Environment and Ecology 43 (3) : 740—747, July—September 2025
Article DOI: https://doi.org/10.60151/envec/QSAL2599
ISSN: 0970-0420 (Print), ISSN: 3049-3625 (Online)

Eco-Floristic Analysis of Tree Species in Satlasana Taluka of Mehsana District, Gujarat, India

Shivani G. Patel, P. K. Patel

Received 12 May 2025, Accepted 10 July 2025, Published on 7 August 2025

ABSTRACT

This study presents an Eco-floristic analysis of tree species in Satlasana taluka in Mehsana district of Gujarat. The investigation aimed to document the diversity, distribution, and ecological characteristics of tree species in the region. A comprehensive survey was conducted across different habitats, and data on tree species composition, density, frequency, and abundance were collected. A total of 107 tree species belonging to 36 families were recorded. The study revealed a significant variation in tree species diversity and composition across different habitats. The findings of this study provide valuable insights into the ecological characteristics of tree species in the region and have implications for conservation and sustainable management of forest resources in Satlasana taluka.

Keywords Eco-floristic, Tree species, Diversity, Satlasana, Mehsana district.

INTRODUCTION

The number of species or types in a certain location or area is known as its diversity. The many forms and variability of plant species within a specific region are related to floristic diversity (Myers 1990). The total global variability, ecosystem, species, Community, population, individual, and even genes within a single individual are all frequently used to assess floristic diversity. Generally, floristic diversity can be described as a dynamic, intricate, and balancing network of different species that are interdependent (Joshi and Shringi 2014). Variations in the structure and content of species can indicate abiotic circumstances that vary, including temperature, light availability, moisture of soil and exposure to the wind. Species and individual dynamics can show patterns of disturbance response and community evolution when monitored over time.

Forests and tree-dominated ecosystems play crucial role in preserving ecological balance, to sustain biodiversity, and providing a range of ecosystem services. Conservation of biodiversity, sustainable land management, and ecological restoration all depend on an understanding of the species compo-

Shivani G. Patel[1]*, P. K. Patel[2]

[2]Head and Assistant Professor
[1,2] Department of Botany, S.P.T. Arts & Science College, Godhra, Gujarat, India

Email: drshivaniresearch17@gmail.com
*Corresponding author

sition and structure of trees in a particular area. An efficient method for evaluating plant diversity and its interactions with the environment is the study of eco-floristics, which combines floristic composition with ecological characteristics.

Gujarat has a very diverse natural environment with the greatest number of large geographical zones. Gujarat is the Indian state with the largest geographical area, which indicates the great biodiversity of the state. People get direct significant benefit from biodiversity. It is found in food, fuel, gum, fiber, resin, dye, and insecticide raw materials. Control of the nutrient cycle is another crucial component of biodiversity. The study of plant communities, is the field of phytosociology. A plant association is a collection of species that coexist in a given habitat and are drawn together by shared ecological tolerances.

MATERIALS AND METHODS

Study area

The present study was conducted in Satlasana taluka of Mehsana district in North Gujarat. Satlasana is situated in Mehsana district in North Gujarat which is shown in Fig. 1. It is located with Banaskantha district at its north, Visnagar taluka of Mehsana district on the south, Kheralu taluka of Mehsana district on the west and Sabarkantha district on the eastern side. Satlasana taluka has covered three forest ranges Dharoi, Timba and Sudasana. It has covered the total area of 2568.28 hectare. The entire part of the area is hilly and elevation varies from to 365 meters above the mean sea level. According to Champion and Seth (1968), the Dharoi range forest is 5/E2 number in forest subtypes of North Gujarat and known as *Boswellia* type dry deciduous forest.

Taranga hill forest of Satlasana taluka is a hilly forest region located at the southernmost point of Aravalli Hill ranges with coordinates of 24°00' N and 72°46' E. THF covers an area of is 18.12 Km^2 (1812 ha). Hillocks, Riverbeds, Farmlands, and Sandy tracts, and Rocky thorn-scrub forest are the features that define THF. The biological diversity of plants, birds, reptiles and mammals are another element of it. This region experiences irregular rainfall and a semi-arid climate. Summer temperature exceeds 46 °C, while winters are short period, with an average minimum temperature of 15.6 °C. January has the lowest mean temperature, while July and August have

