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Phyto-sociological studies for herbaceous vegetation of Purandar tahsil Dist. Pune, M.S. (India)

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Abstract
Vegetation ecology is the study of structure of vegetation and vegetation systematics. This contains the investigation of species composition and the sociological interface of species in communities. In a phyto-sociological study, field sampling is the first step. The quadrat methods were used for studying the plant community. In all 300 quadrats (1m x 1m size) for herbaceous vegetation were laid down in the Purandar tehsil. GPS was noted for every quadrat laid at different locations. Based on the data recorded by quadrat method, qualitative and quantitative structures analysed were Frequency, Abundance, Density, and IVI. The highest Simpson species diversity for herbaceous vegetation reported was 0.94 and Shannon's; 3.19 thus, illustrating the rich plant diversity.
According to the Raunkiaer's law of frequency classes Purandar tehsil represents heterogenous vegetation. The primary and secondary compositions were noted for the other 30 locations of the tehsil where perennial vegetation was studied. The community structure and composition in herbaceous vegetation was variable depending upon the, soil type, climatic factors and anthropogenic activities.

Keywords: Phytosociology, herbaceous, quadrat, raunkiaer's law, diversity index

Introduction
The quantitative structure of the study of vegetation has been called as 'Phyto-sociology' (Odum, 1971). Phytosociology is also called a Vegetation science, Vegetation ecology, Sociological geobotany, ecological geobotany etc. Plants naturally occur together in repetitive groups of associated plants and most frequent and abundant plants describe them well (Mueller- Dombois, 1974) [5]. Vegetation is an assemblage of plants growing together in a particular location and may be characterised either by its species composition or by combination of structural and functional characters that describe the appearance or physiognomy of vegetation (Goldsmith et.al. 1992) [2]. Vegetation form is a significant feature of the given area (Arey, 2010). Phytosociological and floristic studies are widely recognised in acquiring baseline data for the planning and management of any area (Mahajan, Shinde, 2021) [4]. Species composition patterns and outcrop communities are influenced by multiple environmental factors like soil type, elevation, aspect of rock outcrop and micro-environments. Complete diversity on the plateaus in the northern western ghats is not yet revealed satisfactorily (Rahangdale, 2014) [6].
Phytosociological studies are necessary for protecting the biodiversity and natural plant communities (Rao S.D., Murthy, et. al, 2015) [7]. Phytosociological studies are very essential components for understanding the changes accomplished in the past and future (Hamzaoglu, 2006) [3]. Quadrats were laid down at multiple locations considering environmental factors like soil type, elevation, aspect of rock outcrop and micro-environments. Fig.1

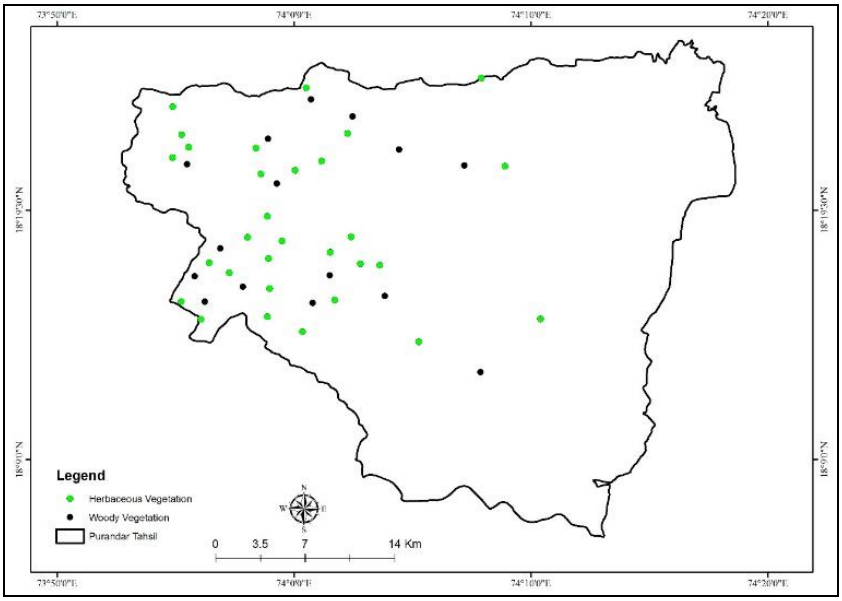

Fig 1: Locations for woody and herbaceous vegetation

Materials and Methods

In a phyto-sociological study, field sampling is the very first step. Biologists, Naturalists, Environmentalists use different implements and skills to perform phyto-sociological studies. The different ranges of considerations are in use as they are investigated to understand the vegetation structure. To learn the multiplicity of plant communities in the Purandar tehsil, following techniques of sampling were followed.

