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BIODIVERSITY AND PHYTOSOCIOLOGICAL ANALYSIS OF PLANTS AROUND THE CHIKHALI TALUKA, NAVSARI DISTRICT, GUJARAT, INDIA

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KEYWORDS

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ABSTRACT

The present study deals with the species diversity of Chikhali Taluka, Navsari district, Gujarat, India during 2010-2013. A total of 72 species were recorded which were represented by 40 families and 67 genera. Out of 72 species, 36 tree species, 34 herbs and 2 orchids. The maximum IVI was recorded for *Tectona grandis* (76.385) and followed by *Adina cordifolia* (21.978), *Terminalia tomentosa* (19.682), *Syzygium cumini* (14.929) and *Oroxylum indicum* (13.293), respectively. Among the herbs species, the highest Shannon - Wiener index recorded for *Commelina benghalensis*, *Curculigo orchioides*, *Phaseoluss pecies, Sonchus oleraceus* (0.162) and followed by *Blainvilleaa cmella, Blumea wightii, Canscor adiffusa, Curcuma odorata, Desmodium gangeticum, Hibiscus lobatus* and *Tridaxprocumbens* (0.124), respectively.

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INTRODUCTION

Forest (either pure or artificial) is an important wheels of vehicle for biodiversity, environmental and ecological benefits, food security, soil conservation potential, mitigation of the impact of climate change and job opportunity in tropics. Ecosystems are undergoing change due to pollution, invasive species, overexploitation by human and climate change. Large scale of deforestation, human settlements, agricultural expansion, pollution, introduces invasive species, and other infrastructure related to development over the last century led to a rapid decline of tropical forests throughout the world, which in turn has affected the biodiversity, climate change, ecological services, soil fauna, soil productivity and the livelihoods of forest dwellers as well as rural people (Kumar, 2016). On the other hand, lack of technical and scientific infrastructure makes efforts of sustainable management of these natural resources extremely difficult (Stock, 2010). Most people are beginning to recognize that diversity at all levels - gene pool, species and biotic community is important and needs to be conserved (Fabicius *et al.,* 2003). It is also clear that better knowledge on biodiversity, growing stock, productivity conservation strategies and reliable alternatives to get rid of uncontrolled and probably dangerous development activities (Laurance and Bierregaard, 1997). Jhariya and Oraon (2012) reported that global biodiversity crisis has given rise to a growing concern at the prospect of a rapidly accelerating loss of species, population, domesticated varieties, medicinal herbs and natural habitats.The need of the hour is conservation and sustainable use of biodiversity as an integral component of economic development (Maynard *et al.,* 2010).

The study of plant community structure is called plant sociology or phytosociology. 'Phytosociology' the study of aspects of communal relations of plant was coined by Paczoski. Phytosociological methods often involve the quantitative estimation of various parameters like cover, abundance, frequency etc. (Palmer, 2002). All these species are not equally important but there are only a few overtopping species which by their bulk and growth modify the habitat and control the growth of other species of the community as these species are called dominants (Gaston, 2000).The immense variety of the climatic, edaphic and altitudinal variations in this region pay the way for a great range of ecological habitats for the Gujarat. Gujarat has poor forest cover (less than 10% forest land of its geographical area) but it has fairly rich biodiversity (Kumar *et al.,* 2013). A major constraint faced in assessing threat status and ecological significance of rare, endangered and threatened species is lack of continuous monitoring over and over again in the previously explored areas or new areas often referred as unexplored areas. Thus, species once common remains common even though population becomes scarce or a rare species turns common as the forms of rarity are less understood (Kumar *et al.,* 2013). Understanding species diversity and distribution patterns is important for helping managers to evaluate the complexity and resources of these forests. However, trees form the major structural and functional basis of tropical forest ecosystems and can serve as robust indicators of changes and stressors at the landscape scale (Mishra, 1968). In this view, objectives of this study was to analyze the patterns of species richness,

species composition for conservation though best management, so that expansion of the protected area network can be suggested.

