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# Phytosociology of selected plant communities in Mumbai District

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**Abstract**
Phytosociology is the study of the characteristics, classification, relationships, and distribution of plant communities. A phytosociological system is a system for classifying these communities. In the present study six sites of Mumbai district were selected for phytosociological studies of plant communities during year 2016-17. At each site, the frequency percentage, frequency class, density and abundance was estimated by using Quadrat method. The data of all the six sites of Mumbai district showed that the plant community was more towards heterogenosity.

**Keywords:** phytosociology, plant community, classification, quadrat

## 1. Introduction
Vegetation units as understood by phytosociologists may express largely abstract vegetation concept (e.g. the set of all hard-leaved evergreen forests of Western Mediterranean area) or actually readily recognizable vegetation types (e.g. cork-oak oceanic forests on Pleistocene dunes with dense canopy in SW-Iberian Peninsula). Such conceptual units are called "syntaxa" (singular syntaxon) and can be set in a hierarchy system called "synsystem" or syntaxonomical system. The act of creation, amelioration or adjusting the synsystem is called "Syntaxonomy". Therefore, the syntaxonomical system is putatively a sufficient empirical representation of vegetation of a given territory. An *International Code of Phytosociological Nomenclature*, issuing the rules for naming "syntaxa" exists and its use has increased among vegetation scientists. To characterize the community as a whole, certain numerical constants called parameters are used. The total counts of individuals of each species, mean value of individuals of a species per plot, for example, are parameters. The value of a parameter as estimated from the samples is the estimate which is hoped to be accurate or close to the real value. In the community, the individuals of all the species are not evenly distributed. Individuals of some species are widely spaced while those of some other species are found in clumps or mats. The distribution patterns of individuals of different species indicate their reproductive capacity as well as their adaptability to the environment. The aim of phytosociology is to achieve a sufficient empirical model of vegetation using plant taxa combinations that characterize univocally vegetation units. The present study gives an insight of the phytosociology of the standing vegetation (small herbs and grasses) including study of all features helpful for better survival and perpetuation of species.

## 2. Materials and Method
Six sites of Mumbai district were selected for phytosociological studies of plant communities. These are:

**Table 1**

| Site No. | Site Name | Site geographical location |
|---|---|---|
| 1. | Sanjay Gandhi National Park, Borivali | 19°15′N 72°55′E |
| 2. | Palghar | 19.69°N 72.76°E |
| 3. | Panvel roadside | 18°59′40″N 73°06′50″E |
| 4. | Parel railway station | 18.99°N 72.84°E |
| 5. | Mahim railway station | 19.035°N 72.84°E |
| 6. | Wilson College campus | 18.951°N 72.811°E |

At each site, the frequency percentage, frequency class, density and abundance was estimated by using 1.0 m x 1.0m ($1.0m^2$) quadrat. The data was complied and were analysed for qualitative and quantitative study using following formulae-

$$\text{Frequency percentage} = \frac{\text{Total number of quadrats in which the species occur}}{\text{Total number of quadrats studies}} \times 100$$