Quadrat of 1x 1m. for herbaceous vegetation, Scale-tape, GPS Instrument, Camera, String, nails, Plastic rods (04), Notebook and Field guide book, Maps, Field diary, Pen, Pencil, Eraser, Ruler etc. are essential.

Plant communities or vegetation are best described by perceiving the identity and growth form of most abundant species. A community is characterised by detailing those species which most contribute to its characteristic structure and composition. The study of the structure and composition of each and every plant community is practically impossible. Therefore, rough estimate of species content of a locality has been done by observing the plant species at variety of places, in the habitat. The quadrat method was used for studying the plant communities. The size of a quadrat varies with the type of vegetation studies. For studying woody vegetation a quadrat of 30mx 30m size was used. The methods used by Misra, (1968); Odum, (1971); Muller-Dombios (1974); Michael, (1984); and Trivedi, Goel, *et.al*., (1988) were followed for the quantification of the data.

Field sampling

A quadrat is a square sample plot or unit of applicable size for detailed analysis of vegetation. It is actually a sample plot method (Weaver, and Frederic, *et al.,* 1938) [11]. For the herbaceous vegetation communities, 1m x1m. size quadrats were used. Fig.2 In all 300 quadrats were laid down for herbaceous vegetation in the Purandar tehsil. GPS were noted for each and every locality Fig. 3 and Table 4

Fig 2: Vegetation sampling by Quadrat method

Fig 3: Vegetation sampling using GPS

Table 1: Raunkiaer's frequency classes and its percentage for Herbaceous vegetation

Village Name	Class A		Class B		Class C		Class D		Class E	
	No.	%	No.	%	No.	%	No.	%	No.	%
Proposed Air-port zone	52	76.47	10	14.7	5	7.35	1	1.47	0	0
Pangare Upper	42	76.36	11	20	2	3.64	0	0	0	0
Kumbharvalan	61	89.71	7	10.29	0	0	0	0	0	0
Jejuri	38	70.37	11	20.37	2	3.7	3	5.55	0	0
Kaldari	51	79.68	6	9.37	6	9.37	1	1.56	0	0
Pangare Low	42	85.71	4	8.16	3	6.12	0	0	0	0
Diveghat	27	55.1	9	18.37	10	20.41	1	2.04	2	4.08
Wagh dongar	30	78.95	5	13.15	2	5.26	1	2.63	0	0
Pagewadi	47	87.04	5	9.25	2	3.7	0	0	0	0
Purandar UR.	23	60.53	7	18.42	7	18.42	1	2.63	0	0
Bhivari	35	70	7	14	5	10	3	6	0	0
Patharwadi	30	55.55	16	29.63	6	11.11	2	3.7	0	0
Ketkawale	25	51.02	10	20.4	7	14.28	7	14.28	0	0
Garade	23	62.16	8	21.62	3	8.11	3	8.11	0	0
Purandar LR.	34	80.95	5	11.9	2	4.76	1	2.38	0	0
Sonori	25	51.06	10	21.27	8	17.02	3	6.38	1	2.13
Fort UR.	32	53.33	19	31.66	7	11.66	1	1.66	1	1.66
Waghapur	19	48.71	8	20.51	6	15.38	4	10.26	2	5.13
Pokhar	32	54.24	12	20.34	11	18.64	4	6.78	0	0
Bhairavwadi	11	27.5	16	40	8	20	4	10	1	2.5
Bopgaon	19	50	10	26.32	8	21.05	1	2.63	0	0
Chambali	18	43.9	10	24.39	8	19.51	3	7.31	2	4.88
Kodit	14	42.42	12	36.36	3	9.09	2	6.06	2	6.06
Chivhewadi	21	48.84	14	32.56	4	9.3	4	9.3	0	0
Kumbhoshi	17	33.33	19	37.25	11	21.56	1	1.96	3	5.88

Fort Lower	25	62.5	7	17.5	5	12.5	2	5	1	2.5
Supe	31	67.39	9	19.56	4	8.69	2	4.35	0	0
Devadi	41	59.42	15	21.74	9	13.04	4	5.79	0	0
Hivare	31	63.26	13	26.53	4	8.16	1	2.04	0	0
Pimpale	32	58.18	16	29.09	5	9.09	2	3.63	0	0
	928	1852.68	311	644.71	163	340.92	62	133.5	15	34.82
		61.54		21.49		11.36		4.45		1.16

Table 2: Summary of Raunkiaer's frequency class distribution for herbaceous vegetation

Sampling Area	Class A	Class B	Class C	Class D	Class E
Purandar tehsil	928	311	163	62	15
Raunkiaer	53	14	9	8	16