MATERIALS AND METHODS

The investigation was carried out the phytosociological study of Chikhali Taluka in Navsari district, Gujarat which is near to Northern zone of Western Ghats (20º45′-20º75′ N and 73º 04′-73º07′E) during 2010-2013 (Fig. 1). The average mean temperature varied from 28º - 46ºC and S-W monsoon brings a humid climate from mid-June to mid-September while the average rainfall was 95 cm. The land is drained by rivers and thus is a vast alluvial deposit of black soil and red loam. The objective of the study was to assess the status of plant resources by quadrate sampling method. Quadrats were laid out to have maximum representation of different types of vegetation. Selection of sites for sampling of vegetation was done by random sampling procedure. Accordingly quadrats of 20 x 20 m for the tree species and 2 x 2 m plots were laid out randomly for sampling shrub layer (Fig. 2). To collect information on ground layer and other herbaceous species, quadrats of 1 x 1m size were laid out within the tree quadratesof all corners and one in center. The girth at breast height (gbh) of all individuals in each quadrate was measured for all species of trees and woody climbers (if it available). All individuals with gbh > 30 cm were considered as trees (Parthasarathy and Karthikeyan, 1997) were botanically identified by Revision of the flora of Bombay Presidency (Blatter and McCann, 1926-1935); Flora of Saurashtra (Santapau, 1962); Vegetation of Dangs district (Jain, 1963); Flora of Gujarat state (Shah, 1978); Floristic and Phytosociological Survey of Some parts f South Gujarat with special reference to Medicinal and Ethnobotanical Parts (Joshi, M. C., 1983); Forest Flora of Gujarat State (Patel, 1984). Floristic, phytosociology and ethnobotanical study of Umarpada forest in South Gujarat (Vashi, 1985); this also includes a sketch of the Flora of Gujarat (Shah *et al*., 1981); and Flora of Saurashtra Vo. I and II (Bole and Pathak, 1988). Basal area of plants was measured following Philips (1959). The primary data recorded on number of individuals in a species and girth was analyzed for secondary attributes like density and frequency, following standard phyto-sociological methods of Misra (1968). Relative values were calculated by following Philips (1959).

Importance Value Index (IVI)

Data collected were subjected to analysis by assessing relative density, relative frequency and relative dominance. Based on these parameters, the Importance Value Index (IVI) at species level was calculated following the method of Curtis, (1959). The IVI was calculated as the sum of relative density (%), relative dominance (%) and relative frequency (%) of the species following the method of Curtis (1959) and Kent and Coker (2001), as.

Density (ni): Number of individuals of the species 'A'

Dominance (D): Sum of the basal areas (at 1.37 m) of individuals of the same species

$$\text{Relativedensity(RD)} = \frac{\text{Totoal no. of individuals of species}}{\text{Total no of indiviuals of all species}} \text{ x } 100$$

$$\text{Relative density (RF)} = \frac{\text{Frequency value of individual species}}{\text{Sum of frequency valu of all species}} \text{ x } 100$$

$$\text{Relative Dominance (RD)} = \frac{\text{Total basal area of individual species}}{\text{Sum of total basal area of all species}} \text{ x } 100$$

Species richness

It is defined as the number of species per quadrate, area or community. In this particular case, the number of observed species across the sample quadrates used as a representation of species richness. The species richness, as a measure of diversity has been used successfully in many studies (Magurran, 1988).

Shannon's diversity index

We used species richness and Shannon-Wiener index to describe the species diversity (Whittaker 1972). Species richness (N) was measured as the absolute number of unique species in each sample plot; Shanon-Wienner index (H′) was calculated $\text{Shanon} - \text{Wiennerindex (H)} = -\sum_{i=1}^{s} \text{In}$

Where, H = Shannon-Wiener index; S = the number of species; In = $\log \text{base}_n$ and *Pi* is the relative importance value of species.

Simpson's floristic diversity index: The dominance of the species was computed by using Simpson's index (Simpson, 1949) as under:

$$\text{Simpson sindex (CD)} = \sum_{i=o}^{s} (pi)^2$$

Here, pi = the proportion of individuals or the abundance of the i^{th} species *i*.e., (ni/N) whereas, S = Number of species in the plot i = 1; ni = Number of individuals of the species i and N = Total number of individuals in the plot.

RESULTS AND DISCUSSION

The present investigated based on the result of three years of intensive and extensive study of the flora of Chikhali Taluka in Navsari district, Gujarat. Here, total of 72 species were represented by 40 families and 67 genera. Out of 72 species, 36 tree species (Table 1), 34herb and 2orchids (Table 2). In tree species *Tectonagrandis* wasthe dominant species and followed by *Adina cordifolia* and *Terminalia tomentosa*. Other dominance species were recorded *Oroxylum indicum, Morinda tomentosa, Terminalia bellerica* and *Ficus racemosa*. In herb, *Cassia tora* was the dominant species and followed by *Curculigoorc hioides*and *Commelina benghalensis*. Other dominant herbaceous species were recorded *Habenaria furcifera, Phaseolus species* and *Sonchus oleraceus*.In orchid, *Habenariaf urcifera*were dominant and followed by *Aerides maculosa*.

