VISIT, PROMOTE & SAVE

NAORADEHI
Wildlife Sanctuary
(The Natural Home of Indian Wolf)

Phytosociology &
Community Structure
INTRODUCTION AND REVIEW OF LITERATURE

Phytosociology is the study of, interrelationship of individuals of many species growing together in the field, and more usually, it includes the study of sets of species forming communities under natural condition.

The word "Phytosociology" is older than ecology and was coined by Ernest Haekel. However, Grisebach 1938, described the plant communities in various regions. Later on school of phytosociology was established in USA, England, Central Europe and North Europe. Various workers have designated it as habitat science (Walter 1971) functional ecology (Odum,1971) or synecology (Braun-Blanquet, 1932).

Oosting (1956) described phytosociology as one of the major aspects in vegetation study. In general phytosociology is defined as the study of composition, development, geographic distribution and environmental relationship of plant communities (Mueller-Dombois and Ellenberg, 1974). A plant community is understood to be a more or less stable combination of naturally occurring species, which are in ecological equilibrium with one another and their environment.

The phytosociological studies are done in order to identify the indicator species which is a traditional activity in ecology and biogeography. The species in a community grow together in a particular environment, because they have similar requirements for existence in
terms of environmental factors such as light, temperature, (Mueller-Dombois and Ellenberg, 1974).

Quantitative measurements and estimation of various parameters of vegetation are considered as a later development in plant ecology. During the last few decades a number of methods and techniques have been evolved in the European and American countries to study them. The European school by Braun-Blanquet had been actively busy in defining and determining the phytosociological characteristics and methodology for estimating the vegetational characteristics. Such phytosociological characteristics like frequency, density, cover, presence, constance and fidelity etc. were precisely defined by Zurich Montpellier school of phytosociology and those were extensively used in the study of vegetation of Europe (Braun-Blanquet, 1932).

A plant community can be defined as a collection of plant species growing together in a particular location that show a definite association of affinity with each other (Mueller-Dombois and Ellenberg, 1974). Most environments of the world support certain associated species which can be characterized as a plant community. The species in a community grow together in a particular environment, because they have similar requirements for existence in terms of environmental factors such as light, temperature, water and soil nutrients. They share the ability to tolerate the activities of animals and humans such as grazing, burning, cutting and trampling. However, the tolerance for the environment by different species would be different and each species will have a definite
tolerance range. If the species grow in association with each other, many
of them, should have similar characters although rarely identical
responses to prevailing environmental conditions.

A plant in a community may be dominant or rare, but there
exists a definite relationship between different species occurring in the
community. However, each species has not only its own ecological
amplitude, but also its particular relationship to the environment and
to the associate species. These interactions among different plants and
between plants and their environment result in the outcome of different
vegetational types in different areas. The quantitative relationship
between rare and profusely growing species is an important structural
property of a community. The quantitative study of the vegetation is
called phytosociology and its principle aim is to describe the vegetation
pattern and classification in a meaningful way.

Cottam (1949) while working on the phytosociology of an oak
woods in southwestern Wisconsin, reported that the two of the herbs
Carex pensylvanica and Poa pratensis possess a density much greater
than any of the other herbs. Poore (1956) while working on the use of
phytosociological methods in ecological investigations came to the
conclusion that the ultimate aim of ecology is to explain the
distribution of vegetation over the earth’s surface in terms of history,
evolution and habitat. In this the phytosociological approach can be
used to elucidate differences of any magnitude, provided they are large
enough to be accompanied by a change in species content.
Cain and Castro (1959) justified the use of multiple plot method for the better understanding of the communities and considered it best to count aerial shoots as separate individuals for all the practical purposes while reviewing the difficulties in evaluating density of plants like bushes and clump grasses.

Mar lange and Meher-Homji (1965) worked on the phytosociological studies of Pondicherry region, concluded that the plant sociological methods used by them were applicable to a tropical region like Pondicherry only, intensively cultivated with high density of population (767 persons per sq. Km.). They also emphasized that country wide survey of the vegetation on a phytosociological basis which would throw light on the behaviour of the vegetation in relation to the environmental complex and their indicator value in different territories.