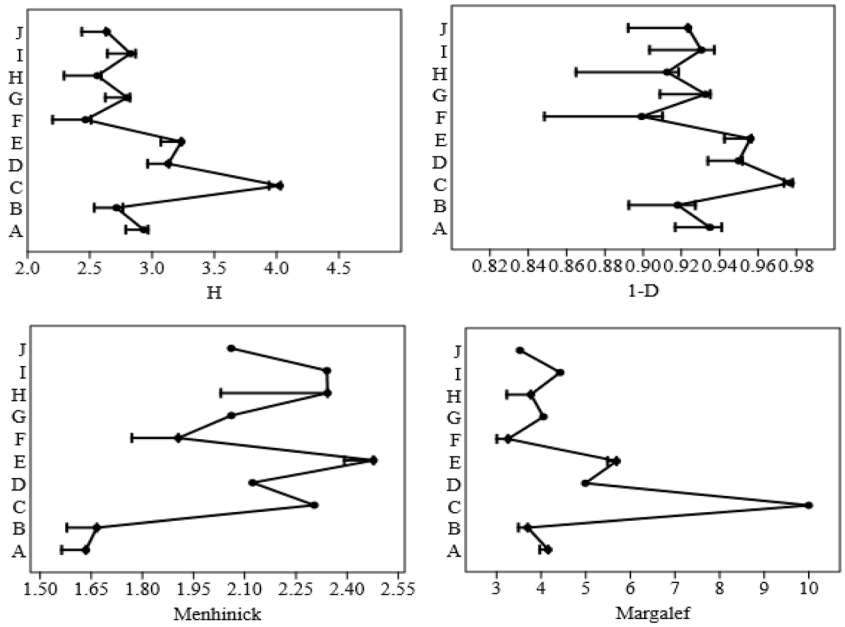

Fig. 1. Diagram showing Shannon index (H), Simpson index (1-D), Menhinck's index and Margalef's index of all experimental sites in Satlasana taluka of Mehsana District, Gujarat.

the highest. 20.1°C is the average annual temperature. The rainy season is limited from November to May. The average rainfall of each year is 74.0 mm/year and most of it falls during the winter months.

Sampling and data collection

The quadrat method was used in Eco-floristic study of tree species for all experimental sites. Random sampling method was used to measure and record the tree species in each study site, using sampling quadrats measuring 20 m × 20 m. Every tree species found in each quadrat was noted, identified, numbered, and its cover percentage was estimated. All the unidentified tree species were identified using flora, Thesis and other relevant literature (Champion & Seth 1968, Saxton & Sedgwick 1918, Shah 1978, Yogi 1970). Red data book of Indian Plant were used to identify the rare, endangered and threatened plant species (Nayar and Shastry 1987).

Data analysis

The analysis of the ecological factors was done following the collection of data from different species. Which are determined for every species in the community using the Raunkiaer (1934) formula and comprise the values of frequency, density, relative frequency, relative density, relative dominance, and Importance value index (IVI). The Importance value index (IVI) of each species was determined by adding the relative frequency, relative density, and relative dominance that were obtained from the frequency, density, and dominance data. The following formula can be used to find relative frequency, relative density, and relative dominance.

The circumference at breast height were measured in order to calculate the basal area of the tree. The formula for this is πr^2, where r is the radius measured at a height of 1.37 meters. The area of the species was estimated by multiplying the average tree basal area by the density; the total basal area was then utilized to calculate the relative dominance of trees. The GBH of each individual in every species was measured to get the total basal cover. The basal area of each species was then computed using the following formula:

$$\text{Density} = \frac{\text{Total number of individuals in all quadrats}}{\text{Total number of quadrats studied}}$$

$$\text{Frequency} = \frac{\text{Number of quadrats in which species occurs}}{\text{Total number of quadrats studied}} \times 100$$

Dominance = Density of a species × Average basal area of the species

Basal area

The area that is occupied by the base of a tree is considered as basal area. It is thought to be a reliable measure of the size, weight, or volume of the tree. It is one of the most crucial factors in determining the standing biomass in a region since it tells us about the relative dominance or proportion of larger and smaller trees in an ecosystem.

Basal area = $GBH^2/4\pi$

Where GBH= Girth at breast height

Usually, the species are ranked in decreasing order of importance following the quantitative evaluation of the relative values of density, frequency, and dominance.

