparse population. Quantitative values of population characteristics viz. frequency (18.18%), density (0.18 / m<sup>2</sup>) and abundance (1) also reveal the same.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found along with *Heteropogon contortus*, *Desmodium laxiflorum* and *Teramnus labialis*.

### **Threats to the genetic diversity**

Like Karnala Sanctuary, this reserve (wildlife sanctuary) is also well preserved by Department of forest through fencing of the boundaries by angled wire to protect the reserve from grazing, illegal cutting, cultivation practices and to avoid disturbance by anthropogenic activities to flora and fauna.

## **3. *Canavalia africana* Dunn.**

### **Distribution**

Majagaon, Katkarwadi and Nandgaon.

### **Description**

stout perennial twiners; stems and branches glabrous. Leaves 3.6 – 7.9 x 3-4.7 cm; petioles 7-8 cm long, glabrous; stipules triangular, deciduous. Leaflets obovate – oblong, rounded at base, shortly acuminate at apex, glabrous on both surfaces; petioles very short; stipules very short, subulate, caduceus. Flowers in lax, axillary racemes, inflorescences rachis 11 cm, pedicels very short, usually in pairs. Corolla pale lilac and sometimes whitish. Pods 16-17 cm long, slightly incurved, glabrous. Seeds 2.1 - 2.3 cm long, 7-8, glabrous, oblong-elliptic.

Fls. & Frts. : October – December.

### **Morphological variations**

Locality : Katkarwadi; here two individuals growing on hedges along roadside at a less disturbed site had comparatively broader standard petals and nicely shining turgid pods indicating good health. These ecads probably developed due to environmental conditions (i.e. environmentally induced) or due to protected habitat.

Locality : Majagaon; considerable number of pods was observed in one individual. Number of pods in this individual was much more than that in the other individuals found within reserve area.

### **Ecological habitat**

Occasional along streams, rivulets and a few along roadsides. One well growing subpopulation (belt of 9 individuals) was found along rivulet. Species prefers sites along rivulet having gravelly or dirty white coarse soil partially exposed to sunlight.

### **Population characteristics**

Few subpopulations were found at restricted sites and so, a sparse population was recorded within reserve area. Population characteristics values viz. frequency (11.63 %), density (0.18 / m<sup>2</sup>) and abundance (1.33) also signify a similar population structure.

Dispersion pattern : Individuals were found aggregated wherever they occurred and without interspersions, therefore, population exhibits extremely clumped dispersion.



### **Associated vegetation pattern**

Found along with *Lantana camara* var. *aculeata*, *Carissa congesta* and *Ixora bracheata*.

### **Threats to the genetic diversity**

Exploitation of pods : Pods are collected by local people and sliced and cooked as vegetable but only upto limited extent.

## **4 *Paracalyx scariosus* Ali 'Ranghevada'.**

### **Distribution**

Supegaon, Vadghar, Chikhalachigan and Velaste.

### **Description**

Twiners; stems and branches downy, pubescent, angular. Leaves trifoliolate; petioles 6-7 cm long, nearly glabrous. Leaflets grey pubescent above, densely downy and prominently reticulately veined; the terminal lanceolate obovate, 6-8.9 x 3.3 – 4.7 cm, the laterals obliquely lanceolate to ovate, 4.5 – 7.8 x 3-3.6 cm, all acute; petioles very short, densely pubescent; stipules short, subulate; pubescent. Flowers in axillary peduncled racemes; peduncles 10 cm long, branched, bracts large, ovate, caduceous, boat-shaped, conspicuously veined, creamy white. Corolla yellow, concealed in calyx. Pods small, oblique, downy, enclosed in calyx, pubescent, seed 1, black, reniform.

Flts. & Frts : December – March.

### **Morphological variations**

Locality : Supegaon; here some remarkable and typical variations were recorded in certain individuals growing along roadside (far road passing through middle of the sanctuary) under the dense shade of tall trees. These individuals had less spread (growth habit), a sparse hairy habit; greenish stems, nearly glabrous, petioles were 6.4 cm long, nearly glabrous, thin. Leaflets were pubescent but not soft velvety with comparatively less conspicuous reticulate venation, the terminal leaflets were lanceolate-obovate, 4.5-6.5 x 3-3.3 cm, all acute. Flowers were in axillary peduncled racemes with branching from base, often with comparatively smaller flowers at the branch endings. As opposed to this, in the other reserves the plant showed good spread, a densely pubescent habit having soft velvety pubescence, broad leaflets with prominent reticulate venation and a rhomboid ovate shape. Also, flowers were long upto 3 cm (calyx length), in copious axillary racemes with long (17 cm) and rarely branched peduncles.

These variations are probably environmentally induced. Phansad is the only sanctuary of Maharashtra situated along west coast very near (Ca 8 km) to the sea shore. So, the typical coastal climate (optimum temperature and humidity) and much eroded red soil substratum may be responsible for the occurrence of habitat forms within sanctuary area.

### **Ecological habitat**

Few on plateaus and hill slopes, especially amidst sparse shrubby vegetation. Individuals grew twining over the shrubs to get more sunlight and on much eroded

top soil (dusty white colour) in a very hot and humid climate. Species favours bright sunlight and humid atmosphere. However, an exception of 2 individuals was seen growing under the shade of trees at Supegaon.

### **Population characteristics**

Intermediate population was found within sanctuary area. Population characteristics values of density (0.22 / m<sup>2</sup>), frequency (13.63%) and abundance (1.66) also support the assumption made about the structure of population.

Dispersion pattern : Individuals were found aggregated into patches wherever they occurred with a few number of individuals interspersed in between i.e., population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with shrubby species viz. *Carissa congesta*, *Memeculon umbellatum*, *Careya arborea* and *Wagatea spicata*.

### **Threats to the genetic diversity**

Exploitation of roots : Roots are exploited by natives for its medicinal value, said to be beneficial in fevers and stomach disorders.

**Note** : i. This species has a high degree of plasticity, as it was found growing at higher altitudes (Kalsubai and Harishchandragadh) in semi evergreen forest conditions and also at a comparatively lower altitude (very near to sea shore) in moist deciduous forest. However, predicting the ecological status of the morphologically variable individuals, whether ecads or ecotypes of the species, needs further ecological and genetical study.

ii. here, a few individuals were seen affected by pest attack. The insects fed especially on leaves. Contrarily, the individuals recorded at other reserves were found very resistant to pest attacks.

## **5 *Vigna sublobata* (Roxb.) Babu et Sharma.**

### **Distribution**

Majagaon, Supegaon, Velaste, Katkarwadi and Surve.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 6.3-10.3 cm long, pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8.3 x 4.7-7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers 1 cm, in condensed racemes with swollen nodes; peduncles 10-12 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 4-6 x 1 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – October.

### **Morphological variation**

i. Locality : Majagaon; here a few individuals were seen growing in association with *A. manihot* ssp. *tetraphyllus* var. *tetraphyllus* i.e. twining over the tall stem of *Abelmoschus* sp. These individuals were found sparsely growing within area occupied by the subpopulation. This is probably due to interspecific competition among *Abelmoschus* sp., *Sesamum* sp. and *Vigna* sp. or a somewhat unsuitable habitat i.e., very eroded substratum near the streams and fields of rice or may be due to difference in associated vegetation pattern.

ii. Locality : Supegaon; few suberect individuals were recorded growing along roadside with comparatively short petioles (6.3 – 8.4 cm.) and peduncles (10-10.9 cm). These habitat forms (ecads) developed due to trampling activity.

### **Ecological habitat**

Occasional along hill slopes and plateaus. Species loves to grow amidst grasses at exposed sites.

### **Population characteristics**

Considerable number of individuals were found but at restricted sites only. This suggests an intermediate population structure within the reserve area. Population characteristics values of frequency (36.36 %), density (0.36 / m<sup>2</sup>) and abundance (1) also support the assumption made about structure of population.

Dispersion Pattern : Individuals were found aggregated into patches interspersed with a very few number of individuals i.e., population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation recorded was of herbaceous type like *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*, *Sesamum mulayanum*, *Indigofera linifolia* and *Celosia argentia*.

### **Threats to the genetic diversity**

Exploitation of pods: pods are exploited by natives for edible purpose but only upto limited extent.

Besides this, the species is free from other threats.

**6 *Vigna vexillata* (L.) A. Rich. var. *vexillata* Singh et Karthik.**

### **Distribution**

Chikhalachigan, Majagaon, Velaste and Vadghar.

### **Description**

Annual twiners; roots fusiform; stem herbaceous, pale green, sparsely hairy when mature. Leaves three-foliolate; petioles ca 6.3 cm long, clothed with reddish brown hairs; stipules ca 0.5 cm long densely hairy, conspicuously nerved, lanceolate, acute. Leaflets 5-8.4 x 3-4.2 cm, 3- nerved from the base, ovate (the laterals unequal sided and subtruncate at the base), sparsely clothed on both sides with short appressed reddish brown hairs; petioles very short, hairy. Flowers 2-3, crowded at the ends of axillary peduncles; pedicels very short. Calyx 10-12 cm long,

pubescent, nerved; teeth longer than the tube, linear, acute. Corolla purple; standard broad upto 2.8 cm, auricled, veined; keel obliquely curved, beaked. Pods 13 cm long, subterreter, straight, clothed when young with brown shining hairs. Seeds 12-13, subreniform, compressed, brown.

Fls. Frts. : September – October.

### **Morphological variations**

Locality : Vadghar ; one nicely spread (growth habit) individual with bright liliac coloured flowers was recorded twining over a tall shrub along slope of hillock especially with feeling of microclimatic conditions.

### **Ecological habitat**

Few on hill slopes. Subpopulations were found amidst sparse shrubby vegetation growing on compact murumy red soil affording a microclimatic condition.

### **Population characteristics**

Few subpopulations with few sparsely distributed individuals were found within sanctuary area therefore, sparse population was recorded. Population characteristics values of frequency (18.18 %), density (0.18 / m<sup>2</sup>) and abundance (1) also reveal the same (sparse) population structure.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation recorded was of shrubby type. Found growing along with *Lantana camara* var. *aculeate*, *Ixora bracheata*, *Leea macrophylla* and *Zizyphus mauritiana*.

### **Threats to the genetic diversity**

Exploitation of roots and pods : tuberous (starchy) roots and pods are exploited for edible purpose.

**Note :** Found affected by same threat in all reserves.

**7 *Trichosanthes cucumerina* L.** Sp. Pl. 9(ed.1) 1008.1753; Cooke, Fl. Pres. Bombay 1:560.1958 (Repr.); Lakshaminarasimhan et Sharma, Fl. Nasik Dt. 231.1991; Kothari et Sharma, Fl. Raigad Dt. 162.1992; Naik, Fl. Marathwada 418.1998. '*Patola*'.

### **Distribution**

Supegaon, Vadghar, Ambevadi and Velaste.

### **Description**

Annual, monoecious, twiners; stem slender, furrowed, sub glabrous; Tendrils 2-3 (usually 3) fid. Leaves 6.5-9.6 x 7.8-11.5 cm; a little broader than long, orbicular – reniform or broadly ovate, distantly denticulate, deeply 5-7 lobed, the lobes broad, acute, glabrous above, pubescent below, scabrid, base deeply cordate; petioles 6-7 cm long, striated, pubescent. Male flowers in axillary racemes with sometimes a solitary male flower from the same axil as the raceme; peduncles of the racemes 9-11 cm long, slender, striate, bearing 8-15 flowers near the apex; pedicels puberulous.