Taxonomically, woody vegetation of Chikhali Taluka, Navsari district, Gujarat Ebenaceae was most diverse family with maximum (6) number of species followed by Combretaceae (4), Bignoniaceaeand Rubiaceae (3), Sterculiacea and Apocynaceae (2) (Fig. 3). But on the shrubs and herbs vegetation, maximum species was recorded in Asteraceae (7)

Table 1: Density, basal area, Importance value index and Shannon-Wiener indexof thetree species in ChikhliTaluka, Navsari district, Gujarat

Species name	F	D	BA	RF	RD	RDOM	IVI	H′	Conc. of D	Simpson
Acacia catechu	0.4	0.2	0.057	4.167	1.093	0.439	5.699	0.049	0.0001	
Adina cordifolia	0.3	0.7	1.967	3.125	3.825	15.027	21.978	0.125	0.0014	
Albizia lebbeck	0.1	0.4	0.039	1.042	2.186	0.266	3.493	0.083	0.0005	
Albizia procera	0.1	0.1	0.275	1.042	0.546	2.103	3.691	0.028	0.00002	
Anogeis us latifolia	0.1	0.1	0.081	1.0412	0.546	0.620	2.208	0.028	0.00002	
Azadiracht aindica	0.1	0.1	0.048	1.042	0.546	0.370	1.958	0.028	0.00002	
Bombax ceiba	0.4	0.2	0.029	4.167	1.093	0.229	5.489	0.049	0.0001	
Butea monosperma	0.1	0.7	0.113	1.042	3.825	0.862	5.729	0.125	0.0014	
Carea arborea	0.1	0.1	0.055	1.042	0.546	0.418	2.007	0.028	0.00002	
Carris acaronda	0.2	0.1	0.009	2.083	0.546	0.074	2.704	0.028	0.00002	
Casearia graveolens	0.1	0.2	0.016	1.042	1.093	0.121	2.255	0.049	0.0001	
Cordia dichotoma	0.1	0.1	0.034	1.042	0.546	0.257	1.845	0.028	0.00002	
Dillenia pentagyna	0.5	0.1	0.008	5.208	0.546	0.066	5.821	0.028	0.00002	
Diospyros melanoxylon	0.1	0.8	0.129	1.042	4.371	0.992	6.405	0.137	0.0001	
Phyllanthus emblica	0.1	0.1	0.143	1.042	0.546	1.091	2.679	0.028	0.00002	
Erythrina indica	0.2	0.1	0.024	2.083	0.5464	0.184	2.813	0.028	0.00002	
Ficus racemosa	0.1	0.2	0.671	1.042	1.093	5.128	7.263	0.049	0.0001	
Gmelina arborea	0.2	0.2	0.037	2.083	1.093	0.283	3.459	0.049	0.0001	
Holoptelea integrifolia	0.2	0.3	0.077	2.083	1.639	0.589	4.311	0.067	0.0002	
Madhuca indica	0.1	0.2	0.316	1.042	1.093	2.417	4.552	0.049	0.0001	
Mangifera indica	0.2	0.1	0.193	2.083	0.546	1.479	4.109	0.028	0.00002	
Miliusato mentosa	0.2	0.2	0.055	2.083	1.093	0.419	3.595	0.049	0.0001	
Mitragyna parviflora	0.1	0.3	0.207	1.042	1.639	1.586	4.267	0.067	0.0002	
Morinda tomentosa	0.7	0.1	0.052	7.292	0.546	0.399	8.236	0.205	0.0001	
Oroxylum indicum	0.1	1.5	0.548	1.042	8.197	4.189	13.428	0.028	0.0002	
Ougeinia oojeinensis	0.1	0.1	0.015	1.042	0.546	0.112	1.700	0.028	0.0002	
Schleichera oleosa	0.4	0.1	0.122	4.167	0.546	0.934	5.647	0.178	0.0067	
Sterculi aurens	0.1	1.2	0.228	1.042	6.557	1.744	9.343	0.028	0.00002	
Sterculia villosa	0.1	0.1	0.008	3.125	0.546	0.062	1.650	0.028	0.00002	
Stereospermum suaveolens	0.3	0.1	0.193	10.417	0.546	1.479	5.150	0.112	0.0010	
Syzygium cumini	1	0.6	0.161	6.25	3.278	1.234	14.929	0.367	0.1223	
Tectona grandis	0.6	6.4	4.603	4.167	34.973	35.162	76.385	0.159	0.0029	
Terminalia arjuna	0.4	1	0.306	4.167	5.464	2.342	11.974	0.083	0.0005	
Terminalia bellerica	0.4	0.4	0.413	2.083	2.186	3.153	9.506	0.014	0.0019	
Terminalia tomentosa	0.2	0.8	1.732	1.042	4.371	13.228	19.682	0.049	0.0001	
Wrightia tinctoria	0.1	0.2	0.043	10.417	1.093	0.327	2.462	0.028	0.00002	
	8.6	18.2	13.007	98.963	99.445	99.383	288.422	2.534	0.141	0.859