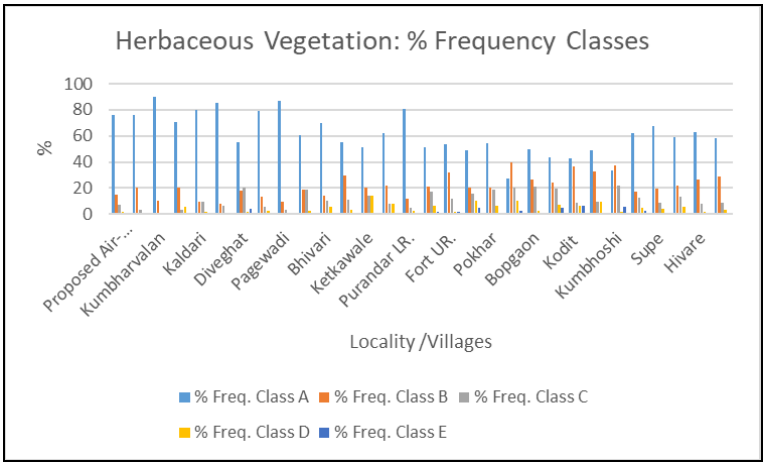

Fig 4: Herbaceous Vegetation-Percentage Frequency Classes A to E

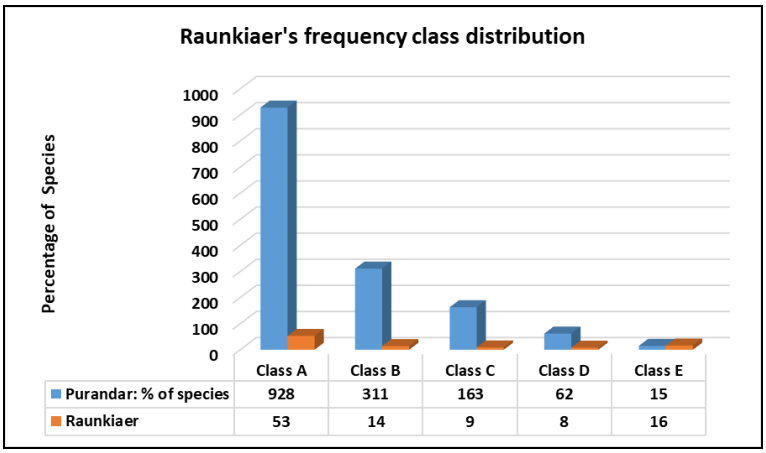

Fig 5: Raunkiaer's Frequency classes for Herbaceous vegetation

Table 3: Herbaceous diversity: Diversity Index

Sr.	Place/ Region/Village	Simpson Index Value	Shannon Index Value
1	Proposed air-port villages	0.94	3.32
2	Pangare Upper	0.91	2.97
3	Kumbharvalan	0.91	3.00
4	Jejuri	0.87	2.76
5	Kaldari	0.92	3.16
6	Pangare Lower	0.88	1.97
7	Diveghat	0.92	3.00
8	Wagh dongar	0.87	2.49
9	Pagewadi	0.92	3.00
10	Purandar Upper	0.84	2.46
11	Bhivari	0.93	3.19
12	Patharwadi	0.93	3.19
13	Ketkawale	0.78	2.52
14	Garade	0.79	2.31
15	Purandar Kaniphnath	0.92	2.96

16	Sonori	0.88	2.58
17	Fort Upper	0.87	2.76
18	Waghapur	0.90	2.71
19	Pokhar	0.93	3.13
20	Bhairavwadi	0.93	3.06
21	Bopgaon	0.91	2.96
22	Chambali	0.84	2.41
23	Kodit	0.85	2.47
24	Chivhewadi	0.84	2.50
25	Kumbhoshi	0.79	2.37
26	Fort Lower	0.86	2.76
27	Supe	0.92	2.96
28	Devadi	0.91	3.09
29	Hivare	0.93	3.07
30	Pimpale	0.93	3.10