Calyx tube dilated at the apex, 2 cm long, wide at the mouth; teeth short, acutely triangular. Petals white, small, lanceolate, lacinate at the apex. Female flowers axillary, solitary, occasionally female flowers very short. Fruits 8-10 cm long, ovoid fusiform, tapering at both the ends and with long sharp beak, green and striped with white streaks when immature, scarlet when ripe, pericarp very thin. Seeds semi-ellipsoid, compressed, surrounded by red pulp.

Flrs. & Frts. : August – October.

### **Morphological variations**

Locality : Supegaon; early fruiting (September) was recorded in two individuals growing on hedges very near to the residential colony of natives.

Locality : Velaste; slightly lobed leaves were found along with deeply lobed leaves. Broadly ovate leaves and deeply lobed leaves could be seen on the same individual. This variation is probably due to the tendency of species to develop from entire shape to deep lobation or grow as it is.

### **Ecological habit**

Few on hedges or shrubs especially near the residential colonies. Almost all individuals were found on hedges of fields and kitchen gardens nearby the residential colonies. Species favours partially exposed disturbed sites or waste places having very compact reddish soil.

### **Population characteristics**

A sparse population exists since only few subpopulations were recorded growing within sanctuary and in villages near the boundry of reserve area. Quantitative values calculated for population characteristics like frequency (9.09 %), density (0.09 / m<sup>2</sup>) and abundance (1) also support the assumption made about population structure.

Dispersion pattern : Population exhibits random dispersion pattern.

### **Associated vegetation pattern**

Found twining over the shrubby species like *Lantana camara* var. *aculeata*, *Vitex negundo*, *Macaranga peltata* and *Carissa congesta*. Also grew along with *Mucuna pruriens*, *Martynia annua* and *Lablab purpureus*.

### **Threats to the genetic diversity**

Exploitation of entire plant : Roots, leaves, seeds and fruits are used medicinally. Roots are used as an antidote for snake bite. Juice of leaves is said to be beneficial in wound healing while dried seed powder and fruits are used for killing the lice.

## 8 *Solanum anguivi* Lam. 'Ran-Vang'.

### Distribution

Supegaon; Pimpalgaon, Katkarwadi and Velaste.

### Description

Biennial undershrubs, 60-76.5 cm, very prickly; pricks large, with long compressed base, sharp; stem stout woody at base while purple and herbaceous at apex; covered with whitish stellate hairs. Leaves 7-10x 3-6cm, ovate in outline, elliptic-oblong, acute, subentire or with a few larger triangular-ovate subacute lobes, sparsely prickly on nerves, clothed above with simple whitish hairs whereas covered below with small stellate hairs; leaf base cordate, often unequal sided; petioles 3-3.5 cm long, hairy. Flowers in extra-axillary racemose cymes; peduncles short; pedicels 1-1.3 cm long, hairy. Calyx hairy; teeth triangular, very small. Corolla 2 x 2.5 cm, pale-purple, clothed with purple hairs; lobes small, deltoid, acute. Anther lobe oblong, lanceolate, bright yellow with apical pore. Ovary sparsely hairy. Style curved at the apex. Berries globose, 0.7-0.8 cm across, bright reddish yellow when ripe, glabrous. Seeds, spherical, minutely pitted, flat, numerous.

Fls. Drts. : August – December.

### Morphological variations

Locality : Supegaon; here, some 75 individuals were recorded growing in kitchen gardens. Among them, 3 tall individuals were in fruiting condition on December, 28 which is a little late than the fruiting period recorded (October) in other reserves. Also, these individuals occupied comparatively different habitat than that in other reserves i.e., individuals were growing on disturbed waste place (left out kitchen garden) and with comparatively more number within small area (ca 08 m<sup>2</sup>) whereas at other localities very sparse subpopulations were recorded.

Locality : Katkarwadi; Two stunted individuals were recorded on gravelly soil along rivulet. These individuals were attaining height upto 35-40 cm and had comparatively less leaf number and smaller size 4-8 x 3-5 cm in flowering condition. These habitat forms (ecad) developed probably due to change in ecological habitat like moist, much eroded (nutrient less) gravelly soil.

### Ecological habitat

Species occupied fairly different ecological habit i.e., individuals were found growing on waste places along roadside, in kitchen gardens (not in use) and also on gravelly substratum. All these places had compact red to much eroded dull white gravelly soil.

### **Population characteristics**

Few individuals were recorded within reserve area. Population characteristics values of frequency (13.63 %), density (0.22 / m<sup>2</sup>) and abundance (1.66) reveal a sparse structure of population within sanctuary area.

Dispersion pattern : Individuals were found randomly distributed over their extent of occurrence except for the subpopulation found at Supegaon. So, population exhibits irregular random dispersion pattern.

### **Associated vegetation pattern**

Found growing along with *Mucuna pruriens*, *Vigna vexillata* var. *vexillata*, *Leea macriphylla* and *Abutilon indicum*.

### **Threats to the genetic diversity**

- i. Exploitation of fruits : fruits are collected and cooked as vegetable but only upto limited extent.
- ii. Pest attack : Found affected by insect bites on leaves.

Prickly habit and a pungent odour render the plant nonpalatable by cattle and so, no threat due to cattle grazing. In general, this species faces little threat to its existence.

**Note** : Aggregation of individuals at Supegaon was probably due to availability of a suitable habitat and little interspecific competition since they grew there on left out kitchen garden.

## **9 *Sesamum malayanum* Nair 'Ran til'.**

### **Distribution**

Majagaon, Katkarwadi, Pimpalgaon, Velaste, Savrat and Surve.

### **Description**

Annual, prostrate herbs, 80-95 cm long; stem and branches grooved, sparsely hairy, with long soft white hairs. Leaves 3.9-7.9 x 3-4.6 cm, elliptic, variously clothed beneath with a white tomentum; petioles 2.9 cm long. Flowers axillary, solitary. Calyx deeply divided, hairy outside; segment linear, strongly ciliate. Corolla lilac with a yellow palate, long, tubular ventriose, minutely pubescent outside. Capsules 3.7-4.3 cm long, scabrous pilose, tetralocular, oblong, compressed, strongly mucronate at the apex. Seeds obovoid, oblong, rugose, black, numerous.

Fls. & Frts.: September – October.

### **Morphological variations**

Locality : All localities; tremendous variation in leaf shape and size was observed among leaves of same individual or different individuals.

Locality : Majagaon; here very sparse subpopulation with stunted (height only about 40 cm) individuals was recorded. Also, sparse hairiness was seen in these individuals whereas individuals recorded at other localities were densely growing and had pubescent habit.

**Ecological habitat**

Occasional along roadsides and on hill slopes. Species prefers waste places like roadsides and barren land along hill slopes, fully exposed to the sunlight and having eroded, compact reddish soil.

**Population characteristics**

Few subpopulations were recorded but with considerable number of individuals. Quantitative values of population characteristics like frequency (13.63%), density (0.81 / m<sup>2</sup>) and abundance (6) reveal an intermediate structure of population. Dispersion pattern : Population exhibits extremely clumped dispersion pattern.

**Associated vegetation pattern**

Associated vegetation recorded was of tall herbaceous type. Found growing along with *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*, *Heteropogon contortus*, *Abutilon indicum* and *Urena lobata*.

**Threats to the genetic diversity**

Nonpalatable due to its pungent odour. Also, reserve area of this sanctuary is well preserved like the Karnala sanctuary. Therefore, the species is free from threats like overgrazing, habitat destruction and habitat degradation.



**Table No.: 4 Quantitative studies of Phansad Sanctuary**

Name of the plant species		Number of quadrats studied											
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	2	-	-	-	1	3	-	-	-	-	-	-
2	<i>Cajanus scarabaeoides</i>	-	-	-	-	-	-	-	-	-	2	-	-
3	<i>Canavalia africana</i>	-	-	-	2	-	-	-	-	-	-	-	1
4	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	-	-	2	-	-	-
5	<i>Vigna sublobata</i>	-	-	2	-	-	-	-	-	-	-	3	-
6	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	1	-	-	-	-	-	-	1	-	-
7	<i>Trichosanthes cucumerina</i>	-	-	-	-	-	-	-	1	-	-	-	-
8	<i>Solanum anguivi</i>	-	-	-	-	-	-	-	1	-	-	2	-
9	<i>Sesamum mulayanum</i>	6	3	-	-	-	-	-	-	-	-	-	-

	Name of the plant species	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q	I
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	-	-	-	-	-	1	-	-	-	-	04	07
2	<i>Cajanus scarabaeoides</i>	2	-	-	-	-	-	-	-	3	-	03	07
3	<i>Canavalia africana</i>	-	-	-	-	-	-	1	-	-	-	03	04
4	<i>Paracalyx scariosus</i>	-	2	-	-	-	-	-	1	-	-	03	05
5	<i>Vigna sublobata</i>	3	-	-	-	-	-	-	-	-	-	08	08
6	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	1	-	-	-	1	-	-	04	04
7	<i>Trichosanthes cucumerina</i>	-	-	-	-	-	-	-	-	-	1	02	02
8	<i>Solanum anguivi</i>	-	2	-	-	-	-	-	-	-	-	03	05
9	<i>Sesamum mulayanum</i>	-	-	-	-	-	9	-	-	-	-	03	18

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	18.18	0.31	1.75
<i>Cajanus scaraboides</i>	11.11	0.25	2.33
<i>Canavalia africana</i>	11.63	0.18	1.33
<i>Paracalyx scariosus</i>	13.63	0.22	1.66
<i>Vigna sublobata</i>	36.36	0.36	1
<i>V. vexillata</i> var. <i>vexillata</i>	18.18	0.18	1
<i>Trichosanthes cucumerina</i>	9.09	0.09	1
<i>Solanum anguivi</i>	13.63	0.22	1.6
<i>Sesamum mulayanum</i>	13.63	0.81	6

## V BHIMASHANKAR SANCTUARY

Established	:	1985,
Location	:	Tal. Ambegaon Dist.: Pune,
Area	:	130.78 km <sup>2</sup> ,
Height	:	1140 m (max.),
Avg. temperature	:	18 <sup>o</sup> C,
“ rainfall	:	608 – 635 mm.,
“ humidity	:	Less than 605,
Type of forest	:	Tropical semievergreen forest
Distance from Pune	:	123 km .

### Wild crop relatives recorded within Sanctuary area

- 1 *Abelmoschus manihot* ssp. *tetraphyllus* var. *megaspermus*,
- 2 *Cajanus lineatus*,
- 3 *Canavalia cathartica*,
- 4 *Paracalyx scariosus*,
- 5 *Vigna dalzelliana*,
- 6 *V. sublobata*,
- 7 *V. vexillata* var. *vexillata*,
- 8 *Cucumis melo*,
- 9 *Luffa acutangula*,
- 10 *Momordica dioica*,
- 11 *Trichosanthes tricuspidata*,
- 12 *Solanum anguivi*,
- 13 *S. giganteum* and
- 14 *Sesamum mulayanum*

### Associated farming system

#### Shifting cultivation

This earlier mentioned traditional agricultural system is practiced in remote localities (Padarachiwadi and Damberpada) of southwestern part of sanctuary area. 'Mahadeokolis', a native tribe, cultivate their crops on hill slopes by shifting cultivation.