Kuruvilla (1967) worked on the ecology and phytosociology of Danges forests, Gujarat in AHWA ‘Block’ and dealt with pattern of distribution of various forest communities in relation to topography, soil, microclimate and biota and assessed their ecological status.

Sharma (1972) worked on phytosociological studies on the sand Dunes vegetation of Sikar, Rajasthan and recognized five plant communities in the various localities during the rainy season. He also investigated the phytosociological characters with reference to the frequency, density, abundance and periodicity.
Shah and Bhatt (1980) working on the phytosociology of the forests of Panchmahal district in eastern Gujarat found that there were 25 communities in 30 localities belonging to eight forest ranges of the Panchmahal district. The dominant community for the district is *Tectona-Diospyros-Butea monosperma*.

Varma and Das (1980 a) observed the presence of 7 communities in Small area of Kalaras range each located in specific type of habitat clearly indicating the property of environmental factor in the development of a type of vegetation. Derivations of community co-efficient were used as a basis for the comparisons of communities in respect to similarity and dissimilarity.


Menon (1983) while working on phytosociology of Saurashtra (Gujarat) observed that the mean average percent IVI of dominant species in the area was found to be 1 however the total IVI of all the species reached about 300 in most of the cases. There was not much variation in continuum values of different localities.

Kumar (1987) while working on the phytosociological and productivity studies of Bhaderwah forests (J & K) calculated frequency, density, abundance and IVI values for herbs, shrubs and transgressive trees at three sites.
Singhal and Sharma (1989) studied the phytosociology of moist (Gangetic) high level alluvial sal forest and Gangetic Tropical Moist Deciduous forest and observed that the distribution of species in both the forest types was contagious and random. Further, they found that sal forests were richer in basal cover and more similar amongst each other in terms of community co-efficient with strongly expressed species dominance in comparison to moist deciduous forest. Khare et al., (1989) studied phytosociology of plant communities in central India with two level ordination and found differences in spatial distribution of stand. These differences have been attributed to the underlying rock formation and soil. Also biotic factors have been observed to play an important role in the species composition. Species ordination indicated the dominance of more than one species. The phytosociological and diversity studies in sal forests have been studied by various workers (Bisht, 1989 and Agni et al., 2000).

Sharma, (1990) studied floristic composition and phytosociology of herbaceous community near Dibrugarh and reported 68 angiosperm herbaceous plant species of which 70.5 percent were annual and 29.4 percent were perennial. Joshi and Tiwari (1990) Carried out phytosociological analysis of woody vegetation in a mountain flank in Garhwal Himalaya, and observed that the dominant species were different at different elevation.

Data for phytosociological analysis can be obtained from different methods of sampling. All methods are specific to objectives of the study, topography and types of vegetation etc. Quadrat method of sampling is
very important for the study of vegetation (Misra, 1968, Curtis and Cottam, 1956, Barpour et al., 1987 and Kent and Coker, 1992) because of the obvious relationship of species to area. Several workers have attempted to standardize the size of quadrat used for different layers of vegetation, where certain species dominate.

Cain (1932) has suggested quadrat sizes of 0.01 or 0.1 sq. m. (for soil layer i.e. cryptogams dominated layer), 1.0 to 2.0 sq. m. (herbaceous layer). 4.0 sq. m. (low shrubs) 16.0 sq. m. (tall shrubs and low trees) and 100.00 sq. m. (superior layer of forests). The minimum size of quadrat may vary according to the objective of the study or type of vegetation. Nautiyal et al., (1987) standardized the quadrat size of 900 sq. m. studying the vegetation of South Raipur, Chhtishgarh.

Kumar and Pandey (1993) studied population structure of protected and disturbed forest communities in tropical deciduous forest. Protected forest communities were observed balanced with normal frequency distribution of tree species. They observed Shorea robusta and Terminalia tomentosa dominant in disturbed and protected forest communities.

Bliss (1962) reported that nature of plant community is determined by the species that grow and develop in that particular environment.