**Table 2:** Distribution of frequency classes-

| Frequency % | Frequency class |
|---|---|
| 1-20% | A |
| 21-40% | B |

| | |
|---|---|
| 41-60% | C |
| 61-80% | D |
| 81-100% | E |

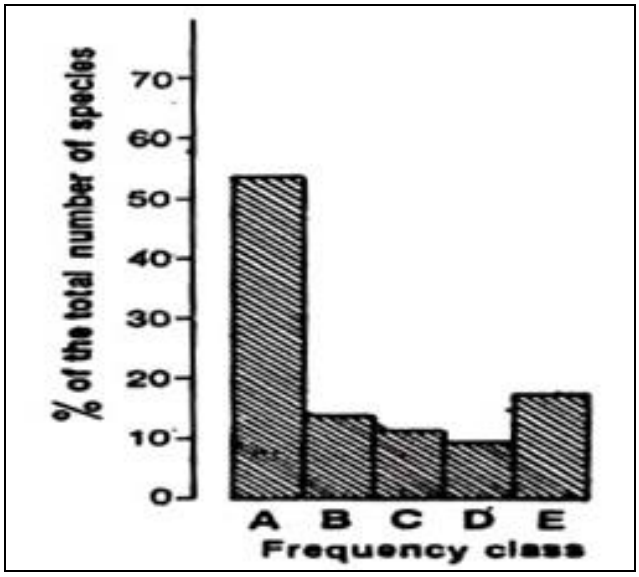


**Fig 1:** Histogram showing normal frequency diagram

The experimental frequency classes were compared with the standard Raunkiaer Law of Frequency as shown below-
A > B> C – D < E (Fig 1.)
Density= Total no. of individual species/ Total no. of quadrat studied
Abundance= Total no. of individual species/ Total no. of quadrat in which species occur

### 3. Results and Discussion

It was observed that at Site-I which was of Sanjay Gandhi National Park, Borivali (Table-1) the vegetation was more towards homogenosity. At this site the frequency classes are A= 14, B= 1, C= 1, D= 0 and E= 0. So the patterns of frequency class was A>B=C. The dominant species at this site was *Arundinella pumila* followed by *Convolvulus arvensis* but the frequency percentage is highest of *Peristrophe bicalyculata*. The density and abundance was found to be highest of *Arundinella pumila*. Table-2 depicts which was at Site-II (Palghar) the vegetation was heterogenous. At Palghar site the frequency classes was found to be A= 0, B= 4, C= 2, D= 2 and E= 0. Hence, the pattern of frequency class is B>C=D. The dominant species at Palghar site was *Impatiens balsamia* followed by $Q_5$ which is *Alternanthera sessillis*. The frequency percentage was highest of *Impatiens balsamia* which was 80%. The density was highest of *Impatiens balsamia* but abundance was found to be highest of *Impatiens balsamia* as well as *Vernonia cinerea*. It was observed at Site-III (Table-3) that the plant community is heterogenous. At Panvel roadside the species which was dominant in this area was *Cyperus rotundus* followed by *Vernonia cinerea*. *Cassia tora* are least in number. At this site the frequency classes was found to be A= 0, B= 1, C= 4, D= 0 and E= 0. Hence the pattern of frequency class is B<C. The frequency percentage was highest of *Cyperus rotundus* which was 60% followed by *Desmodium trifolium*, *Cassia tora* and *Vernonia cinerea* which are all 50%. Density and abundance both are highest in case of *Cyperus rotundus*. Least density and abundance was observed in *Cassia tora*. It was observed in table-4 (Site-IV) at Parel railway station the vegetation was homogenous. At this site the frequency classes are A= 0, B= 0, C= 2, D= 1 and E= 2. So the patterns of frequency class is C>D<E. The dominant species at this site was *Cynodon dactylon* which was 63 in number followed by *Ageratum conyzoides* which was 40 in number. The frequency percentage was highest of *Cynodon dactylon* (100%) and least was observed in *Sida cordifolia* and *Euphorbia hirta* i.e. 60%. The density and abundance was found to be highest of *Cynodon dactylon*. Table-5 shows 5th Site i.e. Mahim railway station. At this site the vegetation was found to be heterogenous. At this site the frequency classes are A= 0, B= 1, C= 1, D= 2 and E= 1. So the patterns of frequency class is B=C<D>E. The dominant species at this site was *Parthenium hysterophorus* which was 134 in number followed by *Calotropis gigantea* which was 37 in number. Least number was recorded in *Sida cordifolia*. The frequency percentage was cent percent in case of *Parthenium hysterophorus*. Density and abundance was also highest of plant $T_1$ i.e. *Parthenium hysterophorus*. Lowest density and abundance was recorded in *Sida cordifolia* ($T_3$) i.e. 0.5 and 1.2, respectively. *Cynodon dactylon* ($U_1$) was found to be highest at site-VI of table-6 which was 80 in number and the vegetation is heterogenous of Wilson college campus. At this site the frequency classes are A= 0, B= 4, C= 1, D= 0 and E= 1. So the patterns of frequency class is B>C=E. The frequency percentage was cent percent in case of species ($U_1$) followed by $U_4$ i.e. *Vinca rosea* which is 50%. Density and abundance was also highest of plant *Cynodon dactylon* i.e 8.