### Main crops and native land race diversity

This tribe is agrarian and cultivates crops like *Oryza sativa* L. (Paddy), *Eleusine coracana* (L.), Gaerth (Nagali), and *Guizotia abyssinica* Cass. (Khurashi) in kharif season only.

Native land race diversity : Rice is the main crop of this area. 2 land race varieties of rice namely, Jini and Kolapi are still under cultivation, while in southeastern part (Nigdale and Warlawadi) of reserve area some improved varieties of rice are under cultivation. This may be due to location of urban area in the vicinity and topography of this region. Nigdale and Warlawadi are situated on plane (plateau) region connected by tar road to the nearby urban area. Due to these facilities, improved and hybrid varieties are under cultivation and use of land race varieties is very less.

### **Irrigation system**

Very few localities of southeastern part of sanctuary are under irrigation while other localities like Padarachiwadi and Dambarpada are under rain feed condition.

**1 *Abelmoschus manihot*** (L.) Medik. ssp. ***tetraphyllus*** (Roxb. ex Horn.) Borss. var. ***megaspermus*** Hemadri. '*Ranbhendi*'.

### **Distribution**

Padarachiwadi, Machi, Kondhwal road, Ahupe, Terungan and Shindewadi.

### **Description**

Annual, erect hairy herbs, 60 - 70 cm long; stem unbranched, with sparse stiff hairs. Leaves 5 - 7 lobed or angled, scabrous, with short stiff hairs, dentate margin 6-8.7 x 7.5 -11cm, stipules lanceolate, stiff bristles on margins. Flowers axillary, solitary and subracemose towards branch endings. Epicalyx segments 4 - 6, small, caduceous and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple centre, petals 5. Capsules 5- angled, hispid, 3.5-4 x 2-3 cm. Seeds globose, concentrically striate, sparsely hairy and greenish brown.

Fls. & Frts.: September – November.

### **Morphological variations**

Locality : Padarachiwadi; here five dwarf mature individuals were recorded attaining height upto ca 50 cm whereas leafsize, shape, hairiness and budding habit is similar to that given in the general description.

Locality : Shindewadi; here deformities in unopened buds and leaves was found due to severe beetle bite.

### **Ecological habitat**

Occasional along roadsides and bunds of fields. Almost all individuals were found growing in partially sunlight exposed sites with moist compact reddish soil, especially near streams and puddles. Species favours partially sunlight exposed sites with moist reddish soil.

### **Population characteristics**

Intermediate population was observed within reserve area. Quantitative values of population characteristics like frequency (7.69%), density (0.11/ m<sup>2</sup>) and abundance (1.5) also reveal a similar structure of population.

Dispersion pattern : Individuals were found aggregated into patches interspersed with very few individuals i.e., this population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Senecio grahamii*, *Impatiens pulcherrima*, *Crotalaria linifolia* and shrubby species like *Carvia callosa*, *Nilgirianthus reticulatess*, *Lantana camara* var. *aculeata* and *Thespesia lampas*.

### **Threats to the genetic diversity**

Pest attack : Almost all individuals were found affected by insect bites which leads to chlorosis, change in leaf shape and deformities in flowering buds. Deformities in reproductive organs affect natality rate.

## **2 *Cajanus lineatus* (Wight & Arn.) Vander Masen. 'Rantur'.**

### **Distribution**

Padarachiwadi, Machi, Kondhwal road, Mhatarbachiwadi, Kondhwal, Shindewadi, Ahupe, Bhattiche ran and Terungan.

### **Description**

Perennial, erect woody scandent shrubs, 0.75 to 1.50m. long; stem much branched, woody, glabrous at base while herbaceous and densely silky hairy at apex. Leaves 3-foliolate, petioles pubescent; stipules long, linear acute, hairy when young, becoming nearly glabrous when mature, 3-nerved and reticulately veined (visible), 1.7-3.2 x 1-1.3 cm. Flowers axillary, solitary or in pairs in racemes, pedicels long and hairy. Calyx short, hairy. Corolla yellow. Pods oblong, acute at both ends, depressed between seeds, brownish silky hairy, seeds 2-3 with conspicuously divided strophiole, brownish black.

Fls. & Frts. : February – April.

### **Morphological variations**

Locality : Bhattiche ran; here one dense subpopulation of *Ca* 50 individuals was recorded growing on margin of plateau along stiff hill slope. At this protected site tall individuals attaining height upto 1.75 m and with broad leaflets (1.9-3.3 x 1.2-1.5cm) were observed. This well growing subpopulation was the largest of all the subpopulations recorded growing within sanctuary area.

### **Ecological habitat**

Common on plateaus and hill slopes. Most of the subpopulations were found on hill slopes. Species prefers open sites with shrubby vegetation having much eroded red soil or dry black rocky substratum at higher altitude.

### **Population characteristics**

Profusely growing subpopulations were observed at restricted localities. However, quantitative (studies) values of population viz. abundance (2) signify the aggregation tendency of species and frequency (11.53 %) and density (0.23/m<sup>2</sup>) values reveal an intermediate structure of population.

Dispersion pattern : Individuals were found aggregated into patches with a few individuals interspersed in between i.e., this population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation pattern recorded was of shrubby type. Found associated with *Solanum anguivi*, *Carissa congesta*, *Carvia callosa*, *Nilgirianthus reticulatus*, *Coix lacryma-jobi*, *Lantana camara* var. *aculeata*, *Paracalyx scariosus*.

### **Threats to the genetic diversity**

Overgrazing : At Ahupe and Terungan stem apices of young individuals were found grazed by cattles. Overgrazing threatens the species but upto little extent.

### **3 *Canavalia cathartica* Thou. 'Abai'**

#### **Distribution**

Padarachiwadi, Ahupe and Mhatarbachiwadi.

#### **Description**

Annual twiners; stems branched, very long, terete, smooth. Leaves large; petioles 6-9 cm long, stipules very small, oblong, obtuse. Leaflets trifoliate, thin, the terminal rhomboid obovate, 5-8 x 4-5 cm, the laterals broadly ovate, 4-5 x 3-4 cm, reticulately veined; the 2-3 basal nerves opposite, conspicuous; petioles 0.4-0.6 cm long, hairy (brownish); stipules lanceolate, small. Flowers several, in axillary racemes, penduncle 25-28 cm long; pedicels short; bracteoles elliptic oblong, veined, ca 1cm, covering the flowering buds. Calyx veined, glabrous; teeth shorter than the tube, upper broad, notched, lower deltoid, ciliate. Corolla bluish purple, veined. Pods turgid, glabrous, 10-13 cm long; beaked; seeds 10-12, oblong, glabrous, brownish.

Fls. & Frts. : September – December.

#### **Morphological variations**

Locality : Padarachiwadi; here one individual growing in a kitchen garden was recorded having much branched stem with branching from the base. It had a height of some 2 m. and dark green, small (5-7 x 4-5 cm), thin, membranous and densely pubescent leaves. However, at other localities very tall individuals with branching from above the middle portion and broad pale green leaves were seen growing in a wild state.

#### **Ecological habitat**

Very few along roadsides. Individuals were found growing on shrubs and small trees along roadsides having much eroded compact lateritic soil. Species favours partially (sunlight) exposed sites with dense tall shrubby vegetation and microclimatic conditions.

#### **Population characteristics**

Very few individuals were recorded within comparatively large reserve area (130.78 km<sup>2</sup>) i.e., fragmented population was recorded. Quantitative values of population characteristics like frequency (3.84%), density (0.03/ m<sup>2</sup>) and abundance (1) also support the assumption made about the structure of population.

Dispersion pattern : Individuals were found randomly distributed within their extent of occurrence therefore, population exhibits random dispersion.

#### **Associated vegetation pattern**

Found associated with shrubby species like *Carissa congesta*, *Meyna laxiflora*, *Lantana camara* var. *aculeata*. Also along with planted individuals ( of kitchen garden) like *Carica papaya*, *Moringa* sp., *Capsicum* sp. (Chilli), *Lagenaria* sp. (Bottle gourd).

### **Threats to the genetic diversity**

Exploitation of pods : According to natives, young pods are poisonous whereas mature pods are edible after cooking as vegetable.

### **4 *Paracalyx scariosus* (Roxb.) Ali. 'Balawane'.**

#### **Distribution**

Machi, Padarachiwadi, Bhimashankar, Shindewadi, Kondhwal road, Kondhwal phata, Bhattiche ran, Ahupe and Patan.

#### **Description**

Extensive twiners; stems and branches finely downy, grey pubescent, angular. Leaves trifoliolate; leaf rachis prolonged 8-10 mm between the insertion of the lateral leaflets and the stipels of the terminal one; petioles 5-5.5 cm long, downy; stipules small, triangular, acute, downy. Leaflets clothed with soft velvety pubescence above, densely downy and prominently reticulately veined beneath, base subcordate; the terminal rhomboid-ovate, 6 –12.5 x 4 - 6.3 cm, the laterals obliquely ovate, coriaceous 7-10.2 x 4 - 5.7 cm; petioles short, densely pubescent, stipels short, subulate; pubescent. Flowers in copious axillary peduncled racemes; pedicels very short, downy; bracts large, ovate, caduceus. Calyx 3.5 x 3 cm, persistent; tube downy; lower lip broad, boat-shaped, conspicuously veined, creamy white. Corolla yellow, concealed in the (scarius) calyx. Pods small, oblique, downy, enclosed in calyx, pubescent, 1-seeded; seed 1, black reniform, tubercled.

Fls. & Frts. : November – April.

#### **Morphological variations**

Locality : Bhattiche ran; here one developing subpopulation was recorded with its individuals randomly distributed within the area occupied by subpopulation. These individuals had comparatively short height about 1 m and yellowish green leaflets. Their random distribution is probably because aggregation or colonization of individuals is still under process since at other localities aggregated patches of well developed individuals were observed.

#### **Ecological habitat**

Common on plateaus and along roadsides. Individuals were found twining over (spreading on top) the shrubs in dense shrubby vegetation patches. This species favours bright sunlight exposure, murumy red soil with little moisture and dense shrubby vegetation.

#### **Population characteristics**

Considerable aggregated patches (subpopulations) were found within comparatively large reserve area (131.8 km<sup>2</sup>) but concentrated only towards western and north-western boundaries of sanctuary area. Population characteristics values of frequency (11.53%), density (0.15/ m<sup>2</sup>) and abundance (1.33) signify an intermediate structure.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.



### **Associated vegetation pattern**

From ecological habitat it is clear that associated vegetation pattern is of shrubby type. Found associated with *Carissa congesta*, *Cajanus lineatus*, *Carvia callosa*, *Nilgirianthus reticulatus*, *Meyna laxiflora* and tree species like *Cassia fistula*, *Ficus* sps. and *Terminalia chebula*.