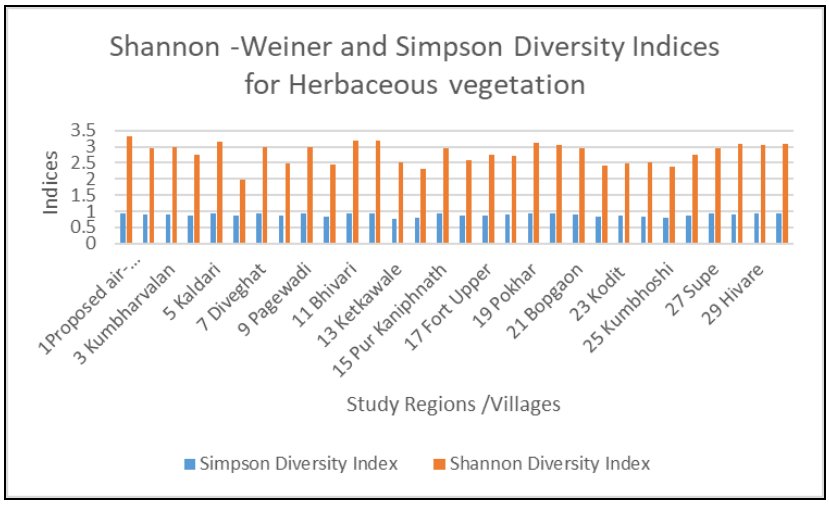

Fig 6: Shannon-Weiner and Simpson's Diversity Indices for various regions

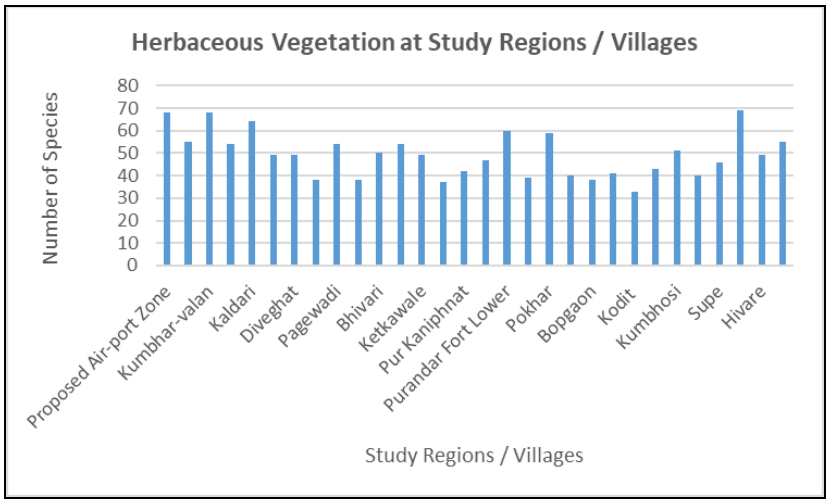

Fig 7: Number of species at study regions/villages

Table 4: Coordinates: Latitude, Longitude for Herbaceous Vegetation

Place/ Village	Coordinates: Latitude, Longitude for Herbaceous Vegetation
Proposed Airport Zone	N18^0 21. 930' E074^0. 08 732'
Pangare Upper	N18^0 14.306' E0 74^0 04.690'
Kumbharvalan	N 18^0 21 930' E0 74^0 08 732'
Jejuri	N18^0 15.491' E0 74^0 10.277'
Kaldari	N18^0 15.182' E074^0 00.135'
Pangare Upper	N18^0 14.306' E0 74^0 04.690'
Diveghat	N18^0 24.911' E0 74^0. 00.225'
Wagh dongar	N18^0 21.530' E0 74^0 00.891'
Pagewadi Sacred grove	N 18^0 15.715' E0 74^0 01.718'
Purandar Lower	N18^0 16.849' E0 73^0 58.790'

Bhivari	N18^0 22.156' E0 73^0 55.555'
Patharwadi	N 18^0 22.683' E0 73^0 55.259'
Ketkawale	N18^0 15.646' E0 73^0 56.237'
Garade	N18^0 22.003' E0 73^0 55.266'
Kaniphnath	N18^0 18.556' E0 73^0 58.829`
Sonori	N 18^0 22.971' E0 74^0 02.141'
Fort Upper	N18^0 16.847` E0 73$^0$ 58.766`
Waghapur	N18^0 25.360' E0 74^0 07.761'
Pokharbil	N18^0 18.353' E0 73^0 58.040'
Bhairavwadi	N18^0 16.199' E0 73^0 58.976'
Bopgaon	N18^0 23.856' E0 73^0 54.884'
Chambali	N18^0 21.889' E0 73^0 58.477'
Kodit	N18^0 21.258' E0 73^0 58.615'
Chivhewadi	N18^0 16.863' E0 73^0 57.271'
Kumbhoshi	N18^0 14.902' E073^0 56.066'
Fort Lower	N18^0 16.849' E0 73^0 58.790'
Supe	N 18^0 17.727` E0 74$^0$ 01.526`
Devadi	N18^0 17.280' E0 73^0 56.414'
Hivare	N 18^0 21.375' E0 74^0 00.285'
Pimpale	N 18^0 17.245' EO 74^0 02.795'