and followed byMalvaceae (5) (Fig. 4). Similar results were observed at neo- tropical forests (Martin and Aber, 1997) and Shervarayan hills (Kaduvul and Parthasarathy, 1999).

Based on importance value index (IVI), the top five dominant species recorded in Chikhali Taluka, Navsari district, represented for woody species in Table 1 and shrubs, herbs and orchids in Table 2. Among the tree species, the maximum IVI recorded for *Tectona grandis* (76.385) and followed by *Adina cordifolia* (21.978), *Terminalia tomentosa* (19.682), *syzygium cumini* (14.929) and *Oroxylum indicum* (13.293) respectively (Table 1). Among the herbs species, the highest Shannon-Wiener index recorded for *Commelina benghalensis*, *Curculigo orchioides*, *Phaseolus species, Sonchus oleraceus* (0.162) and followed by *Blainvillea acmella, Blumea wightii, Canscora diffusa, Curcuma odorata, Desmodium gangeticum, Hibiscus lobatus, Tridaxpro cumbens* (0.124), respectively (Table 2).

In a diverse community the species are adapted to narrowly drawn niches and are extraordinarily successful within those niches. On the basis of basal area and density, *Shorearo busta*prefers the mid-hills at 900-1100 m and *Syzygium cumini* prefer to grown in upper hills (1100-1350 m). The Shannon-Wiener index (H′) value was 0.272, which is lower compared to 5.68 Shannon value of the Tropical forest in the Eastern Ghats (Reddy *et al.,* 2011) and Tropical forest of Similipal Biosphere reserve (Reddy *et al.,* 2007). Similar results have been reported by Menon and Balasubramanian (1985), Khatri *et al.* (2004), Sarkar *et al.* (2011) and Ahir *et al.* (2012). In another study, Jeevan (2007) reported that *Vateriaindica* was the most dominant tree based on the species importance value index and based on the family importance value index, Dipterocarpaceae was the most dominant family in Western Ghats of Karnataka.

The girth class distribution is one of the character of stand structure and graphical representation of different girth class trees and comparatively higher number of individuals (ha^{-1}) were recorded in lower girth class (30-60 cm) followed by higher girth classes at Chikhali Taluka, Navsari (Fig. 5). Similar, trend also found in shrubs, herbs and orchids vegetation (Fig. 6).

Several workers have studied floristic composition and biological spectrum of different regions in India (Jamir *et al.,* (2006); Shukla and Mishra (2006); Patel *et al.* (2010), Pharswan et al. (2010); Thakur and Khare (2011); Bajpai *et al.* (2012); Thakur *et al.* (2012);Desai and Ant (2012);Sindhuja et al.

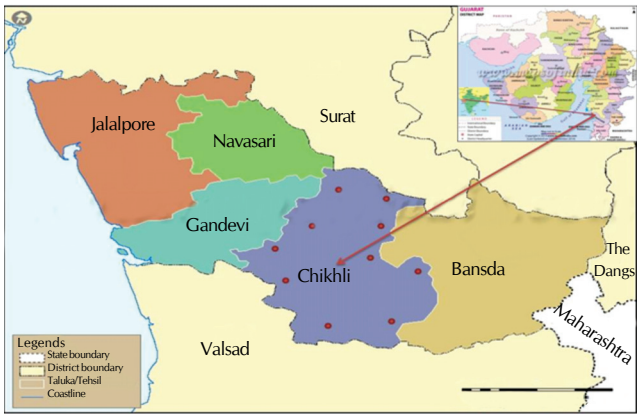

Figure 1: Geographic map of the study area and dark dot indicate the place of the research area