### **Threats to the genetic diversity**

Habitat degradation : Eastern part of the reserve is found greatly affected by encroachment of land by neighbouring farmers for cultivation as well developed cultivated fields under private ownership could be seen within reserve area. Also, construction of guest houses and hotels for pilgrims and tourists( as Bhimashankar is one of the most holy palces of Hindus) are a cause for concern. All these activities threaten the species in eastern side.

## **5 *Vigna dalzelliana* (O.ktze.) Verdc. 'Vadvas'**

### **Distribution**

Kondhwal, below Nagphani point, Shindewadi and Patan.

### **Description**

Twining or creeping herbs; stems filiform, striated and nearly glabrous. Leaves 3-foliolate; petioles 2-3.5 cm, glabrous; stipules very short, attached above the base. Leaflets 3-6 x 2-3 cm, membranous, ovate to rhomboid – ovate with tendency to become lobate (the terminal largest, equal sided, laterals inequilateral, all acuminate at apex, sparsely hairy on both surfaces, green above, pale or ash coloured beneath; petioles very short; stipels minute, lanceolate. Flowers small, ca 0.8 cm long, pedicels short; bracteoles very small, linear subulate. Calyx short, glabrous or sparsely hairy. Corolla yellow, small. Pods ca 6 cm long, subcylindric, slightly recurved and beaked, quite glabrous. Seeds 8-10, subcylindric, truncate, smooth, dark brown.

Flrs. & Frts. : August – October.

### **Morphological variations**

At all localities tremendous variation in lobation and shape of leaflets was found in a number of individuals. Ovate to obovate shape and 0-3 lobes in leaflets of same individual or in different individuals was observed. These variations are probably due to tendency of leaflets to become lobate.

### **Ecological habitat**

Occasional along the hill slopes and in grassland. Almost all individuals were found on sunlight exposed sites having eroded red soil. A few individuals were found under the dense shade of shrubs growing on humus rich soil. Species loves to grow amidst herbaceous vegetation partially exposed to sunlight.

### **Population characteristics**

Few sparsely growing subpopulations were recorded within comparatively large area (131.8 km<sup>2</sup>) i.e. intermediate population was observed. Quantitative values of frequency (11.53 %), density (0.11 / m<sup>2</sup>) and abundance (1) also reveal a similar structure of population.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Vigna sublobata*, *Senecio grahami*, *Cucumis melo*, *Indigofera linifolia* and shrubby species like *Cajanus lineatus*, *Carissa congesta*, *Carvia callosa* and *Nilgirianthus reticulatus*.

### **Threats to the genetic diversity**

i. Habitat degradation : Few individuals were found affected by uncontrolled ground fire. Along with this physical degradation, reduction in number of individuals was seen due to loss of associated vegetation pattern i.e. loss of dense patches of shrubs due to completion of lifespan (7 years) of *Carvia callosa* and *Nilgirianthus reticulatus*.

ii. Disease : Individuals growing at Kondhwal were found suffering from vein clearing disease. The incidence of this disease was more here than in the plants of neighbouring areas.

## **6 *V. sublobata* (Roxb.) Babu et Sharma. 'Vadvas'.**

### **Distribution**

Below Nagphani point, Kondhawal, Kondhwal road, Kondhwal, Shindewadi, Ahupe, Terungan, Patan, Mhatarbachiwadi and Gupt-Bhimashankar.

### **Description**

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 8-11 cm long, pubescent; stipules 1.5-2 cm long, ovate, acute, ciliate, hairy; leaflets 6-8 x 4-6.3 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipels linear. Flowers in condensed racemes with swollen nodes; peduncles 14-15 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 5-6 x 1.5 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – November.

### **Morphological variations**

Locality : Below Nagphani point; here both trailing and suberect individuals were recorded in the same subpopulation growing along hill slope. Trailing individuals were very long upto 1 m and grew in grassland under the shade of shrubs while suberect individuals (height upto 30 cm) were seen along very short roadsides. These suberect ecads had developed due to trampling and other human disturbances.

### **Ecological habitat**

Common on hill slopes. Almost all individuals were recorded on much eroded (often with layer of humus) soil having herbaceous (grassland) or shrubby vegetation. Species strictly favours partially (sunlight) exposed sites having dense shrubby vegetation.

### **Population characteristics**

Considerable subpopulations were reorded. Also found abundantly wherever it occurred. Quantitative values calculated for population characteristics like frequency (23.07 %), density (0.46 / m<sup>2</sup>) and abundance (2) signify an intermediate structure and commonness (nature) of population.

Dispersion pattern : Individuals were aggregated into patches with nearly no individual interspersed in between i.e., population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with herbaceous species like *Vigna dalzelliana*, *V. vexillata* var. *vexillata*, *Pinda kokenensis*, *Senecio grahmi*, *Habnaria monophylla*, *H. grandifloriformis*, *Diplocyclos palmatus* and shrubby species like *Carvia callosa*, *Nilgirianthus reticulatus* and *Ixora bracheata*.

### **Threats to the genetic diversity**

i. Habitat degradation : Individuals were found affected by habitat degrading activities like uncontrolled ground fire and overgrazing or clearing of ground flora for fodder purpose by natives.

ii. Loss of associated vegetation : reduction in individual number was recorded i.e., fragmentation of one dense subpopulation developing along hill slope (below Nagphani point). Number of individuals was reduced by about Ca 60% than that present in the last year (October 1999). This reduction was due to loss of associated shrubby vegetation of *Nilgirianthus reticulatus* and *Carvia callosa* which had completed their lifespan of 7 years in March 1999 and April 2000 respectively. Both these species cover hill slopes of W. Ghats of Maharashtra and act as soil binders. However, this undergrowth was lost completely and this caused direct sunlight exposure and drying of top soil.

iii. Pest attack : Almost all individuals were found affected more or less by insect bite with the leaves being especially affected.

**Note:** Although having dense (long) hairy habit, found much susceptible to pest attack (insect bite).

**7 *V. vexillata* (L.) A. Rich. var. *vexillata* Singh et Karthik. 'Halundi'.**

### **Distribution**

Kondhwal road, Machi, Patan, Ahupe, Terungan and Shindewadi.

## Description

Annual, trailing or twining herbs; roots fusiform, stem herbaceous, sparsely hairy. Leaves 3-foliolate; petioles 5.5 cm long, hairy; stipules ca 0.5 cm long, brownish, hairy, nerved, lanceolate. Leaflets 6.2-10 x 4-5 cm, 3 nerved from the base, obovate to lanceolate (the laterals unequal sided), with brownish hairs on both sides, mucronate at apex; petioles very short 5 cm and brownish hairy. Flowers fragrant, few, in capitate racemes; pedicels very short; Calyx pubescent; teeth longer than the tube, linear, acute. Corolla purple; standard broad upto 2.5-3 cm, veined; keel obliquely curved, beaked. Stamen 9+1, enclosed in keel petal; stigma capitate, sugary style, bearded. Pods 10-14 cm long, seeds 12-15, brownish, subreniform, compressed.

Flrs. Frts. : September – October.

## Morphological variations

Locality : Machi; here two much long (ca 2 m) individuals were recorded twining over the shrubs with comparatively broader leaflets ca 8-10 x 4.5-6.2 cm and dark violet coloured thick stem whereas at other localities trailing or twining individuals were found with length upto 2m.

## Ecological habitat

Occasional along roadsides and plateaus. Almost all individuals were found under the shade of trees and shrubs, also twining over the shrubs but not on the top. Species favours shady places having compact red or lateritic soil with little microclimatic conditions.

## Population characteristics

Considerable subpopulations with few sparsely growing individuals were observed within large area (130.78 km<sup>2</sup>). However, quantitative characteristics values of frequency (11.53 %), density (0.11 /m<sup>2</sup>) and abundance (1) signify an intermediate structure of population.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

## Associated vegetation pattern

Associated vegetation was of multistoried type. Found associated with herbaceous species like *Senecio grahmi*, *Impatiens pulcherrima*, *Abelmoschus manihot* ssp. *tetraphyllus* var. *megaspermus*, *Solanum anguivi*; shrubby species like *Carissa congesta*, *Carvia callosa*, *Nilgirianthus reticulatus*, *Ixora brancheata* and tree species of *Terminalia chebula*, *T. bellarica* and *Mangifera indica*.

## Threats to the genetic diversity

This species faces the same threats as described for *V. vexillata* var. *sepiaria* (Kalsubai Harishchandragadh Sanctuary).

## 8 *Cucumis melo* L. 'Chibada'.

### Distribution

Kondhwal road, Kondhwal, Shindewadi, Ahupe, Padarachiwadi, Terungan, Kondhwal and Patan.

## Description

Annual, scabrid, twining or trailing monoecious herbs. Stem stender, angled, rough with short rigid hairs. Tendrils simple. Leaves suborbicular in outline, 5.5-6.3 x 5-6 cm, scabrid on both surfaces, cordate at the base, dentate, 5-7 lobed, lobes ovate to obovate; petioles slender, scabrid, 4.6-6 cm long. Male flowers solitary or in clusters. Calyx tube campanulate, hairy, teeth very short. Corolla yellow Ca 1 cm; sparsely pubescent. Appendage of the connective very short. Female flowers : peduncles 2-3 cm long, densely hairy. Ovary hairy. Fruits subglobose or trigonous, 4.6-5x 3.7 cm, longitudinally variegated with 10 green stripes, deciduous (glandular) bristles, pale yellow when ripe. Seed many, whitish with bitter pulp.

Flrs. & Frts. : Septembr – November.

## Morphological variations

Locality : Kondhwal road; here one large profusely growing and much branched individual was recorded twining over (spreading on top) shrubs and small trees. Comparatively thicker and branched stem, broader leaves, bigger fruit size (5-5.3 x 3.5 cm) and bright yellow flowers were observed in this individual whereas almost all other individuals were found trailing on waste places near residential colonies of natives.

## Ecological habitat

Common near residential colonies and along roadsides. Most of the individuals were found growing on cow-dung pits (compost pits) i.e., on waste places exposed to bright (direct) sunlight . A few individuals were found growing on red murummy soil along roadsides, twining over the top of shrubs and trees. Species greatly favours bright sunlight exposure and waste places near residential colonies.

## Population characteristics

Intermediate population was recorded but found abundant wherever it occurred. Quantitative values of frequency (11.53 %), density (0.11 / m<sup>2</sup>) and abundance (1) also reveal an intermediate structure of population.

Dispersion pattern : Population exhibits extremely clumped dispersion pattern.

## Associated vegetation pattern

Found associated with herbaceous species like *Alternanthera pungens*, *Croton bonplandianus*, *Justicia micrantha*, *Achyranthes aspera* and shrubby species like *Lantana camara* var. *aculeate* and *Carissa congesta*.

## Threats to the genetic diversity

Exploitation of fruits : Mature fruits are used as lamps during Deepawali festival. Ovoid fruits are cut into two equal parts, pulp is drawn out from fruit and the empty fruit parts are then used for lightening the lamps as a holy tradition of native tribes. This activity threatens the plant but only upto limited extent.

**9 *Luffa acutangula*** (L.) Roxb. Fl. Ind. 3:713.1832; (Repr.) 1:566.1958; Cooke Fl. Pres. Bombay Lakshaminarasimhan et Sharma Fl. Nasik Dt. 228.1991 *Cucumis acutangula* L. Sp. Pl. 1:1011.1753. *Luffa acutangula* var. *amara* (Roxb.) C.B. Cl. in Hook f.op. cit.; Cooke, op.Cit 567. 'Kadudodaka'.