**Table 1:** Site- I. Sanjay Gandhi National Park, Borivali

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $P_1$ | 22 | 15 | 20 | 7 | - | 3 | - | 4 | - | - | 71 | 6 | 10 | 60 | C | 7.1 | 11.8 |
| 2. | $P_2$ | 180 | 120 | 150 | - | - | - | - | - | - | - | 450 | 3 | 10 | 30 | B | 45 | 150 |
| 3. | $P_3$ | 1 | - | - | - | - | - | - | - | - | - | 1 | 1 | 10 | 10 | A | 0.1 | 1 |
| 4. | $P_4$ | - | 5 | - | - | - | - | - | - | - | - | 5 | 1 | 10 | 10 | A | 0.5 | 5 |
| 5. | $P_5$ | - | 20 | - | - | - | - | - | - | - | - | 20 | 1 | 10 | 10 | A | 2 | 20 |
| 6. | $P_6$ | - | - | 2 | - | - | - | - | - | - | - | 2 | 1 | 10 | 10 | A | 0.2 | 2 |
| 7. | $P_7$ | - | - | 1 | - | - | - | - | - | - | - | 1 | 1 | 10 | 10 | A | 0.1 | 1 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8. | $P_8$ | - | - | - | 1 | - | 1 | - | - | - | - | 2 | 2 | 10 | 20 | A | 0.2 | 1 |
| 9. | $P_9$ | - | - | - | 3 | - | - | - | - | - | - | 3 | 1 | 10 | 10 | A | 0.3 | 3 |
| 10. | $P_{10}$ | - | - | - | 6 | - | - | - | - | - | - | 6 | 1 | 10 | 10 | A | 0.6 | 6 |
| 11. | $P_{11}$ | - | - | - | - | 13 | - | - | - | - | - | 13 | 1 | 10 | 10 | A | 1.3 | 13 |
| 12. | $P_{12}$ | - | - | - | - | 140 | - | - | - | - | - | 140 | 1 | 10 | 10 | A | 14 | 140 |
| 13. | $P_{13}$ | - | - | - | - | - | - | 50 | - | - | - | 50 | 1 | 10 | 10 | A | 5 | 50 |
| 14. | $P_{14}$ | - | - | - | - | - | - | - | 1 | - | - | 1 | 1 | 10 | 10 | A | 0.1 | 1 |
| 15. | $P_{15}$ | - | - | - | - | - | - | - | 4 | - | - | 4 | 1 | 10 | 10 | A | 0.4 | 4 |
| 16. | $P_{16}$ | - | - | - | - | - | - | - | - | 25 | - | 25 | 1 | 10 | 10 | A | 2.5 | 25 |

Where,

$P_1$= *Peristrophe bicalyculata,* $P_2$= *Arundinella pumila,* $P_3$= *Acalypha alba,* $P_4$= *Abutilon indicum,* $P_5$= *Euphorbia hirta,* $P_6$= *Calotropis gigantean,* $P_7$= *Ricinus communis,* $P_8$= *Barleria prinoitis,* $P_9$= *Pongamia pinnata,* $P_{10}$= *Scorpularia dulcis,* $P_{11}$= *Ageratum conyzoides,* $P_{12}$= *Convolvulus arvensis,* $P_{13}$= *Macaranga peltata,* $P_{14}$= *Zizuphus jujube,* $P_{15}$= *Vernonia cinerea,* $P_{16}$= *Sida cordifolia*

**Table 2:** Site- II. Palghar

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $Q_1$ | 5 | 2 | 3 | 4 | 2 | 2 | - | - | 1 | 2 | 20 | 8 | 10 | 80 | D | 2 | 2.5 |
| 2. | $Q_2$ | - | 3 | - | - | - | 2 | 1 | - | - | 1 | 7 | 4 | 10 | 40 | B | 0.7 | 1.7 |
| 3. | $Q_3$ | 1 | - | 2 | - | 2 | - | 5 | - | 1 | 2 | 13 | 6 | 10 | 60 | C | 1.3 | 2.1 |
| 4. | $Q_4$ | 1 | 2 | - | 2 | 1 | 2 | - | 3- | - | 2 | 13 | 7 | 10 | 70 | D | 1.3 | 1.8 |
| 5. | $Q_5$ | - | - | 2 | - | 4 | - | 6 | - | 4 | - | 16 | 4 | 10 | 40 | B | 1.6 | 4 |
| 6. | $Q_6$ | - | 2 | 1 | - | 5 | 2 | - | - | - | - | 10 | 4 | 10 | 40 | B | 1 | 2.5 |
| 7. | $Q_7$ | - | - | - | - | - | 4 | - | 2 | - | 1 | 7 | 3 | 10 | 30 | B | 0.7 | 2.3 |
| 8. | $Q_8$ | - | - | 1 | - | - | 1 | - | 2 | 2 | 3 | 9 | 5 | 10 | 50 | C | 0.9 | 1.8 |