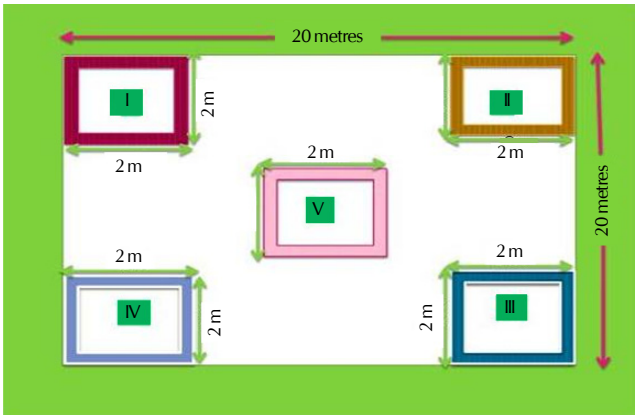

Figure 2: Assessment of phytosociological study through quadrate method

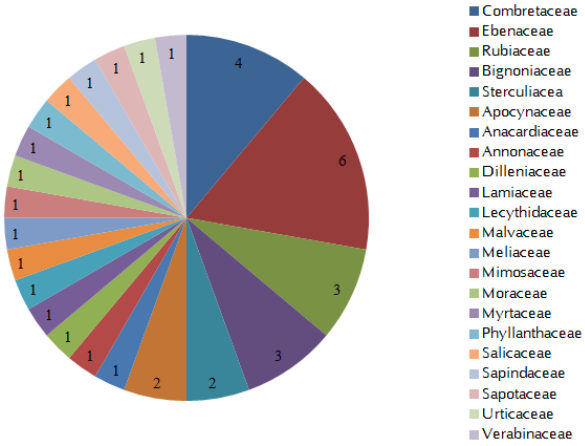

Figure 3: Family basis of woody vegetation of Chikhali Taluka, Navsari district, Gujarat

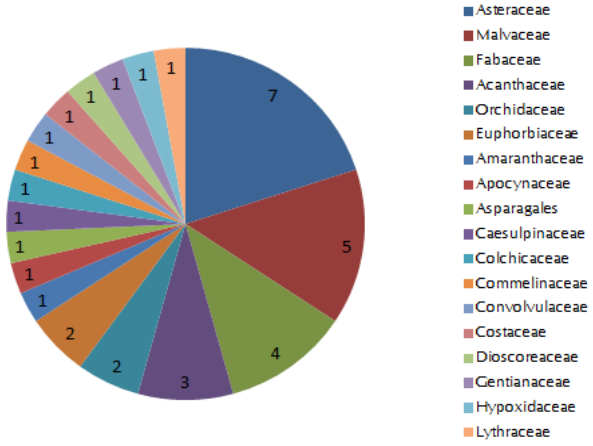

Figure 4: Family basis of herbs and orchids of Chikhali Taluka, Navsari district, Gujarat

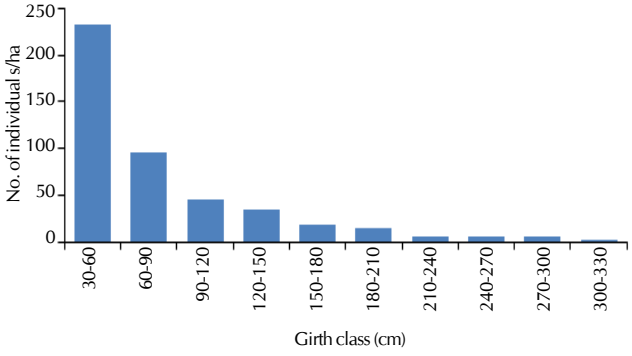

Figure 5: Class distribution of woody plant density per hectare of Chikhali Taluka, Navsari district, Gujarat

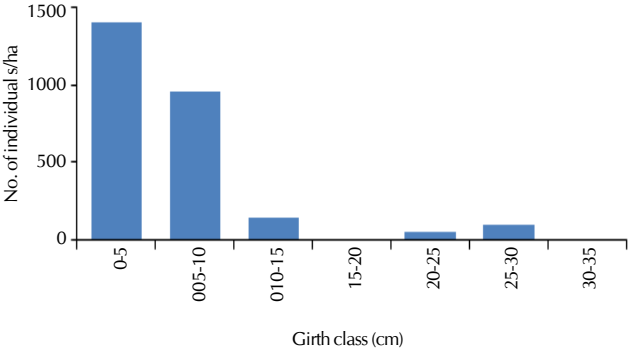

Figure 6: Class distribution of shrubs, herbs and orchids density per hectare of Chikhali Taluka, Navsari district, Gujarat

(2012);Vediya and Kharadi (2012); Sarkar and Devi (2014); Ashwini *et al.* (2014); Chauhan *et al.* (2014); Mohammad and Joshi (2015); Sundarapandian and Subbiah (2015) and Kumar (2016).