Kunhikannan (1999) reported five forest communities from Tadoba National park, Chandrapur, Maharrastra and reported 741 plant species belonging to 427 genera and 115 families.
Communities are mainly classified according to the difference in dominant species whose abundance, size or other attributes exert a major influence upon other species occurring in same locality, classification of communities in the highest level being the subdivision of world vegetation in to recognizable physiognomic categories or biomes (Weaver and Element, 1938).

The concept of importance value index (IVI) has been developed in order to express the dominance and ecological success of any species in single value. Forest with a tree species whose dominance is 40 or more is called single dominant species.


Pandey and Shukla (2005) made the phytosociological characterization of the regional forested landscape of Northeastern Uttar Pradesh which is a mosaic of major and minor plantation forests and interspersed paths of mixed forests. The latter showed greater species richness and number of trees, shrubs and lianas than the associated communities of plantation forests of Sal and Eugenia.

Galav et al., (2005) worked on the phytosociological studies of grassland communities of southern Aravalli Hills of Rajasthan and reported that *Heteropogon contortus* and *Sehima nervosum* are more
frequent on plain and hillock areas of grassland communities respectively. The high value (0.04) of dominance index was recorded on hillock area, while low value (0.039) on plain area. Diversity index was found to be negatively correlated (r =1.00) with dominance index.

Sanjeev and Sankhayan (2006) carried out work on micro watershed area of 13.43 km² in Mussoorie hills, Garhwal Himalayan region and characterized the species composition, vegetation structure and floristic diversity by land use categories. In all, 64 species belonging to 63 genera and 56 families were found to be growing in the micro watershed. The vegetation recorded on scrub forest was found to be more equitable when compared to the vegetation on forest and degraded land.


quantitative parameters such as frequency, abundance, density, IVI concentration of dominance and diversity index.


Mishra and Joshi (1952) recognized seven types of forest communities from Patharia hill and described phytosociological data for the tree, shrub and herb layer.

Pandya (1954) studied grasslands of Sagar and observed that exchangeable calcium to some extent determine the distribution of associations of grasses. *Themeda caudata* occupies soil with moderate amount of exchangeable calcium. *Eulalia cymbopogon* appears in lime rich soil whereas *Hetropogon contortus* appears to evade them.

Bhatia (1958) analysed the vegetation of a mixed deciduous teak forest of central India at Sagar and recognized 4 types and 11 sub types of forests on the basis of co-dominant species.

Mishra (1961) studied the forest communities of five different forests of Sagar in relation to the underlying rock and soil type occupying different physiographic units. Athaya (1980) analysed eight forest site around Sagar and found the vegetation heterogeneous in their compositions, density and extent due to extreme biotic interferences. Thakur (2003) studied the structure and composition of six forest stands in Mainpani forest of Sagar district.
MATERIAL AND METHODS

Phytosociological and other related parameters have been studied in the dry deciduous mixed forest of Naoradehi sanctuary. During this period tree vegetation were studied for phytosociological characteristics using quadrat method (Misra, 1968). The analytical characteristics of tree species were determined by taking 30 quadrats of 10 × 10m size, from various directions at five selected sites.

Quantitative analysis of vegetation for frequency, density and abundance was calculated following Misra, (1968) and Ambasht (1969). The relative frequency, relative density, relative dominance and Importance Value Index (IVI) were calculated after Phillips (1959), Tansley (1946) and Oosting (1956) on five selected sites.

(I) Mohali
(II) Singhpur
(III) Naoradehi
(IV) Sarra
(V) Dongargaon

Phytosociological studies of various plant species were calculated by using the formula as follows:

Frequency: Frequency as introduced by Raunkiaer (1934) indicates the number of sampling units in which a species occurred and thus expresses the distribution or dispersion of various species in a community from this percentage frequency is calculated as follows.
% Frequency \( (F) = \frac{\text{Number of sampling units in which the species occurred}}{\text{Total number of units studied}} \times 100 \)

**Density**: The number of individuals of a species per unit area.

\[ \text{Density } (D) = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats studied}} \]

**Abundance**: The number of individuals of a species per unit of occurrence.

\[ \text{Abundance } (A) = \frac{\text{Total number of individuals of a species in all quadrats}}{\text{Total number of quadrats in which the species occurred}} \]