Table 5: Important Figures and Characters of the Herbaceous Vegetation

Place/ Village	No. of quad	No. of Sps.	No. of Ind.	Abundant species	Raunkiaer's Frequency equation
Proposed Air-port Zone	10	68	845	*Dactyloctenium agypticum, Oplismenus, burmanni, Cynotis cristata, Lavandula bipinnata, Leucas biflora, Habenaria corniculata*	A>B>C>D>E
Pangare Upper	10	55	2180	*Oplismenus burmannii, Eragrostis unioloides, Oldenlandia corymbosa, Cynotis cristata, Celosia argentea, Heliotropium ovalifolium*	A>B>C>D=E
Kumbhar-valan	10	68	1469	*Indigofera cordifolia, Alysicarpus rugosus, Lophopogon tridentatus, Parthenium hysterophorus, Heteropogon contortus, Glossocordia bosvallea*	A>B>C=D=E
Jejuri	10	54	1588	*Acanthospermum hispidum, Striga densiflora, Lavandula bipinnat, Ziziphus maurtiana (Plantlets), Rhus mysorensis (Plantlets), Apluda mutica*	A>B>C<D>E
Kaldari	10	64	2216	*Zornia diphylla, Melanocenchris jacquemontii, Heteropogon contortus Oplismenus burmanii, Spermacoce pusilla, Apluda mutica*	A>B=C>D>E
Pangare Lower	05	49	1220	*Oplismenus burmannii, Mariscus squarrosus, Cynotis cristata, Urochloea ramosa, Cynodon dactylon, Bidens sulphurea*	A>B>C>D=E
Diveghat	10	49	1936	*Oplismenus burmanii, Cynodon dactylon, Spermacoce hispida, Apluda mutica, Vigna radiate, Commelina sinensis*	A>B<C>D<E
Wagh-dongar	10	38	729	*Alysicarpus belgaumensis, Cassia uniflora, Chloris barbata, Aristida funiculata, Alternanthera sessilis, Senecio edworthii*	A>B>C>D>E
Pagewadi	10	54	1130	*Apluda mutica, Dicanthium sp., Alysicarpus rugosus, Echinchloa colona, Aristida funiculata, Bidens pilosa*	A>B>C>D=E
Purandar fort Upper	05	38	991	*Spermacoce pusilla, Tridax procumbens Indigofera cordifolia, Apluda aristate. Parthenium hysterophorus, Euphorbia hirta*	A>B=C>D>E
Bhivari	10	50	1199	*Cyperus difformis, Glossocordia bosvallea, Apluda mutica, Heteropogon contortus, Oplismenus compositus, Parthenium hysterophorus*	A>B>C>D>E
Pathar-wadi	10	54	2031	*Oplismenus burmanii, Apluda mutica, Heteropogon contortus, Spermacoce pusilla, Achyranthes aspera var. porphyristachya, Parthenium hysterophorus*	A>B>C>D>E
Ketkawale	10	49	1632	*Oplismenus compositus, Heteropogon contortotus, Apluda aristata, Cosmos sulphurius, Alysicarpus rugosus, Chloris barbata*	A>B>C=D>E
Garade	10	37	1098	*Oplismenus burmanii, Cynodon dactylon, Parthenium hysterophorus, Commelina, benghalensis, Cynotis cristata, Xanthium strumarium*	A>B>C=D>E
Pur Kaniphnat	10	42	1023	*Apluda aristata, Aristida funiculata, Alternanthera sessilis, Alysicarpus rugosus, Urochloa panicoides, Vernonia cinerea*	A>B>C>D>E
Sonori	10	47	3538	*Pulicaria wighitiana, Celosia argentia, Arachis hypogea, Boerhavia diffusa, Euphorbiahirta, Dactyloctenium aegypticum*	A>B>C>D>E