Herbarium specimen number : 32 & 40.

## **Distribution**

Kondhwal, Mhatarbachiwadi and Terungan.

## **Distribution**

Annual monoecious climbers; stems 5-angled, glabrous, with sharp angles. Tendrils usually 2-3 fid. Leaves orbicular in outline, pale green, at first whitish and softly villous, at length scabrid, 5-7 angled or sublobate, base chordate; nerves and veins prominent beneath, 3-6x4-7 cm; petioles ca 5 cm long, angular, scabrid. Male flowers in axillary 8-10 flowered racemes. Calyx pubescent, 1-1.5 cm long; lobes lanceolate. Petals spreading, obovate, yellow with green hairy veins. Stamens 3. Female flowers solitary, axillary; peduncles 2-2.5 cm long. Ovary strongly ribbed. Fruits obovoid, obtusely conical at both the ends, 8-9 cm long, 10 ribbed with bitter pulp. Style persistent in dried fruits. Seeds ovoid oblong, compressed, rugose, many, black.

Flts. & Frts. : September – November.

## **Morphological variations**

Locality : Kondhwal; here one individual was seen growing under the dense shade of trees with comparatively smaller leaves (3 x4 cm) and a weak stem about 4 cm long whereas other individuals were found growing extensively (spreading on top) over shrubs and small trees and having much broader leaf size than that mentioned in general description,

Locality : Ahupe; here change in shape and size of flowers and flowering buds was observed in two individuals. Curling of petals and reduced flower size was recorded in these individuals which was probably due to some disease.

## **Ecological habitat**

Infrequent on hill slopes and hillocks. Almost all individuals were found twining over top of the shrubs and trees especially at protected sites having humus rich red soil. Species favours bright sunlight exposure and humus rich soil with little moisture especially at protected sites.

## **Population characteristics**

Sparse population was observed because few individuals were found aggregated at few localities within large (131.8 km<sup>2</sup>) area. Comparatively small density (3.84 / m<sup>2</sup>) and frequency (3.84 %) values also support the assumption made about the structure of population.

Dispersion pattern : This population exhibits extremely clumped dispersion pattern.

## **Associated vegetation pattern**

Associated vegetation recorded was of shrubby type. Found associated with *Carissa congesta*, *Lantana camara* var. *aculeata*, *Nilgirianthus reticulatus*, *Meyna laxiflora* and *Terminalia crenulata*.

## **Threats to the genetic diversity**

Exploitation of leaves, fruits and seeds: The whole plant is exceedingly bitter and seeds are cathartic and emetic. Leaf juice and fruit juice are said to be beneficial in stomach disorders and poisoning, also used in veterinary medicines by natives.

Few individuals were found strongly suffering from vein chlorosis in leaves and deformities in reproductive organs.

**Note :** i. Sparse structure of population is probably due to sensitivity to its ecological habitat.

ii. Probable centre of origin and primary gene centre of *Luffa* is tropical India. (Tarsem & Dhaliwal, 1992).

## **10 *Momordica dioica* Roxb.ex. Willd. 'Kartoli'**

### **Distribution**

Killa, Padarachiwadi, Bhattiche ran, Mhatarbachiwadi and Patan.

### **Description**

Annual, dioecious twiners with tuberous roots; stem slender, branched, furrowed, glabrous and shining. Tendrils simple, striate, elongate, glabrous. Leaves broadly ovate in outline, cordate at base, 3-5 lobed, margins denticulate, 4.5-11 x 5-9 cm; petioles 3-4 cm long, channeled above, pubescent, eglandular. Male flowers : Peduncle solitary 1-flowered, 14-15 cm long, slender, angled, bract cucullate, orbicular-reniform, strongly nerved. Calyx lobes distant, 0.5-1 cm long, linear lanceolate. Corolla yellow, 3-3.5 cm long. Female flowers : peduncles nearly equal to the male inflorescence, bracts small. Ovary clothed with long soft papillae. Fruits 6 x 3-3.2 cm, ovoid, shortly beaked, densely echinate with soft spines. Seeds many, broadly ovoid, irregularly corrugated, enclosed in red pulp.

Flrs. & Frts. : July – October.

### **Morphological variations**

Locality : Padarachiwadi; Here one individual was found growing on margin of water fall having extremely eroded i.e. black rocky substratum and very dense shade of tall trees. It had comparatively broad leaves (11 x 8 cm), a trailing habit with trailing length upto ca 2 m and it showed no flowering or fruiting in the month of September. This ecad was adapted to a totally different ecological habitat and showed variation in habit (i.e., trailing) whereas in general, the individuals showed a twining (spreading on top) habit over open shrubby vegetation on plateaus or plains.

### **Ecological habitat**

Few on plains and plateaus . Species favours twining and spreading (on top) habit i.e. direct sunlight exposure, shrubby vegetation and compact soil.

### **Population characteristics**

Sparse population was observed. Individuals were found dispersed at distant localities with few number at each of the localities. Density value calculated (0.07 / m<sup>2</sup>) for population also signifies a similar structure of population.

Dispersion pattern : Population exhibits random dispersion pattern.

### **Associated vegetation pattern**

From ecological habitat it is clear that associated vegetation was of shrubby type. Found associated with *Carissa congesta*, *Acacia chundra*, *Zizyphus glaberrima* and *Maytenus emarginata*.

### **Threats to the genetic diversity**

Exploitation of roots and fruits : Tuberos roots are used medicinally to cure piles and fevers in children whereas unripe fruits are collected and cooked as vegetable. These activities threaten this species in all the reserves where it occurs.

**Note :** Found susceptible to vein chlorosis disease of leaves.

## **11 *Trichosanthes tricuspida* 'Dolephuti'.**

### **Distribution**

Padarachiwadi, Shindewadi, Bhattiche ran, Mhatarbachiwadi and Kondhwal.

### **Description**

Perennial, huge twiners; stems robust, woody below, branched, grooved, the older light gray with scabrous spots, the younger smooth, green. Tendrils long, pinkish-brown, 3-fid. Leaves 10-15 x 8-10 cm, variable, palmately compound, 3-5 circular glands scattered along lower side, glabrous, base cordate, margin more or less dentate; petioles 8- cm long, glabrous. Male flowers in axillary 5-10 flowered racemes 7-8 cm long; pedicel thick, short; bracts 2.5-3 cm long, pale green, many nerved, fringed; dotted with glandular spots. Calyx tube 5-6 cm long, pubescent, longitudinally striate. Corolla creamy white, petals wedge shaped, fringed exceeding the calyx tube, 6-7 cm long. Filaments slightly hairy. Female flowers axillary, solitary; peduncles 2 cm long. Fruit 3 cm diameter, globose, red when ripe, pericarp thick, orange streaks inconspicuous. Seeds numerous, ellipsoid, smooth with greenish pulp.

Flrs. & Frts. : July – October.

### **Morphological variations**

Locality : Padarachiwadi and Mhatarbachiwadi; at these places 3 individuals were recorded climbing over tall trees attaining a height of ca 15 m. Their leaves had the maximum possible dimension (i.e., 15 x 10 cm) and also the leaves were deeply lobed.

Locality : Mhatarbachiwadi; large number of fruits were found on one big individual with the number being three times that seen in other individuals.

Locality : Shindewadi ; here one mature individual was recorded attaining a length of only about ca 2.5 m which is comparatively less than the general range of length.

Locality : Padarachiwadi and Bhattiche ran; on the same day (September 28, 2000) some individuals were seen in flowering stage only whereas others were with mature fruits but, these individuals grew in different subpopulations.

### **Ecological habitat**

Common on plateaus and plains especially near the residential colonies. Almost all individuals were found climbing over tall trees growing near residential



colonies and fields of natives. Species favours disturbed areas having poor compact reddish soil and tree canopy as associated vegetation.

### **Population characteristics**

Intermediate population was observed. Quantitative values of population characteristics like frequency (11.53 %), density (0.15/ m<sup>2</sup>) and abundance (1) also signify a similar structure of population.

Dispersion pattern : Individuals were aggregated into patches interspersed with a very few number of individuals i.e., population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with tree species like *Ficus glomerata*, *Terminalia chebula*, *T. bellerica*, *Mangifera indica* and *Ixora nigracans* i.e., associated vegetation was of canopy type.

### **Threats to the genetic diversity**

i. Exploitation of fruits : fruits are poisonous and haemagglutinating. They are used to cure asthma and also as an antidote for snakebite. Unripe fruits are used for their medicinal value whereas ripe fruits (having attractive orange red coloured pericarp) are used to decorate the door frame of houses. One can see the ripe fruits on sale in the vegetable markets of Pune (a metropolitan city) during Ganapati festival and Navratra and herbal medicines stall at Bhimashankar (holy place) sells these fruits at a price of Rs.10 per fruit.

ii. Shifting cultivation : At Padarachiwadi few individuals were found depleted by slash and burn operation of shifting cultivation i.e., due to cutting of branches of neighbouring trees.

**Note :** Well growing species and an ethnobotanically important plant especially due to its medicinal value therefore, has a good biological potential.

## **12 *Solanum anguivi* L. 'Ringani'.**

### **Distribution**

Kondhwal road, Padarachiwadi, Bhimashankar, below Nagphani point, Bhattiche ran, Ahupe and Terungan.

### **Description**

Biennial undershrubs, 60-70 cm long, very prickly; pricks large, with long compressed base, sharp; stem stout woody at base while purple and herbaceous at apex; covered with whitish stellate hairs, leaves 4.2-11.7x 2.4-8.6cm, ovate in outline, elliptic-oblong, acute, subentire or with a few larger triangular-ovate subacute lobes, sparsely prickly on nerves, clothed above with simple whitish hairs whereas covered below with small stellate hairs; leaf base cordate, often unequal sided; petioles 3-3.5 cm long, hairy. Flowers in extra-axillary cymes; peduncles short; pedicels 1-1.3 cm long, hairy. Calyx hairy; teeth triangular, very small. Corolla 2 x 2.5 cm, pale-purple, clothed with purple hairs; lobes small, deltoid, acute. Anther lobe oblong, lanceolate bright yellow with apical pore. Ovary sparsely hairy. Style curved at the apex. Berries globose, 0.7-0.8 cm across, bright reddish yellow when ripe, glabrous. Seeds, spherical, minutely pitted, flat, numerous.

Fls. Drts. : August – October.

### **Morphological variations**

Locality : Below Nagphani point : very woody and much branched individuals (3) were found growing on margin of very short road along stiff hill slope. More prickly habit, membranous leaves and much woody dusty white coloured stems were observed in these individuals. These ecads (habitat forms) probably developed due to trampling and other continuous human disturbances.

Locality : Kondhwal road; flowering and fruiting was observed in a few individuals of the same subpopulation at the same time.

### **Ecological habitat**

Occasional along roadsides and on barren fields near housing complexes. Almost all individuals were found under the shade (fully or partially) of shrubs and trees and never in open situations. Species prefers moist red or lateritic soil and shade of shrubs or small trees affording microclimatic conditions.