**Relative frequency**: Is the proportion of frequency of a species to the stand as a whole.

\[ \text{R.F.} = \frac{\text{Number of occurrences of the species}}{\text{Number of occurrences of all species}} \times 100 \]

**Relative density**: Is the proportion of density of a species to that of stand as a whole.

\[ \text{R.D.} = \frac{\text{Number of individual of the species}}{\text{Number of individual of all species}} \times 100 \]

**Relative dominance**: Is the proportion of basal area of a species to that of stand as a whole.

\[ \text{R.D.} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \times 100 \]
Importance Value Index (IVI)

Frequency gives an idea as to how a species is dispersed in the specific area, density denotes the numerical strength while dominance indicates the basal cover. However, the overall ecological status of a species in a given community can be better represented by adding the percentage values of relative frequency (R.F.), relative density (R.D.) and relative dominance (R.Dom.) together. This value out of 300 is called IVI (Curtis and Mc.Intosh, 1950, Cain et al., 1956 and Misra, 1968). IVI is so significant that various associations are derived based on its values. It will also enable one to compare the vegetational structure of various stands as well as the same stand over a period of time so, it gives the total picture or the sociological structure of a species in a community.

\[
\text{IVI} = \text{R. Frequency} + \text{R. Density} + \text{R. Dominance.}
\]

COMMUNITY STRUCTURE

The specific field of the study of communities with respect to their component, structure and classification, forms the basis of a division of ecology called phytosociology. Importance value index (IVI) is one of the important phytosociological attributes used for community identification. Plant communities were referred after the three tree species arranged in this way (Mueller-Dombois and Ellenberge, 1974). Field observations and the photographs were taken during different seasons to represent seasonal changes in the vegetational composition of species.
RESULTS

1. STUDY OF PHYTOSOCIOLOGY:

Phytosociological attributes were studied in all five selected sites.

1. Frequency:

Site - I

This site was inhabited by 30 species of the tree vegetation. 12 species had a frequency value of 50 or above, 16 species had frequency value ranging between 30% to 49% and 2 species had a frequency value of 10% to 29%.

At Mohali the highest frequency value (100%) was shown by *Tectona grandis* and lowest (20%) by *Kydia calycina*.

*Bauhinia racemosa* (53.3%), *Emblica officinalis* (60%), *Flacourtia indica* (50%), *Lagerstroemia parviflora* (80%), *Miliusa tomentosa* (56.6%), *Terminalia tomentosa* (90%) and *Zizyphus xylopyra* (66.6%) were the most frequent species from site 1 (Table 6.1).

Site- II

Out of a total of 31 species of the tree vegetation on this site, 19 species had a frequency value of 50% or above, 9 species had a frequency value of 30% to 49% and 3 species had a frequency value of 10% to 29%.

At Singhpur the highest frequency value (100%) was shown by *Tectona grandis* and lowest (20%) by *Madhuca indica*. 
Aegle marmelos (60%), Albizia lebbek (63.3%), Butea monosperma (90%), Cassia fistula (63.3%), Dalbergia paniculata (73.3%), Diospyros melanoxylon (80%), Miliusa tomentosa (63.3%), Mitragyna parvifolia (73.3%), Terminalia tomentosa (100%) and Wrightia tinctoria (56.6%) were the other frequent species at this site 2 (Table 6.2).

Site - III

This site was inhabited by 30 species of the tree vegetation. 12 species had frequency value of 50% or above, 14 species had frequency value of 30% to 49% and 4 species had frequency value of 10% to 29%.

At Naoradehi the highest frequency value (100%) was shown by Tectona grandis and lowest (20%) by Gardenia latifolia.

Bauhinia racemosa (53.3%), Butea monosperma (66.6%), Dalbergia latifolia (56.6%), Dalbergia paniculata (60%), Diospyros melanoxylon (80%), Holoptelea integrifolia (56.6%), Randia dumetorum (66.6%), Schleichera oliosa (53.3%), Terminalia tomentosa (100%) and Zizyphus xylopyra (46.6%) were the most frequent species from site 3 (Table 6.3).