Where,

$Q_1$= *Impatiens balsamia,* $Q_2$= *Celosia argentea,* $Q_3$= *Phyllanthus niruri,* $Q_4$= *Achyranthes aspera,* $Q_5$= *Alternanthera sessillis,* $Q_6$= *Vernonia cinerea,* $Q_7$= *Cassia tora,* $Q_8$= *Tridex procumbens*

**Table 3:** Site- III. Panvel roadside

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $R_1$ | 2 | 1 | 3 | 7 | - | - | 1 | - | - | 5 | 19 | 6 | 10 | 60 | C | 1.9 | 3.1 |
| 2. | $R_2$ | 1 | - | - | 1 | - | 2 | - | 1 | - | 2 | 7 | 5 | 10 | 50 | C | 0.7 | 1.4 |
| 3. | $R_3$ | - | - | 1 | - | 2 | - | 1 | - | 1 | 1 | 6 | 5 | 10 | 50 | C | 0.6 | 1.2 |
| 4. | $R_4$ | - | - | - | - | 4 | - | 1 | - | 2 | 2 | 9 | 4 | 10 | 40 | B | 0.9 | 2.2 |
| 5. | $R_5$ | - | 5 | - | 1 | - | 2 | - | 2 | 1 | - | 11 | 5 | 10 | 50 | C | 1.1 | 2.2 |

Where,

$R_1$= *Cyperus rotundus,* $R_2$= *Desmodium trifolium,* $R_3$= *Cassia tora,* $R_4$= *Tridex procumbens,* $R_5$= *Vernonia cinerea*

**Table 4:** Site- IV. Parel railway station

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $S_1$ | 20 | 10 | 5 | 5 | 6 | 7 | 2 | 2 | 2 | 4 | 63 | 10 | 10 | 100 | E | 6.3 | 6.3 |
| 2. | $S_2$ | 10 | 8 | 7 | 4 | 5 | 2 | 1 | 2 | - | 1 | 40 | 9 | 10 | 90 | E | 4 | 4.4 |
| 3. | $S_3$ | - | 2 | 3 | - | 5 | - | 2 | 1 | - | 2 | 15 | 6 | 10 | 60 | C | 1.5 | 2.5 |
| 4. | $S_4$ | - | 2 | - | 4 | - | 2 | - | 1 | 1 | 1 | 11 | 6 | 10 | 60 | C | 1.1 | 1.8 |
| 5. | $S_5$ | 2 | 4 | - | 1 | 2 | 1 | - | 2 | 1 | 2 | 15 | 8 | 10 | 80 | D | 1.5 | 1.8 |

Where,

$S_1$= *Cynodon dactylon,* $S_2$= *Ageratum conyzoides,* $S_3$= *Sida cordifolia,* $S_4$= *Euphorbia hirta,* $S_5$= *Abutilon indicum*