### **Population characteristics**

Intermediate population was observed. Individuals were recorded at almost all localities but in small numbers. Quantitative values of population characteristics like frequency (11.53%), density (0.19 / m<sup>2</sup>) and abundance (1.66) also support the assumption made about the structure of population.

### **Associated vegetation pattern**

Found along with *Carissa congesta*, *Woodfordia subfruticosa*, *Carvia callosa*, *Nilgiranthus reticulatus*, *Euphorbia ligularia* and tree species like *Terminalia chebula* and *Memeylon umbelatum*.

### **Threats to the genetic diversity**

i. Exploitation of fruits : Immature fruits are collected by natives as vegetable but only upto limited extent.

**Note** : Though having pungent odour and prickly habit, found susceptible to insect bite.

## **13 *S. giganteum* 'Chichurdi'.**

### **Distribution**

Below Nagphani point, Gupt Bhimashankar, Patan and Machi.

### **Description**

Perennial much branched tall shrubs, 1.87–2.30 m long, armed with broadly triangular prickles which are yellow towards the point and usually tomentose at the base; young branches, inflorescence, and underside of leaves clothed with dense close white stellate tomentum. Leaves 11.7–15 x 6 - 8 cm, oblong-lanceolate, acute entire, glabrous above when mature, base tapering into the petiole, often unequal-sided main nerves 10-12, conspicuous on uppermost cymes; peduncles stooping, 3

cm long; pedicels very short. Calyx hairy, teeth triangular and thick. Corolla bluish-purple, deeply divided, lobes lanceolate, hairy outside. Ovary glabrous; style glabrous. Berry ca 1 cm across, red when ripe. Seeds many, small, flat, brownish and slightly muriculate.

Flrs & Frts. : October – March.

### **Morphological variations**

Locality : Gupt Bhimashankar and Patan; very late fruiting was observed in two isolated subpopulations. These individuals were found growing at protected sites along stiff hill slopes. Almost all individuals of these subpopulations were seen in fruiting condition in the month of May (May 16,2000) whereas general flowering and fruiting period of the species is October – March.

### **Ecological habitat**

Few along hill slopes and hillocks. Individuals were found growing on much eroded murumy substratum at protected sites i.e., surrounded by dense shrubby vegetation.

### **Population characteristics**

Few subpopulations were recorded within comparatively large area (131.8 km<sup>2</sup>) i.e., sparse population was observed. Comparatively small population characteristics values of frequency (7.69 %) and density (0.19 / m<sup>2</sup>) also signify a sparse structure of population.

Dispersion pattern : Individuals were aggregated into patches located at distant places, therefore, this population exhibits extremely clumped dispersion pattern.

### **Associated vegetation pattern**

Found associated with *Coix lacryma-jobi*, *Vigna sublobata*, *V. dalzelliana*, *Indigofera linifolia* and shrubby species like *Carvia callosa*, *Nilgirianthus reticulatus*, *Carissa congesta* and *Meyna laxiflora*.

### **Threats to the genetic diversity**

Exploitation of fruits : Fruits are cooked as vegetable by natives. This activity threatens the species but only upto little extent.

Note : Sparse population is probably due to sensitivity to its ecological habitat.

Found much resistant to insect bite compared to *Solanum anguivi*. May be having a good biological potential.

## **14 *Sesamum mulayanum* Nair. 'Ran - til'.**

### **Distribution**

Padar (Machi), Bhimashankar, Kondhwal and Ahupe.

### **Description**

Annual prostrate herbs, 70-80 cm long, stem and branches grooved, sparsely hairy with long soft white hairs. Leaves 3.2 – 6.7 x 2.1 – 4.3cm, elliptic, variously clothed beneath with a white tomentum; petioles 2.3 cm long.

Flowers solitary, axillary. Calyx deeply divided, hairy outside; segment linear, strongly ciliate. Corolla lilac with a yellow palate, long, tubular ventriose, minutely pubescent outside. Capsules 3.7 - 4 cm long, scabrous pilose, tetralocular, oblong, compressed, strongly mucronate at the apex. Seeds, obovoid, oblong, rugose, black, numerous.

Flrs. & Frts.: September – October.

### **Morphological variations**

Locality : All localities; considerable variation was found in shape, size and margin of leaves. Lanceolate, ovate, obovate and elliptic leaves were seen in same individual or among different individuals of same subpopulation or among individuals of different subpopulation. Also, entire to dentate margin with leaf size differing from 4-7 x 3-4 cm and height varying from 30-60 cm in mature individuals of the same or different subpopulations was observed.

### **Ecological habitat**

Few on plateaus. Almost all individuals were recorded on gravelly soil in open situation especially near streams. Species favours gravelly soil along extended and barren plateaus i.e., sunlight exposed sites.

### **Population characteristics**

Found abundantly wherever it occurred but few subpopulations were recorded at distant localities. A comparatively large abundance (2.5) value signifies the aggregation tendency of species and, comparatively intermediate density (0.19 / m<sup>2</sup>) and frequency (7.69 %) values signify an intermediate structure of population. Dispersion pattern : Individuals were seen aggregated into patches with nearly no individual interspersed in between i.e., this population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

As found on barren plateaus (sparse vegetation), associated vegetation recorded was of herbaceous type. Found growing along with *Senecio grahmi*, *impatiens pulcherrima*, *Celosia argentia*, *Tribulus terrestris*, *Lavandula bipinnata* and *Justicia prostrata*.

### **Threats to the genetic diversity**

Habitat degradation : One subpopulation recorded near Kondhwal was found greatly affected by ground fire and erosion of top soil from plateaus due to depletion of ground cover by overgrazing and forest fire.

**Note** : Considerable flower and fruit number, nice fruit setting capacity and resistance to pest attack and diseases were noted and so, the plant has a good biological potential.

**Table No. : 5 Quantitative studies of Bhimashankar Sanctuary**

Name of the plant species		Number of quadrats studied													
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	-	-	-	2	-	-	-	-	-	-	-	-	-	-
2	<i>Cajanus lineatus</i>	1	-	-	-	-	-	-	-	1	-	-	-	-	1
3	<i>Canavalia cathartica</i>	-	-	-	-	1	-	-	-	-	-	-	-	-	-
4	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	2	-	-	-	-	-	-	-
5	<i>Vigna dalzelliana</i>	-	-	-	-	-	-	-	-	-	-	1	-	-	-
6	<i>V. sublobata</i>	3	-	-	-	-	-	-	-	-	-	2	-	-	1
7	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	-	-	-	-	-	1	-	-	-	1	-
8	<i>Cucumis melo</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	<i>Luffa acutangula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	<i>Momordica dioica</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-
11	<i>Trichosanthes tricuspidata</i>	-	-	-	-	-	1	1	-	-	-	-	-	-	-
12	<i>Solanum anguivi</i>	-	-	-	1	-	-	-	-	-	-	-	-	2	-
13	<i>S. giganteum</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-
14	<i>Sesamum mulayanum</i>	-	-	-	-	-	-	-	3	-	-	-	-	-	-

Continued...

	Name of the plant species	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q	I
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	-	-	1	-	-	-	-	-	-	-	-	-	02	03
2	<i>Cajanus lineatus</i>	-	-	-	-	-	-	-	3	-	-	-	-	03	06
3	<i>Canavalia cathartica</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	01
4	<i>Paracalyx scariosus</i>	-	-	-	-	-	-	-	-	1	-	1	-	03	04
5	<i>Vigna dalzelliana</i>	1	-	-	-	-	-	-	-	-	-	-	1	03	03
6	<i>V. sublobata</i>	1	-	-	2	-	-	-	-	-	-	-	3	06	12
7	<i>V. vexillata</i> var. <i>vexillata</i>	-	-	-	1	-	-	-	-	-	-	-	-	03	03
8	<i>Cucumis melo</i>	-	-	1	-	1	1	-	-	-	-	-	-	03	03
9	<i>Luffa acutangula</i>	-	2	-	-	-	-	-	-	-	-	-	-	01	02
10	<i>Momordica dioica</i>	-	-	-	-	-	-	-	-	-	-	1	-	02	02
11	<i>Trichosanthes tricuspidata</i>	-	-	-	-	-	2	-	-	-	-	-	-	03	04
12	<i>Solanum anguivi</i>	-	-	-	-	-	-	-	-	2	-	-	-	03	05
13	<i>S. giganteum</i>	-	-	-	-	-	-	-	-	-	-	-	-	01	02
14	<i>Sesamum mulayanum</i>	-	-	-	-	-	-	-	-	-	2	-	-	02	05

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>megaspermus</i>	7.69	0.11	1.5
<i>Cajanus lineatus</i>	11.53	0.23	2
<i>Canavalia cathartica</i>	3.84	0.03	1
<i>Paracalyx scariosus</i>	11.53	0.50	1.33
<i>Vigna dalzelliana</i>	11.53	0.11	1
<i>V. sublobata</i>	23.07	0.46	2
<i>V. vexillata</i> var. <i>vexillata</i>	11.53	0.11	1
<i>Cucumis melo</i>	11.53	0.11	1
<i>Luffa acutangula</i>	3.84	0.07	2
<i>Momordica dioica</i>	7.69	0.07	1
<i>Trichosanthes tricuspidata</i>	11.53	0.15	1
<i>Solanum anguivi</i>	11.53	0.19	1.66
<i>S. giganteum</i>	7.69	0.19	2.5
<i>Sesamum mulayanum</i>	3.84	0.07	2

## VI KARNALA SANCTUARY

Established	:	1968,
Location	:	Near Panvel, Dist. : Raigad,
Area	:	4.48 km <sup>2</sup> ,
Avg. temperature	:	27°C ,
“ rainfall	:	2286-2540 mm,
“ humidity	:	60-70 %,
Type of forest	:	Moist deciduous forest
Distance from Pune	:	120 km .

### Wild varieties of crop plants recorded within Sanctuary area

- 1 *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*,
- 2 *Canavalia africana*,
- 3 *Vigna dalzelliana*,
- 4 *V. sublobata*,
- 5 *Trichosanthes tricuspidata*,
- 6 *Solanum virginianum* and
- 7 *Sesamum mulayanum*.

### Associated farming system

A small area of 4.48 sq. kms. along the Karnala fort has been developed as a bird reserve. Reserve area (land) of the Karnala sanctuary is completely free from cultivation practices. This may be due to unsuitable environmental and geographical conditions for cultivation, like dominant tree canopy of moist deciduous forest, much eroded soil and abnormal topography (stiff hillocks) of this region.

1 *Abelmoschus manihot* (L.) Medik. ssp. *tetraphyllus* (roxb. ex horn.) Borss. var. *tetraphyllus* Singh et Kathik. ‘*Ran Bhendi*’.

### Distribution

Along Mumbai – Goa National highway, Borimal trail and Ransai.

### Description

A large annual erect hairy plant, 1.5-1.75 m high; stems with small scattered prickles. Leaves 5.7 –11.3 x 4 –9.2 cm in dimension, scabrid, with short stiff hairs, cordate, serrate, acutely angled, palmately 5-7 lobed; usually acuminate; petioles long upto 6-10 cm, prickly. Stipules very short, linear lanceolate, bristly on margins. Pedicels 2-2.5 cm long, axillary, solitary, prickly. Epicalyx segments 4, large, persistent, broadly ovate, overlapping. Calyx softly villous, sepals connate to the tip. Corolla yellow with purple base. Capsules 3-4 x 2 cm long, ovoid, 5-angled, hispid, cuspidate. Seeds globose, faintly pubescent.