Site - IV

Out of a total of 26 species of the tree vegetation on this site, 21 species had a frequency value of 50% or above, 3 species had a frequency value of 30% to 49% and 1 species had a frequency value of 10% to 29%.

At Sarra the highest frequency value (100%) was shown by Tectona grandis and lowest (20%) by Miliusa tomentosa.
Acacia catechu (66.6%), Adina cordifolia (70%), Anogeissus pendula (66.6%), Butea monosperma (90%), Diospyros melanoxylon (50%), Emblica officinalis (73.3%), Lannea coromandelica (56.6%), Randia dumetorum (60%), Terminalia tomentosa (86.6%) and Wrightia tinctoria (63.3%) were the other most frequent species at this site 4 (Table 6.4).

Site - V

This site was inhabited by 28 species of the tree vegetation. 23 species had a frequency value of 50% or above, 5 species had frequency value ranging between 30% to 49% and none of the species had a frequency value of 10% to 29%.

At Dongargaon the highest frequency value (100%) was shown by Tectona grandis and lowest (30%) by Diospyros melanoxylon.

Acacia catechu (66.6%), Aegle marmelos (60%), Anogeissus pendula (90%), Bridelia retusa (73.3%), Butea monosperma (63.3%), Emblica officinalis (60%), Lagerstroemia parviflora (60%), Randia dumetorum (70%), Terminalia tomentosa (93.3%) and Zizyphus xylopyra (63.3%) were the most frequent species from site 5 (Table 6.5).

2. Density :

Site - I

Out of a total of 30 species, none of the species had the density value of 10 or more, 16 species had density values ranging from 1 to 10 and 14 species had values in fractions.
At Mohali the highest density value (2.93) was shown by Tectona grandis and lowest (0.4) by Acacia catechu.

Albizzia lebbek (1.83), Butea monosperma (1.86), Flacourtia indica (1.26), Diospyros melanoxylon (1.43), Terminalia tomentosa (2.23), Wrightia tinctoria (1.06) and Zizyphus xylopyra (1.2) were the most densely distributed species at site 1 (Table 6.1).

Site - II

Out of a total of 31 species, none of the species had the density value of 10 or more, 21 species had density values ranging from 1 to 10 and 10 species had values in fractions.

At Singhapur the highest density value (3.16) was shown by Tectona grandis and lowest (0.4) by Lagerstroemia parviflora.

Acacia catechu (1.43), Adina cordifolia (1.56), Butea monosperma (2.6), Dalbergia paniculata (1.93), Flacourtia indica (1.46), Mitragyna parvifolia (1.83), Terminalia tomentosa (2.93), Wrightia tinctoria (1.06) and Zizyphus xylopyra (1.43) were the most densely distributed species at site 2 (Table 6.2).

Site - III

Out of a total of 30 species, none of the species had the density value of 10 or more, 12 species had density values ranging from 1 to 10 and 18 species had values in fractions.

At Naoradehi the highest density value (3.06) was shown by Tectona grandis and lowest (0.4) by Flacourtia indica.
Butea monosperma (1.06), Dalbergia paniculata (1.13), Diospyros melanoxylon (2.46), Holoptelea integrifolia (1.4), Lagerstroemia parviflora (1.46) Mitragyna parvifolia (1.33), Randia dumetorum (1.23), Terminalia tomentosa (2.83) and Zizyphus xylopyra (1.03) were the most densely distributed species at site 3 (Table 6.3).

Site - IV

Out of a total of 26 species, none of the species had the density values of 10 or more, 13 species had density values ranging 1 to 10 and 13 species had values in fractions.

At Sarra the highest density value (3.00) was shown by Tectona grandis and lowest (0.7) by Randia dumetorum.

Adina cordifolia (1.03), Albizzia lebbek (1.06), Bauhinia racemosa (1.03), Butea monosperma (2.93), Diospyros melanoxylon (1.4), Mitragyna parvifolia (1.53), Terminalia tomentosa (2.4) and Zizyphus xylopyra (1.16) were the most densely distributed species at site 4 (Table 6.4).

Site - V

Out of a total of 28 species, none of the species had the density value of 10 or more, 19 species had density values ranging 1 to 10 and 9 species had values in fractions.