**Table 5:** Site- V. Mahim railway station

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $T_1$ | 24 | 21 | 15 | 18 | 10 | 8 | 10 | 12 | 11 | 5 | 134 | 10 | 10 | 100 | E | 13.4 | 13.4 |
| 2. | $T_2$ | 1 | 2 | 3 | - | 2 | 1 | - | - | 1 | 2 | 12 | 7 | 10 | 70 | D | 1.2 | 1.7 |
| 3. | $T_3$ | 1 | - | 1 | - | - | 2 | - | 1 | - | - | 5 | 4 | 10 | 40 | B | 0.5 | 1.2 |
| 4. | $T_4$ | 9 | 6 | 5 | 9 | 4 | - | 2 | - | - | 2 | 37 | 7 | 10 | 70 | D | 3.7 | 5.2 |
| 5. | $T_5$ | 2 | 1 | - | - | - | 1 | - | - | 2 | 1 | 7 | 5 | 10 | 50 | C | 0.7 | 1.4 |
| Where, | | | | | | | | | | | | | | | | | | |
| $T_1$= *Parthenium hysterophorus*, $T_2$= *Ipomea carica*, $T_3$= *Sida cordifolia*, $T_4$= *Calotropis gigantean*, $T_5$= *Phyllanthus niruri* | | | | | | | | | | | | | | | | | | |

**Table 6:** Site- VI. Wilson College Campus

| Serial No. | Plant species | No. of quadrats | | | | | | | | | | Total no. of a species | Total no. of quadrats in which species occured | Total no. of quadrats studied | Freq.% | Frequency class | Density | Abundance |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | | | | | | | |
| 1. | $U_1$ | 12 | 10 | 8 | 11 | 12 | 8 | 7 | 3 | 4 | 5 | 80 | 10 | 10 | 100 | E | 8 | 8 |
| 2. | $U_2$ | 2 | - | - | 1 | - | - | 2 | - | - | 1 | 6 | 4 | 10 | 40 | B | 0.6 | 1.5 |
| 3. | $U_3$ | 3 | - | - | 2 | - | - | 1 | - | - | 2 | 8 | 4 | 10 | 40 | B | 0.8 | 2 |
| 4. | $U_4$ | - | 2 | 1 | - | 1 | - | 2 | - | - | 2 | 8 | 5 | 10 | 50 | C | 0.8 | 1.6 |
| 5. | $U_5$ | 2 | - | - | - | 2 | - | - | 1 | - | 1 | 6 | 4 | 10 | 40 | B | 0.6 | 1.5 |
| 6. | $U_6$ | 2 | - | 1 | - | - | 1 | - | - | 2 | - | 6 | 4 | 10 | 40 | B | 0.6 | 1.5 |
| Where, | | | | | | | | | | | | | | | | | | |
| $U_1$= *Cynodon dactylon*, $U_2$= *Mimosa pudica*, $U_3$= *Duranta plumieri*, $U_4$= *Vinca rosea*, $U_5$= *Phyllanthus niruri*, $U_6$= *Euphorbia hirta* | | | | | | | | | | | | | | | | | | |

A key component of these biodiversity studies is the Phytosociological analysis, with the aid of sampling techniques; the organization and structure of communities can be studied and expressed quantitatively both in absolute terms of species with respect to all other plant species of the area. It indicates species diversity which determines the distribution of individuals of among the species in a particular habitat. Species diversity in the tropics varies dramatically from place to place. Compared to other tropical forest types, dry deciduous forests are among the most exploited and endangered ecosystems of the biosphere (Murphy and Lugo 1986) [3]. Documenting basic patterns of biodiversity is fundamental for prioritizing areas for conservation and management action (Villasenor *et al*., 2007) [6]. Oudhia (1999) [4] conducted a phytosociological survey in wastelands during rainy season and recorded about 27 weed species associated with *Parthenium hysterophorus.* Among all weeds *P. hysterophorus* and *Cassia tora* showed high degree of sociability and formed large colonies under arable soil habitats. The data on distribution revealed that *P. hysterophorus, C. tora* and *Achyranthes aspera* recorded high Importance Value Index and were found to be dominant. Another phytosociological survey in Islamabad and Rawalpindi revealed that some weed species are dominant replacing other weeds (Shabbir and Bajwa, 2004) [5]. Ecological surveys conducted by Anjum *et al*., (2005) [1] in Lahore and Jaggi *et al.*, (2012) [2] in Agra, India also revealed the similar findings.

## 4. Conclusion

The data of all the six sites of Mumbai district showed that the plant community is more towards heterogenosity. When values of frequency classes B, C and D are comparatively higher than their values in normal frequency diagram, the vegetation is said to be heterogenous (Higher values of class E indicate homogenosity of vegetation). Density gives the numerical strength of a species in a community. Abundance, on the other hand, gives the number of individuals of a species in a habitat.

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