Flrs. & Frts. : October – December.

### Morphological variations

Locality : Near Thalkar farm (along National highway); here reduced height ( only about 1.25 m) in individuals of one dense subpopulation was recorded. On the other



hand, at other localities on bunds of fields or hill slopes few sparsely growing individuals attaining height upto 1.5-1.7 m were observed.

Locality : Ransai; here pigmentation (i.e., scarlet red to brown spot) was seen on leaves of individuals growing along short road side with sparse shrubby vegetation .

### **Ecological habitat**

Common along roadsides and open fields. Individuals were found growing on open (fully exposed to sunlight) and partly shady places having red murumy soil especially near puddles along roadsides. Species favours moist soil, bright sunlight and sparse shrubby vegetation as associated vegetation.

### **Population characteristics**

Considerable population was observed. One long belt (subpopulation) of numerous individuals was seen growing along National Highway. Few subpopulations were recorded growing on bunds and open fields . Population characteristics values of frequency (30%), density (0.55/m<sup>2</sup>) and abundance (1.83) reveal the commonness of species within sanctuary area.

Dispersion pattern : Individuals were aggregated and found interspersed with a few number of individuals i.e., population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation pattern recorded was of tall herbaceous and shrubby type. Found associated with herbaceous species like *Abutilon indicum*, *Croton bonplandianum*, *Malachra capitata*, *Hibiscus vitifolius*, *Crotalaria prostrata*, *Sesamum mulayanum* and shrubby species like *Gnedia glauca*, *Meyna laxiflora*, *Ixora bracheata*, *Careya arborea* and *Acacia chundra*.

### **Threats to the genetic diversity**

Air pollution : Individuals growing along National highway (passing through the middle of sanctuary) were found greatly affected by continuous exposure to hot smoke and polluted air exhausted from heavy vehicular transport.

**Note** : It was observed that polluted air (smoke) causes habitat degradation and noise pollution causes disturbance to habitat of birds (Bird sanctuary).

## **2 *Canavalia africana* Dunn. 'Aba'**

### **Distribution**

Thakurpada, Ransai, Borimal, Garmal and Karnala fort.

### **Description**

A stout perennial twiner; stems and branches glabrous. Leaves 4-8.2 x 3-6.1 cm in dimension; petioles 7-8 cm long, glabrous; stipules triangular, deciduous. Leaflets obovate – oblong, rounded at base, shortly acuminate at apex, glabrous on both surfaces; petioles very short; stipules very short, subulate, caduceus. Flowers in lax axillary racemes, inflorescence rachis 11 cm long, pedicels very short, usually in pairs from corolla. Corolla pale lilac and sometimes whitish. Pods 16-17 cm long, slightly incurved, glabrous. Seeds 2 - 2.5 cm long, glabrous, oblong-elliptic.

Flrs. & Frts. : October – December.

### **Morphological variations**

Localities : Garmal and Ransai; here variation in length of inflorescence rachis, pedicel length and size of pods was observed. Comparatively more length in inflorescence rachis upto 13.2 cm, 1 cm more length in pedicel and bigger pod size i.e., 16 x 5 cm was observed in a few individuals growing randomly.

### **Ecological habitat**

Few on hill slopes. Individuals were found growing on margins of streams having much eroded dark red murumy soil supporting a sparse tall shrubby or small tree vegetation. This species favours protected sites near water reservoirs or streams.

### **Population characteristics**

Few individuals were recorded at distant localities. A sparse population was observed within comparatively very small reserve area (4.48 km<sup>2</sup>). Quantitative values calculated for population characteristics like frequency (25%), density (0.3) and abundance (1.2) also signify a sparse population structure.

Dispersion pattern : Individuals were found randomly distributed over their extent of occurrence therefore, population exhibits random dispersion pattern.

### **Associated vegetation pattern**

Associated vegetation pattern recorded was of shrubby type. Found associated with *Zizyphus mauritiana*, *Careya arborea*, *Schleichera oleosa* and trees species like *Bocagea dalzelli*, *Garuga pinnata* and *Terminalia crenulata*.

### **Threats to the genetic diversity**

Exploitation of pods : Pods are sliced and cooked as vegetable by local people but only upto limited extent.

**Note** : Pods of *C.cathertica* are poisonous whereas pods of this species are nonpoisonous and edible.

## **3 *Vigna dalzelliana* (O.Ktze.) Verdc. 'Ranudid'.**

### **Distribution**

Borimal, Sapdyamal and Thakurpada

### **Description**

Twining or creeping herbs; stems filiform, striate and nearly glabrous. Leaves 5-7.4 x 4-5.5 cm, petioles 6-8 cm, glabrous; stipules very short, attached above the base. Leaflets 2.5-6 x 2-3 cm, membranous, ovate to rhomboid – ovate with tendency to become lobate (the terminal largest, equal sided, laterals inequilateral, all acuminate at apex, sparsely hairy on both surfaces, green above, pale or ash coloured beneath; petioles very short; stipules minute, lanceolate. Flowers small, ca 1 cm long in pedicels short; bracteoles very small, linear subulate. Calyx short, glabrous or sparsely hairy. Corolla yellow, small. Pods ca 6 cm long, subcylindric, slightly recurved and beaked, quite glabrous. Seeds 8-10, subcylindric, truncate, smooth dark brown.

Flrs. & Frts. : August – October.

### **Morphological variations**

Localities : Like in other sanctuaries (Kalsubai Harishchandragadh and Bhimashankar) here too, similar variations i.e., ovate – rhomboid ovate leaflets with entire to lobed margins (1-3 lobes) were seen.

Locality : Borimal; here, late flowering and fruiting was recorded in a few individuals ( i.e., in November 18,2000) whereas general flowering and fruiting period is August – October.

### **Ecological habitat**

Occasional on plateaus amidst grasses. Individuals were found in grassland or herbaceous vegetation having red murumy soil with little moisture. Species prefers more or less plain substratum having moist soil, direct sunlight and dense herbaceous vegetation.

### **Population characteristics**

Intermediate population was observed. Numerous individuals were seen wherever the species occurred but such instances were restricted to a few localities separated by large distances. Population characteristics values of frequency (15%), density (0.25/ m<sup>2</sup>) and abundance (1.66) reveal an aggregation tendency in species and an intermediate structure of population.

Dispersion pattern : Population exhibits slightly clumped dispersion pattern.

### **Associated vegetation pattern**

From ecological habitat it is clear that associated vegetation is of herbaceous type. Found associated with *Herteropogon contortus*, *Lavandula bipinnata*, *Tribulus terrestris*, *Desmodium laxiflorum* and *Alysicarpus vaginalis*.

### **Threats to the genetic diversity**

Karnala is one of the best terrestrial sanctuaries reserved for the birds, and maintained very nicely by the forest department. A number of conservation measures ( like construction of contours, terrace uplands, plantation on barren plateaus, reserve area protected from physical degradation by forest fire and ground fire) have been taken for preservation of ecological habitat and conservation of ground flora and fauna. As a result this species is now free from major threats except for diseases like vein chlorosis disease of leaves in a few individuals.

**Note** : Sometimes it is very difficult to conclude whether morphological variations recorded in leaves are environmentally induced or due to some inherent tendency of the species.

## **4 *Vigna sublobata* (Roxb.) Babu et Sharma 'Ran mug'.**

### **Distribution**

Borimal trail, Sapdyamal and Garmal.

## Description

Annual twining or trailing herbs; stems herbaceous, clothed with spreading reddish-brown silky hairs; stem apex densely hairy. Leaves trifoliolate; petioles 5.7-3 cm long, pubescent; stipules 1.5 cm long, ovate, acute, ciliate, hairy; leaflets 5-8.2 x 4 – 6.7 cm (terminal larger and ovate to rhomboid ovate, the laterals ovate, acute, inequilateral with truncate base), all acute, with silky hairs on both sides, conspicuously three nerved from the base; petioles short, hairy; stipules linear. Flowers 1 cm, in condensed racemes with swollen nodes; peduncles 7-13 cm long, hairy; bracts hairy, deciduous; bracteoles linear, ciliate. Calyx small, nearly glabrous, teeth deffoid. Corolla 1.5-2 cm long, yellow. Pods 6-6 cm; linear, cylindric, densely clothed with reddish-brown silky hairs, seeds 10-12, subquadrate, brown, oblong with truncate ends.

Fls. & Frts. : September – October.

## Population characteristics

Quantitative values of frequency (25 %), density (0.40 / m<sup>2</sup>) and abundance (1.6) indicate a sparse structure of population.

## Associated vegetation pattern

Associated vegetation pattern recorded was of herbaceous type like *Vigna sublobata*, *V. vexillata*, *Leucas aspera* and *Caesularia axillaries*.

## Threats to the genetics diversity

Disease : Many individuals of this species were found affected by vein clearing disease found commonly in cultivated species.

## 5 *Trichosanthes tricuspidata* Laur. 'Kavalyacha amba'.

### Distribution

Near Karnala fort, Garmal and along National Highway (Mumbai–Goa)

### Description

Annual, erect hairy herbs, 60-70 cm long; stem unbranched, sparsely hairy, hairs stiff. Leaves 5-7 lobed or angled, scabrous, with short stiff hairs, dentate margin, 6-8.7x 7.5-11cm in dimension, stipules lanceolate, stiff bristles on margins; Flowers axillary, solitary and subracemose towards branch endings. Epicalyx segments 4-6, small, caduceus and distantly arranged. Sepals 5, softly villous, ovoid. Corolla yellow with purple centre, petals 5. Capsules 5- angled, hispid, 3.5-4 x 2-3 cm. Seeds globose concentrically striate, sparsely hairy and greenish brown.

Fls. & Frts.: September – November.

### Morphological variations

Locality : Near Karnala fort; comparatively longer fringed (fringe length upto 7 cm) flowers were found in one extensive male individual twining over a tall tree whereas the general range of fringe length recorded is only 5 cm.

Locality : Garmal; here, tubercled growth was recorded in secondary and tertiary branches of stem especially near nodes. These tubercles were probably the insect galls.

### **Ecological habitat**

Few along roadsides and on plateaus. Individuals were found on extremely eroded substratum and at one locality on dirty white gravelly soil near a water stream. All the individuals were found in sparse tree canopy vegetation. Species occupies a somewhat different habitat than that recorded in Kalsubai and Bhimashankar Sanctuary.

### **Population characteristics**

Few randomly distributed individuals were recorded in the small reserve area (4.48 km<sup>2</sup>) i.e., species had a sparse population. Comparatively smaller quantitative characteristics values of frequency (105), density (0.10 / m<sup>2</sup>) and abundance (1 ) also reveal a similar structure.

Dispersion pattern : Population exhibits random distribution pattern.

### **Associated vegetation pattern**

Found associated with tree species viz. *Lagerstromia lanceolata*, *Bocagea dalzelli* and *Terminalia tomentosa*.

### **Threats to the genetic diversity**

Exploitation of roots and fruits : The roots are used in carbuncles and said to be beneficial in the inflammation of lungs. They are also used as an antidote to snake bites. The fruits are poisonous, haemagglutinating and used to cure asthma. Ripe fruits are also used for decorative purpose due to their shining scarlet red pericarp. However, exploitation of roots causes depletion of complete individual from its extent of genepool.