At Dongargaon the highest density value (3.2) was shown by Tectona grandis and lowest (0.4) by Chloroxylon swietenia.

Acacia catechu (1.83), Albizzia lebbek (1.73), Anogeissus pendula (2.56), Bridelia retusa (2.00) Emblica officinalis (1.23), Flacourtia indica
Lagerstroemia parviflora (1.26), Pterocarpus marsupium (1.06), Randia dumetorum (1.73), Terminalia tomentosa (2.8) and Zizyphus xylopyra (1.16) were the most densely distributed species at site 5 (Table 6.5).

3. Abundance:

Site - I

Out of a total of 30 species which were recorded from site 1, 29 species had abundance values below 10, out of which 1 species had abundance values in fractions.

At Mohali the highest abundance value (3.00) was shown by Emblica officinalis and lowest (0.7) by Anogeissus latifolia.

Acacia leucophloea (2.0) Bauhinia racemosa (1.90), Buchanania lanzan (2.53), Butea monosperma (2.33), Flacourtia indica (2.53), Kydia calycina (1.43), Lagerstroemia parviflora (2.84), Mirtagyna parvifolia (1.4), Tectona grandis (2.93), Terminalia tomentosa (2.39) and Zizyphus xylopyra (2.62) were the abundant species at this site (Table 6.1).

Site - II

Out of a total of 31 species, 30 species had abundance values below 10, out of which 1 species had abundance values in fractions.

At Singhpur the highest frequency value (4.77) was shown by Gardenia latifolia and lowest (0.8) by Lagerstroemia parviflora.

Acacia catechu (2.52), Adina cordifolia (2.61), Butia monosperma (2.88), Diospyros melanoxylon (2.91), Miliusa tomentosa (1.68),
Mitragyna parvifolia (2.5), Tectona grandis (3.16), Terminalia tomentosa (2.93), Wrightia tinctoria (1.88) and Zizyphus xylopyra (2.26) were the abundant species at this site (Table 6.2).

**Site - III**

At this site, out of a total of 30 species, 29 species had abundance values below 10, out of which 1 species had values in fractions.

At Naoradehi the highest value (5.00) was shown by Lannea coromandelica and lowest (0.88) by Dalbergia latifolia.

Aegle marmelos (1.35), Cassia fistula (1.84), Diospyros melanoxylon (3.08), Elaeodendron glaucum (2.44), Holoptelea integrifolia (2.47), Lagerstroemia parviflora (3.14), Randia dumetorum (2.31), Tectona grandis (3.06), Terminalia tomentosa (2.83) and Zizyphus xylopyra (2.21) were the abundant species at this site (Table 6.3).

**Site - IV**

Out of a total of 26 species, all the 26 species had abundance values below 10, out of which none of the species had values in fractions.

At Sarra the highest frequency value (5.33) was shown by Miliusa tomentosa and lowest (1.11) by Lannea coromandelica.

Albizzia lebbek (1.88), Butea monosperma (3.25), Diospyros melanoxylon (2.8), Flacourtia indica (1.52), Madhuca indica (2.88),
*Mitragyna parvifolia* (3.06), *Tectona grandis* (3.00), *Terminalia tomentosa* (2.76) and *Zizyphus xylopyra* (1.94) were the other abundant species at this site (Table 6.4).

**Site - V**

Out of a total of 28 species which were recorded from site 5, 28 species which had abundance value below 10, out of which none of the species had abundance values in fraction.

At Dongargaon the highest frequency value (3.25) was shown by *Albizia lebbeck* and lowest (1.3) by *Anogeissus latifolia*.

*Acacia catechu* (2.75), *Bauhinia racemosa* (2.70), *Cassia fistula* (2.33), *Emblica officinalis* (2.05), *Flacourtia indica* (2.76), *Mitragyna parvifolia* (2.8), *Randia dumetorum* (2.47), *Tectona grandis* (3.2), *Terminalia tomentosa* (3.00) and *Zizyphus xylopyra* (1.84) were the abundant species at this site (Table 6.5).