Purandar Fort Lower	10	60	1635	*Oplismenus burmanii, Apluda mutica Eriolaena quinquelocularis, Cenchrus americanus, Smithia hirsute, Zornia diphylla*	A>B>C>D>=E
Waghapur	05	39	979	*Heteropogon contortus, Indigofera cordifolia, Brachiaria eruciformis, Leucas biflora, Oplismenus burmanii, Cynotis cristata*	A>B>C>D>E
Pokhar	10	59	2546	*Oplismenus compositus, Heteroogon contortus, Alysicarpus rugosus, Urochloea ramose, Kyllinga triceps, Blainvillea acmella*	A>B>C>D>E
Bhairavwadi	10	40	1247	*Heteropogon contortus, Apluda mutika, Isachaemum indicum, Launaea nudicaulis, Lavandula bipinnata var. rothiana, Oplismenus burmanii*	A<B>C>D>E
Bopgaon	10	38	574	*Cassia gaudichaudii, Oplismenus burmanii, Heteropogon contortus, Chloris barbata, Achyranthes aspera var. porphyristachya, Curculigo orchioides*	A>B>C>D>E
Chambali	10	41	2063	*Parthenium hysterophorus, Oplismenus burmanii, Senna gaudichaudii, Cynodon dactylon, Cyperus difformis, Sida acuta*	A>B>C>D>E
Kodit	10	33	3059	*Oplismenus burmanii, Cynodon dactylon, Alysicarpus rugosus, Indigofera cordifolia Cleome simplicifolia, Cynotis cristata*	A>B>C>D=E
Chivhe wadi	10	43	2043	*Spermacoce hispida, Oplismenus burmanii, Cynodon dactylon, Impatiens balsamina, Parthenium hysterophorus, Kyllinga bulbosa*	A>B>C=D>E
Kumbhosi	10	51	2686	*Spermacoce pusilla, Oplismenus burmanii, Heteropogon contortus, Apluda mutica, Senna glauca, Urochloea ramosa*	A<B>C>D<E
Fort Area	10	40	436	*Oplismenus burmanii, Urochloea ramose, Cucumis melo var. agrestis, Paracayopsis coelesina, Cyperus difformis, Carissa congesta* (Saplings)	A>B>C>D>E
Supe	10	46	1901	*Oplismenus burmanii, Alysicarpus rugosus, Heteropogon contortus, Spermacoce pusilla, Eriocaulon parviflorum, Cyperus rotundus*	A>B>C>D>E
Devadi	10	69	2674	*Spermacoce pusilla, Setaria verticillate, Oplismenus compositus, Eragrostis Pilosa, Alysicarpus rugosus, Cynotis cristata*	A>B>C>D>E
Hivare	10	49	2418	*Crotalaria hebecarpa, Mukia madaraspatensi, Acacia nilotica* (saplings), *Indigofera cordifolia, Heteropogon contortus, Amaranthes spinosus*	A>B>C>D>E
Pimpale	10	55	1755	*Oplismenus burmanii, Aristida funiculate, Cynotis cristata, Vigna indica, Alysicarpus rugosus, Sehima nervosum*	A>B>C>D>E
-	285	1479	50841	-	-

Raunkiaer's frequency class and its percentage for Herbaceous vegetation: A = 61.54%, class B=21.49%, class C =11.36%, class =4.45% and class E =1.16% Table 1

Raunkiaer's frequency class distribution for herbaceous vegetation for class A,B,C,D,and E is 53,14,9,8,16 respectively. Raunkiaer's frequency class distribution for herbaceous vegetation of Purandar tehsil is 928, 311, 163, 62 and 15 respectively. Table 2 and Fig.4, 5

Diversity Index of Herbaceous diversity is depicted in Table 3 While Table 4 shows Coordinates: Latitude, Longitude for Herbaceous Vegetation.

Among the above 30 locations, at Proposed Airport Zone, Pangare Upper, Kumbhar-valan, Jejuri, Kaldari, Pangare Lower, Diveghat, Pagewadi, Bhivari, Patharwadi, Ketkawale, Purandar fort Lower, Pokharbil, Kumbhoshi, Devadi, Hivare and Pimpale the number of species recorded were more in number (49 to 68 per 10 quadrats) Table 5 and Fig. 7

Among the above locations, majority of them belongs to hilly region. The climatic conditions for the herbaceous vegetation found favorable in most of the years. Ketkawale and Kumbhoshi fall in eco-sensitive zones. Purandar fort is under the administration of military. Devadi and Pokharbil villages are very close to Chandra and Surya Mountains. Some of the plots belonging to proposed airport zone are covered by fences by plot owners. The herbaceous vegetation present in the zone is protected from the grazing animals. Kaldari and Pagewadi villages are centrally located in the tehsil, where no anthropogenic activities have been observed.

The average annual rainfall in the year 2014 was 371.3mm., in 2015 it was 388.8mm., in 2016 it was 270.2mm., in 2018 it was 358.1mm. (Data Source: IMD Pune).

At the remaining 13 locations like Wagh-dongar, Purandar fort Upper, Garade, Purandar (Kaniphnat), Sonori, Waghapur, Bhairavwadi, Bopgaon, Chambali, Kodit, Chivhewadi, Fort and Supe less number of species (33 to 47 per 10 quadrats) were recorded. These locations belong to non-hilly regions. At majority of these places, the developmental activities took place and are in progress. Wagh Dongar is close to Saswad town. At the base of the wagh-dongar landscape garden has been developed by the forest department. On and around the Purandar fort, military department had widened the roads as well as established garden in the military camp area. Due to anthropogenic activities, the number of wild species has been dwindled.