Perspectives of Forest Biodiversity Conservation in study area

India's national forest policy (1952) has revised in 1988 and recommended 33% forest cover in the country and emphasized to maintain two third forest cover in hills and mountains. Government of India has launched several programs which has helped *in situ* conservation of biodiversity through protected area networks from time to time. According to definition of vegetation, it is an embodiment of unique physiognomy, structure and floristic (intrinsic factors) influenced by climate, topography and anthropogenic factors (extrinsic factors). Plant sociological characters such as

Table 2: Density andShannon-Wiener indexof the herbs and orchids species in Chikhali Taluka, Navsaridistrict, Gujarat

Species name	F	D	RF	pi	log Pi	H′	Conc. of Do	Simpson
Acalyphaindica	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Aeridesmaculosa	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Ammanniabaccifera	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Blainvilleaacmella	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Blumeawightii	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Canscoradiffusa	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Cassia tora	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Commelinabenghalensis	0.1	0.3	5.660	0.056	-2.871	0.162	0.0032	
Corchorustridens	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Costusspeciosus	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Curculigoorchioides	0.1	0.3	5.660	0.056	-2.871	0.162	0.003	
Curcuma odorata	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Degeriamuricata	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
DesmodiumGangeticum	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Dioscoreaspp	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Emilia sonchifolia	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Eranthemumspp	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Euphorbia nerifolia	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Gloriosasuperba	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Habenariafurcifera	0.1	0.3	5.660	0.056	-2.871	0.162	0.0032	
Helicterisisora	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Hibiscus lobatus	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Holarrehnaantidysentrica	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Ipomoea fistulosa	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Nerviliaaragoana	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Phaseolusspp	0.1	0.3	5.660	0.056	-2.871	0.162	0.0032	
Phylanthusniruri	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Pulicariawightiana	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Ruelliatuberose	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Sidaglutinosa	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Sonchusoleraceus	0.1	0.3	5.660	0.056	-2.871	0.162	0.0032	
Strobilanthescallosa	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Tridaxprocumbens	0.1	0.2	3.773	0.038	-3.277	0.124	0.0014	
Urenalobata	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Xanthium strumarium	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
Zorniagibbosa	0.1	0.1	1.887	0.019	-3.970	0.075	0.0003	
						3.478	0.0328	0.967

frequency, density and abundance were exclusively influenced by the natural as well as biotic stresses prevailing at the present study sites. Waghai forest range has mainly dominated woody vegetation species *Tectonagradis* which is independently of its economic importance. The associated species with *Adina cordifolia, Oroxylumindicum, Morindatomentosa, Terminalia bellerica*and *Ficus racemose* in top storey of Chikhali Taluka, Navsari district. The *Xyliaxylocarpa, Schleicheraoleosa and Careyaarborea* are common, mainly in the second storey. The *Bambusa bambos* and *Dendrocala musstrictus* are encountering near to water canal of this area. Chikhali Taluka is experiencing high degree of anthropogenic pressure mainly because of age old shifting agriculture practice for livelihood of growing tribal population (Bhils, Dublas, Dhodias,Koli, Konkni, Gond, Gamit, Valvi, Talvi, Rathava, Siddi etc. spread in district, predominantly inhabit the forest areas all along its southeastern boundary) (Kumar, 2015). Most of the protected areas are having small size and are under the pressure because of the use and abuse of resources by the neighboring human settlements. Another important conservation strategy by the community in India is sacred groves, which are protected to worship for their ancestral sprit and deities. Thus systematic biodiversity conservation efforts would be required to conserve the biodiversity, with special attention in tropical regions. These efforts would require a critical monitoring and base line information in quantitative terms at each level of biodiversity organization. Since biodiversity is a multidimensional concept so it cannot be expressed through a single scalar quantity. It can better be represented if it covers the range of information like geographical (latitude and longitude), abiotic (temperature and precipitation), taxonomic variety (taxonomic information of the species) and life form variations (size or the biomass) to describe the diversity of ecosystems. Further, improvement of conservation status of endemic species under threatened categories along with their abiotic conditions would be required by using critical site based information. It is a difficult task to record the compositional, structural and functional diversity of an ecosystem or a landscape. However, it is prerequisite to collect such information for the proper understanding of the biodiversity assessment and better strategies for its conservation in study area.

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