4. **Importance Value Index (IVI):**

**Site - I**

Out of total of 30 species, 7 species had IVI values more than 10 and remaining 23 species had IVI values less than 10.

At Mohali the highest IVI value (36.48) was shown by *Tectona grandis* and lowest (4.47) by *Kydia calycina*.

Apart from the earlier mentioned species, following are the other associated species IVI values at this site, *Aegle marmelos* (7.89),
Albizzia lebbeck (9.3), Bauhinia racemosa (9.33), Buchanania lanzan (10.93), Emblica officinalis (12.7), Madhuca indica (6.59), Pterocarpus marsupium (5.24), Terminalia tomentosa (32.01), Lagerstroemia parviflora (13.29), Wrightia tinctoria (6.6) and Zizyphus xylopyra (10.61) (Table - 6.1).

Site - II

Out of total of 31 species, 6 species had IVI values more than 10 and remaining 25 species had IVI values less than 10.

At Singhpur the highest IVI value (25.89) was shown by Tectona grandis and lowest (3.04) by Sterculia urens.

Apart from the earlier mentioned species, following are the other associated species IVI values at this site, Acacia catechu (11.05), Butea monosperma (18.61), Cassia fistula (7.89), Diospyros melanoxylon (12.6), Flacourtia indica (9.84), Lannea coromandelica (7.86), Mitragyna parvifolia (12.99), Terminalia bellerica (6.37), Terminalia tomentosa (24.57), Wrightia tinctoria (24.57), Wrightia tinctoria (7.11) and Zizyphus xylopyra (8.53) (Table 6.2).

Site - III

Out of total of 30 species, only 5 species had IVI values more than 10 and remaining 25 species had IVI values less than 10.

At Naoradehi the highest IVI value (41.72) was shown by Tectona grandis and lowest (3.4) by Flacourtia indica.
Apart from the earlier mentioned species, following are the other associated species IVI values at this site. *Acacia catechu* (6.92), *Bauhinia racemosa* (7.78), *Butea monosperma* (14.54), *Diospyros melanoxylon* (22.21), *Grewia tiliaefolia* (7.99), *Lagerstroemia parviflora* (9.39), *Randia dumetorum* (10.33), *Schleichera oliosa* (5.27), *Terminalia tomentosa* (33.23) and *Zizyphus xylopyra* (6.73) (Table 6.3).

**Site - IV**

Out of total of 26 species, only 8 species had IVI values more than 10 and remaining 18 species had IVI values less than 10.

At Sarra the highest IVI value (39.52) was shown by *Tectona grandis* and lowest (5.72) by *Miliusa tomentosa*.

Apart from the earlier mentioned species, following are the other associated species IVI values at this site, *Adina cordifolia* (11.03), *Bauhinia racemosa* (12.089), *Butea monosperma* (27.16), *Cassia fistula* (11.89), *Emblica officinalis* (12.21), *Lagerstroemia parviflora* (9.88), *Madhuca indica* (7.27), *Mitragyna parvifolia* (9.85), *Randia dumetorum* (8.24), *Terminalia tomentosa* (26.81), *Wrightia tinctoria* (10.17) and *Zizyphus xylopyra* (9.66) (Table 6.4).

**Site - V**

Out of total of 28 species, only 7 species had IVI values more than 10 and remaining 21 species had IVI values less than 10.

At Dongargaon the highest IVI value (32.23) was shown by *Tectona grandis* and lowest (4.13) by *Diospyros melanoxylon*.
Apart from the earlier mentioned species, following are the other associated species IVI values at this sites, *Acacia leucophloea* (8.36), *Anogeissus pendula* (22.94), *Butea monosperma* (14.35), *Cassia fistula* (8.96), *Emblica officinalis* (10.63), *Lannea coromandelica* (8.12), *Mitragyna parvifolia* (8.11), *Randia dumerorum* (10.07), *Schleicheria oleosa* (8.69), *Terminalia tomentosa* (28.67) and *Zizyphus xylopyra* (8.95) (Table 6.5).