## **6 *Solanum virginianum* L. 'Bhuiringani'.**

### **Distribution**

Near R.F.O. (Range Forest Officer) office.

### **Description**

Very prickly diffuse prostrate herbs, woody at the base; stem somewhat zigzag; much branched, the younger ones clothed with dense stellate hairs, prickles compressed, straight, yellow, glabrous and shining exceeding 1 cm in length. Leaves 8-11 x 4-5 cm in dimension; laterate, attenuate at base, acute at apex, prickly and with stellate hairs; petioles 2-3 cm long, with stellate hairs and prickly. Flowers in extra-axillary few flowerd (sometimes single flower) racemes; peduncles short; pedicels short, curved, hairy. Calyx 0.5-1 cm long, linear lanceolate, acute, hairy outside. *Corolla* pale violet, lobes deltoid, hairy outside. Filaments short, anthers lanceolate, opening by small apical pores, yellowish orange coloured. Ovary ovoid; style glabrous. Berries globose, glabrous, white with green veins, surrounded by enlarged calyx. Seeds numerous, compressed, spherical and minutely rugose.

Flrs. & Frts. : December – February.

### **Morphological variations**

Only 4 individuals were recorded within reserve area and so, remarkable variations were not observed.

### **Ecological habitat**

Few on waste places. Only four individuals were found on trampling site (in between R.F.O. office and National Highway) partially exposed to sunlight and having much eroded, compact, dry whitish soil.

### **Population characteristic**

Only 4 individuals were observed within whole sanctuary area therefore, the species can be said to have a fragmented population. Comparatively small quantitative values of population characteristics like frequency (5%), density (0.05 / m<sup>2</sup>) and abundance (1) also support the assumption about structure of population.

### **Associated vegetation pattern**

Found along with *Argemone mexicana*, *Achyranthes aspera* and *Alternanthera pungens*.

### **Threats to the genetic diversity**

Individuals were found affected by trampling activity but upto limited extent.

**Note :** Very sturdy species, also, very resistant to pest attack as compared with two other species viz. *S. anguivi* and *S. giganteum*.

### **7 *Sesamum mulayanum* Nair. 'Ran-til'.**

#### **Distribution**

Along National Highway (Mumbai – Goa) and Khairatwadi.

#### **Description**

Annual prostrate herbs, 1 m long, stem and branches grooved, sparsely hairy with long soft white hairs. Leaves 3.2 – 6.7 x 2.1 – 4.3 cm, elliptic, variously clothed beneath with a white tomentum; petioles 2.5 cm long. Flowers solitary, axillary. Calyx deeply divided, hairy outside; segment linear, strongly ciliate. Corolla lilac with a yellow palate, long, tubular ventriose, minutely pubescent outside. Capsules 3.7 - 4 cm long, scabrous pilose, tetralocular, oblong, compressed, strongly mucronate at the apex. Seeds, obovoid, oblong, rugose, black, numerous.

Flrs. & Frts.: September – October.

#### **Morphological variations**

Localities : At both localities; Polymorphic leaves were found in almost all the individuals. Lanceolate to obovoid, acute to subacute and entire to serrate margin was seen in the leaves and sometimes comparatively smaller leaves developed in between the younger and older leaves of the same individual.

Locality : At roadside (National Highway) comparatively taller (height upto 1m) individuals were recorded in this sanctuary than the individuals growing at Bhimashankar sanctuary. Development of polymorphic leaves was due to inherent tendency of the species whereas ecads (habitat forms) developing along National highway were probably a product of the availability of favourite climatic conditions (avg. temperature 27<sup>o</sup>c, rainfall upto 2540 mm and humidity upto 70%) i.e. of Konjan region.

### **Ecological habitat**

Common along roadsides. Almost all subpopulations were recorded growing along roadside and a few on bunds of cultivated fields near the boundary of sanctuary area. Species prefers mostly waste places like roadsides and bunds of fields having poor and very compact soil with considerable amount of moisture and partially exposed to the sunlight.

### **Population characteristics**

Found abundantly wherever it occurred but comparatively few subpopulations were recorded i.e. distributed at few localities. Quantitative characteristics values of population viz. frequency (15 %), density (0.40/m<sup>2</sup>) and abundance (2.6) also reveal its abundant nature and an intermediate structure.

### **Associated vegetation pattern**

As the species occupied waste places, it was found associated with tall herbaceous species viz. *Heteropogon contortus*, *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*, *Hibiscus vitifolius*, *Malachra capitata*, *Urena lobata* and *Mucuna pruriens*.

### **Threats to the genetic diversity**

Air pollution : As growing along roadsides and in association with *Abelmoschus manihot* ssp. *tetraphyllus* var. *tetraphyllus*, found affected by the same factor i.e., smoke (hot polluted air).

**Notes :** During different visits in a span of two years (1999 and 2000) it was noted that a large number of individuals were aggregated and colonized, competing inter- as well as intraspecifically mainly for space (as growing in limited space between National highway and tree canopy) and nutrition. This ultimately resulted into climax stage through a progressive succession. Dudgeon (1921) named this type of succession as 'Seasonal succession' (as this community developed only in monsoon while other kinds of communities developed in remaining seasons of the year), whereas Misra (1955) stated that 'such changes are simply recurrent and not developmental and thus should not be designated as succession'.

A belt (subpopulation) of aggregated individuals was seen growing along roadsides, nicely adapted to polluted habitat i.e., species may be having a good air pollution tolerance capacity.

**Table No.: 6 Quantitative studies of Karnala Sancury**

Name of the plant species		Number of quadrats studied											
		Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	-	-	-	-	-	3	1	-	1	-	2	-
2	<i>Cajanus scarabaeoides</i>	-	-	-	1	-	-	-	-	-	2	-	1
3	<i>Canavalia cathartica</i>	-	-	1	-	-	-	-	-	-	-	-	-
4	<i>Vigna dalzelliana</i>	2	-	-	-	-	-	-	-	1	-	-	-
5	<i>Vigna sublobata</i>	1	2	-	-	-	-	-	-	-	1	-	-
6	<i>Trichosanthes tricuspidata</i>	-	-	1	-	-	-	-	-	-	-	-	-
7	<i>Solanum virginianum</i>	-	-	-	-	-	-	-	-	-	-	-	-
8	<i>Sesamum mulayanum</i>	-	-	-	-	-	2	5	-	-	-	1	-

Continued ...



	Name of the plant species	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q	I
1	<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	3	-	-	-	1	-	-	-	06	11
2	<i>Cajanus scarabaeoides</i>	-	1	-	-	-	-	-	-	04	05
3	<i>Canavalia cathartica</i>	-	-	-	1	-	1	-	-	03	03
4	<i>Vigna dalzelliana</i>	-	2	-	-	-	-	-	-	03	05
5	<i>Vigna sublobata</i>	-	-	3	-	1	-	-	-	05	08
6	<i>Trichosanthes tricupidata</i>	-	-	-	-	-	-	1	-	02	02
7	<i>Solanum virginianum</i>	-	-	-	-	-	-	-	1	01	01
8	<i>Sesamum mulayanum</i>	-	-	-	-	-	-	-	-	03	08

Where,

Q = Total number of quadrats in which species occurred,

I = Total number of individuals occurring in all quadrats.

Name of the plant Species	Frequency (%)	Density ( / m <sup>2</sup> )	Abundance
<i>Abelmoschus manihot</i> ssp. <i>tetraphyllus</i> var. <i>tetraphyllus</i>	30	0.55	1.83
<i>Cajanus scarabaeoides</i>	20	0.25	1.25
<i>Canavalia africana</i>	15	0.15	1
<i>Vigna dalzelliana</i>	15	0.25	1.66
<i>Vigna sublobata</i>	25	0.40	1.6
<i>Trichosanthes tricuspidata</i>	10	0.10	1
<i>Solanum virginianum</i>	5	0.05	1
<i>Sesamum mulayanum</i>	15	0.40	2.6

## RESULTS

- 1 In general, occurrence of taxa (wild varieties of crop plants) was higher from August onwards.
- 2 In the study period, a total of 27 (11 genera, 23 species and 4 varieties) wild varieties of crop plants were recorded.
- 3 Maximum number (17 species) of wild varieties were recorded in Kalsubai Harishchandragadh sanctuary whereas minimum (5 species) were recorded from Nandur Madhmeshwar sanctuary.
- 4 Except for *Cajanus lineatus* (Flrs. & Frts. February – April), all wild varieties were in flowering and fruiting condition during monsoon and post monsoon season (August – November).
- 5 *Vigna dalzelliana*, *V. sublobata* and *Solanum anguivi* were commonly occurring species and recorded in most reserves whereas, *Abelmoschus pungens*, *Vigna khandalensis*, *V. sericeus* and *Cucumis setosus* were very rarely occurring species.
- 6 Most of the wild varieties were recorded growing at higher altitudes.
- 7 About 75% land of Nandur Madhmeshwar Sanctuary was found under (modern / commercial) cultivation.
- 8 Shifting cultivation, forest fire, commercial exploitation of plant parts and various developmental activities like Hydroelectric project, Road construction and setting up of tourist resorts were recorded within reserve areas.
- 9 Most of the wild varieties were ethnobotanically important plants and found exploited especially for their medicinal value and edible purpose.
- 10 A number of land race varieties of cereals (Rice, *Eleusine* and *Panicum*) and oil seeds (*Guizotia*) are still under cultivation within reserve areas.

## CONCLUSION

- 1 Higher altitudes of W. Ghats harbour maximum wild crop relatives.
- 2 Most of the wild varieties of crop plants favour shrubby vegetation along hill slopes (hilly forests) and plateaus as ecological habitat.
- 3 *Cajanus lineatus* is a very sturdy species and adapted to varied ecological habitats and quite resistant to various diseases therefore, it may be having a good biological potential value.
- 4 In *situ* conservation within Nandur Madhmeshwar Sanctuary is very very difficult because of tremendous encroachment by modern cultivation system.  
*A. manihot* ssp. *tetraphyllus* var. *pungens* was found resistant to diseases commonly observed in other species of the genus but found sensitive to its ecological habitat
- 5 To conclude ecads of different wild varieties as ecospecies, needs genetical study.
- 6 *Abelmoschus manihot* ssp. *tetraphyllus* var. *pungens*, *Canavalia cathartica*, *Vigna khandalensis* and *Vigna vexillata* var. *sepiaria* were rarely occurring species and need immediate conservation measures.
- 7 In Kalsubai Harishchandragadh Sanctuary and Sanjay Gandhi National Park anthropogenic activities are very common.
- 8 Anthropogenic activities at localities viz. Kalsubai hill (shifting cultivation and encroachment by new residential colonies), Ghatghar (Hydroelectric project) and Chunapada (trampling activity) where some endemic and threatened species were recorded, if not controlled, within coming few years will be depleted.
- 9 Commercial exploitation of fruits of *Cucumis melo*, *Momordica dioica* and *Trichosanthes tricuspidata* is merely for decorative and holy purpose therefore needs banning measures.
- 10 *Oryza rufipogon* needs conservation of its ecological habitat.

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