The field surveys and samplings reveal that, the vegetation shows variations. Depending upon the climate, season, rainfall and soil type, luxuriant growth of grasses, climbers, shrubs and trees found in different locations like various

niches and microhabitats. Though the most of floristic composition is alike in the entire tehsil, the growth and vigor of plants was more in hilly regions of the tehsil, this could be due to soil and rainfall variations.

The following species shown highest percentage frequency in the different locations of the tehsil. *Oplismenus burmanii, Apluda mutica, Heteropogon contortus, Parthenium hysterophorus, Brachiaria eruciformis* (100% frequency each). *Cynodon dactylon* (90%), *Apluda mutica* (85% frequency), *Leucas stelligera, Parthenium hysterophorus, Oplismenus compositus, Heteropogon contortus, Apluda mutica, Alysicarpus rugosus, Xanthium strumarium, Indigofera cordifolia, Cynodon dactylon, Rungia repens, Leucas biflora, Launea nudicaulis, Sida acuta, Cucumis melo var. agrestis* (80% Frequency each) indicating the dominance of grasses.

Maximum abundance shown by *Marsisus squarrosus* (223), *Heliotropium ovalifoliun* (170), *Spermacoce hispida* (166.2), and *Spermacoce pusilla* (150.7) while sparse species were *Blainvillea latifolia, Tribulus terrestris* (0.10), *Ensete superbum, Cyamopsis tetragonoloba, Momordica dioca* (1.00).

The highest importance value index noted for *Oplismenus compositus* (48.87), *O. burmanni* (46.99) and minimum for *Pinda concanensis* (0.12) and *Blainvillea latifolia* (0.72). The entire tehsil illustrated rich plant diversity except east zone of the tehsil. The Simpson and Shannon diversity indices were calculated for both herbaceous and woody vegetation. The highest IVI with respect to herbaceous vegetation was 0.94 and 3.32 respectively for Simpson and Shannon index respectively whereas the lowest was 0.78 and 1.97 respectively Table 3 and Fig. 6

The primary and secondary community structure at proposed airport region noted in between *Dactyloctenium agypticum- Oplismenus, burmanni- Cynotis cristata* and *Oplismenus burmannii -Eragrostis unioloides- Oldenlandia corymbosa* respectively. Accordingly, the primary and secondary community structure documented for the remaining 29 locations where quadrats were laid down. The community structure and composition in herbaceous vegetation was variable depending upon the anthropogenic activities, soil type and climatic factors.

Herbaceous Vegetation Structure: Primary and Secondary Composition

Acacia nilotica - Acanthospermum hispidum - Achyranthes aspera,

Alternanthera sessilis - Alysicarpus belgaumensis - Alysicarpus rugosus,

Amaranthes spinosus - Apluda aristata - Apluda mutica,

Aristida funiculata- Bidens pilosa- Bidens sulphurius,

Blainvillea acmella - Boerhavia diffusa - Brachiaria eruciformis,

Carissa congesta (Saplings) **-** *Cassia glauca - Cassia uniflora,*

Celosia argentia - Cenchrus americanus - Chloris barbata,

Cleome simplicifolia- Commelina sinensis - Cosmos sulphurius,

Crotalaria hebecarpa - Cucumis melo var. agrestis - Curculigo orchioides,

Cynodon dactylon - Cynotis cristata - Cyperus difformis,

Cyperus rotundus - Dactyloctenium aegypticum - Dicanthium sp.,

Echinchloa colona- Eragrostis Pilosa - Eragrostis unioloides,

Eriocaulon parviflorum - Eriolaena quinquelocularis - Euphorbia hirta,

Glossocordia bosvallea - Habenaria corniculate - Heliotropium ovalifolium,

Heteroogon contortus- Impatiens balsamina - Indigofera cordifolia,

Isachaemum indicum - Kyllinga bulbosa - Kyllinga triceps,

Launaea nudicaulis - Lavandula bipinnata - Lavandula bipinnata var. rothiana,

Leucas biflora - Lophopogon tridentatus - Mariscus squarrosus,

Melanocenchris jacquemontii- Mukia madaraspatensis- Oldenlandia corymbosa,

Oplismenus burmanii- Oplismenus compositus- Paracayopsis coelesina,

Parthenium hysterophorus- Pulicaria wighitiana- Rhus mysorensis (Saplings),

Sehima nervosum - Senecio edworthii - Setaria verticillata,

Sida acuta - Smithia hirsuta- Spermacoce hispida,

Spermacoce pusilla - Striga densiflora - Tridax procumbens,

Urochloa panicoides - Urochloea ramose- Vernonia cinerea,

Vigna indica - Vigna radiata - Xanthium strumarium

Diversity

The entire tehsil including Purandar fort consists of variety of plant species. The floristic studies have been done by Santapau in 1958 [9]. In the entire tehsil, 1350 number of flowering plant specimens were documented. They belong to 749 genera and 106 families. Among the total no. of Angiosperms 82% were dicotyledonous plants and 18% were monocotyledonous taxa. As far as Habit of the plant forms is concern, trees were 15.56 %, shrubs 17.85%, herbs 56.80 % and climbers 9.79 %.