2. STUDY OF COMMUNITIES:

Plant communities are studied by using analytical characters which can be sub-divided into quantitative (Frequency, Density, Abundance, Cover, Dominance etc.) and qualitative characters (Physiognomy, Phenology, Life form etc.). The vegetational analysis, therefore, is the study of both the structure of vegetation and vegetation systematics, giving emphasis on species composition as well as inter relationships of species in communities. It further includes the process or method of community variations in the spatial or geographic sense and the study of community development, change and stability in time sense (Mueller-Dambois and Ellenberg, 1974). Each community is characterised with particular species dominant or constant etc., hence this concept is considered as individualistic concept. It considers that each species has a distribution within its total range of tolerance to environmental factors and each individual species tends to be distributed independently of others, occurring where it can disperse and survive (Gleason, 1926).
Complexes of vegetation are called plant communities. They are dynamic and are subjected to variations due to environmental complexes. Plant communities have been classified on various phytosociological characters, geology of the area, geography, soil type, climate, altitude, floristic units and dominant species. No single system of classification provides a real insight into the community structure of a specific area because of the dynamics and unmarked boundaries of a particular community.

In the present study, the tree vegetation of the sanctuary area has been classified on the basis of presence of the most conspicuous or dominant species, which is termed as dominant type (Whittaker 1972).

A broad account of various plant communities of five selected sites of the study area is presented as under:

**Site - I**

1. *Tectona grandis* had maximum importance value index (IVI) (36.48), followed by *Terminalia tomentosa* (32.02) and *Lagerstroemia parviflora* (13.29) therefore the plant community was identified as **Tectona-** *Terminalia- Lagerstroemia* type (Table 6.1).

**Site - II**

2. *Tectona grandis* had maximum importance value index (IVI) (25.89), followed by *Terminalia tomentosa* (24.57) and *Butea monosperma* (18.61), therefore the plant community was identified as **Tectona-** *Terminalia-Butea* type (Table 6.2).

**Site - III**

3. *Tectona grandis* had maximum importance value index (IVI) (40.72), followed by *Terminalia tomentosa* (33.23) and *Diospyros*
melanoxylon (22.21), therefore the plant community was identified as **Tectona-Terminalia-Diospyros** type (Table 6.3).

**Site - IV**

4. *Tectona grandis* had maximum importance value index (IVI) (39.52) followed by *Terminalia tomentosa* (26.81) and *Butea monosperma* (27.16), therefore the plant community was identified as **Tectona-Terminalia-Butea** type (Table 6.4).

**Site - V**

5. *Tectona grandis* had maximum importance value index (IVI) (32.23) followed by *Terminalia tomentosa* (28.67) and *Anogeissus pendula* (22.94), therefore the plant community was identified as **Tectona-Terminalia-Anogeissus** type (Table 6.5).

IVI study of the present forest indicate 5 different kinds of communities on different sites. Out of 31 tree species occurring in the forest, *Tectona grandis, Terminalia tomentosa, Butea monosperma, Lagerstroemia parviflora* and *Anogeissus pendula* were dominants. The other co-dominants species were *Aegle marmelos, Acacia catechu, Bridelia retusa, Buchanania lanzan, Diospyros melanoxylon, Emblica officinalis, Mitragyna parvifolia, Randia dumetorum, Wrightia tinctoria* and *Zizyphus xylopyra*.

This indicates that different environmental complex regulated the vegetation in different sites. The variation on vegetation may be attributed to the different intensity of exposure to the grazing and lopping.
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1- Area covered with *Terminalia tomentosa* W&A trees

2- Area covered with teak mixed forest type

3- A close view showing dominant tree species *Aegle marmelos* Correa at Singhpur (site II)
1- A dense forest vegetation at Mohali (site I)

2- Area covered with Bamboo trees

3- Area covered with Acacia arabica Wild trees
1- Forest vegetation at Mohali (site I)

2- Dominant tree species
*Terminalia tomentosa*
W&A at Singhpur (site II)

3- Vegetation of Naoradehi (side III) showing dominant tree
*(Tectona grandis Linn)*
1- Forest vegetation at Sarra (site IV)

2- Dense forest vegetation at Dongargaon (site V)

3- Large trees of *Tectona grandis* Linn in the forest at Sarra (site IV)