Result and Discussion

The field surveys and samplings reveal that, the vegetation shows variations. Depending upon the climate, season, rainfall and soil type, luxuriant growth of grasses, climbers, shrubs, and trees found in different locations like various niches and microhabitats. Though the most of floristic composition is similar in the entire tehsil, the growth and vigor of plants was more in hilly regions of the tehsil, this could be due to soil and rainfall variations.

The Simpson and Shannon diversity indices were projected for majority of the villages of the tehsil where quadrats were laid down for sampling of the herbaceous vegetation. The typical values are fundamentally between 0.78 and 3.32 in majority of the ecological readings and the indices rarely larger than 3.0 The Shannon index rises as both the frequency and outcome of the community number. The Simpsons index is built on the possibility of any two entities drawn by a chance from an indeterminately big community fitting to the same species. The conclusion of diversity indices of the herbaceous vegetation is shown in the Table 3.

The results of diversity indices for herbaceous vegetation shows that the more species diversity (Simpson = 0.94 and Shannon = 3.32) was found at proposed airport zone of the tehsil. The lower species diversity noted for region Ketkawale and Pangare (0.78 and 1.97 respectively). The

proposed airport station zone depicts the moderate plant diversity with respect to herbaceous vegetation.

On the basis of diversity index, the overall rank order of the villages in which quadrats were laid down has been presented in Table 3. As per Simpsons diversity index, the diversity status of the concerned villages and surrounding areas is arranged with maximum number in the end: Ketkawale < Garade = Kumbhoshi < Purandar I = Chambli= Chivhewadi < Kodit Fort II < Jejuri = Wagh Dongar= Fort I < Pangare II = Sonori < Waghpur < Pangare I = Kumbharvalan = Bopgaon = Devadi < Kaldari = Diveghat = Pagewadi = Supe = Purandar (Kaniphnath) < Bhivari = Patharwadi = Pokhar = Bhairavwadi = Hivare = Pimpale < Aero Villages.

On the basis of diversity catalog, the overall rank order of the villages in which quadrats were laid down has been presented in Table 5 As per Shannons diversity index, the diversity status of the concerned villages and surrounding areas is arranged with maximum percentage at the end: Pangare Lower < Garade < Kumbhoshi < Chambali < Purandar < Kodit < Waghdongar < Chivhewadi < Ketkawale < Sonori < Waghapur < Jejuri < Purandarfort < Purandar (Kaniphnath) < Bopgaon Supe < Pangare I < Kumbharvalan < Diveghat < Pagewadi < Bhairavwadi < Hivare < Devadi < Pimpale < Pokhar < Kaldari < Bhivari < Patharwadi < proposed airport zone Villages.

The recorded total number of species and number of individuals for herbaceous vegetation has been presented in Table 5

Conclusion

At Proposed Airport Zone villages like Pangare, Kumbhar-valan, Jejuri, Kaldari, Pangare Lower, Diveghat, Pagewadi, Bhivari, Pathar-wadi, Ketkawale, Purandar fort, Pokhar, Kumbhoshi, Devadi, Hivare and Pimpale (17 locations), the number of species recorded were more in number (49 to 68 species per 10 quadrats). Among the above locations, majority of the locations belongs to hilly region. The climatic conditions were favorable for most of the years (2014 -2020). The average annual rainfall in the year 2014 was 371.3mm., in the year 2015 average annual rainfall was 388.8mm., in 2016 it was 270.2mm., in 2018 it was 358.1mm. (Data Source: IMD Pune).

While at Wagh-dongar, Purandar fort Upper, Garade, Purandar (Kaniphnat), Sonori, Waghapur, Bhairavwadi, Bopgaon, Chambali, Kodit, Chivhewadi, Fort and Supe (13 locations) a smaller number of species (33 to 47 species per 10 quadrats) were recorded. These locations belong to non-hilly regions. At majority of these places, developmental activities took place and are in progress. Wagh Dongar was close to Saswad town. At the base of the wagh-dongar landscape garden has been developed by the forest department. A military department had widened the roads as well as established garden in the camp area of the fort. Due to all such anthropogenic activities, the number of wild species had been dwindled.

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