Importance value index (IVI)

IVI = Relative density + Relative frequency + Relative dominance (Shahid and Joshi 2016)

$$\text{Relative density} = \frac{\text{Density of a species}}{\text{Sum of density of all species}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of a species}}{\text{Sum of frequency of all species}} \times 100$$

$$\text{Relative dominance} = \frac{\text{Total basal area of a species}}{\text{Total basal area of all species}} \times 100$$

Simpson's index (1949): Dominance of plant species is measured by using this index,

$$CD = \sum (ni / N)^2$$

Where, ni = Importance value index of species
N = Sum of importance value index of all the species

Shannon wiener index (1963): It is also known as species diversity index. The overall number of species' natural logarithm. This index, which prioritizes rare species over common ones, outperforms the Simpson's because it is based on information theory. Thus, we employ this technique to provide a clear image of species dominance.

$$H = \sum (ni / N) \log (ni / N)$$

Where, ni = Importance value index of species
N = Sum of importance value index of all the species

Species richness

As a simple indicator of species richness, Margalef's index was applied (Margalef 1958).

$$\text{Margalef sindex} = \frac{(S-1)}{\text{In N}}$$

Where, S = Total number of species
N = Total number of individuals in the sample
ln = Natural logarithm

RESULTS

Composition and distribution of tree species

A total of 10 sites were surveyed, and a total 107 plant species belonging to 36 families and 81 genera were recorded (Table 1). Out of them, 78 species were recorded inside sampling plots and 29 species were either ornamental or planted at roadsides. Fabaceae family was the most dominant with 21 species

Table 1. List of tree species recorded at Satlasana taluka, Mehsana District, Gujarat.

No.	Scientific name	Local name	Family
1	*Acacia auriculiformis* Benth.	-	Mimosaceae
2	*Acacia catechu* (L.) Willd.	Khair	Mimosaceae
3	*Acacia chundra* (Roxb. ex Rottl.)	Khair	Mimosaceae
4	*Acacia eburnea* (L. f.) Willd.	Marmat	Mimosaceae
5	*Vachellia nilotica* L. subsp. nilotica	Baval, Ram baval	Mimosaceae
6	*Adina cordifolia* (Roxb.) Brandis	Haldu	Rubiaceae
7	*Aegle marmelos* L.	Bili	Rutaceae
8	*Ailanthus excelsa* L.	Arduso	Simaroubaceae
9	*Alangium salviifolium* (L.f.) Wangerin	Ankol	Cornaceae
10	*Albizia lebbeck* (L.) Benth.	Shirish	Fabaceae
11	*Albizia odoratissima* (L.f.) Benth.	Kalo shirish	Fabaceae
12	*Albizia procera* (Roxb.) Benth.	Dholo Shirish	Fabaceae
13	*Alstonia scholaris* L.	Saptaparni	Apocynaceae
14	*Anacardium ocidentale* L.	Kaju	Anacardiaceae
15	*Annona squamosa* L.	Sitafal	Annonaceae
16	*Anogeissus pendula* Edgew.	Dhao, Dhankra	Combretaceae
17	*Azadirachta indica* A. Juss.	Limdo	Meliaceae
18	*Balanites aegyptiaca* (L.) Delile	Ingoriyo	Zygophyllaceae
19	*Bauhinia purpurea* L.	Kanchnar	Fabaceae
20	*Bauhinia racemosa* Lam.	Asundro	Fabaceae
21	*Bombax ceiba* L.	Shimlo	Bombacaceae
22	*Boswellia serrata* Roxb.	Salai, Gugal	Burseraceae
23	*Bridelia retusa* (L.) A. Juss	Asan, Akalkanto	Phyllanthaceae
24	*Butea monosperma* (Lam.) Taub.	Khakhro, Kesudo	Fabaceae
25	*Callistemon lanceolatus* DC.	Bottle brush	Myrtaceae
26	*Canthium coromandelicum* (Burm.F.) Alston	Gengani	Rubiaceae
27	*Capparis grandis* L.F.	Vatt bor	Capparaceae
28	*Caryota urens* L.	Shivajata	Arecaceae
29	*Cassia fistula* L.	Garmalo (yellow)	Fabaceae
30	*Commiphora wightii* (Arn.) Bhandari	Gugal	Burseraceae
31	*Cordia dichotoma* Forst.	Moto Gundo	Boraginaceae
32	*Cordia sinensis* Lam.	Nani Gundi	Boraginaceae
33	*Couroupita guianensis* Aubl.	Kailashpati	Lecythidaceae
34	*Crateva nurvala* Buch.- Ham. Var. nurvala	Vay-varno	Capparaceae
35	*Dalbergia latifolia* Roxb.	Pahi, Patrali	Fabaceae
36	*Dalbergia sissoo* L.	Moto Sisam	Fabaceae
37	*Delonix regia* (Hook.) Raf.	Gulmahor (Red)	Fabaceae
38	*Derris indica* (Lam.) Benn.	Kanji	Fabaceae
39	*Diospyros melanoxylon* Roxb.	Timru	Ebanaceae
40	*Diospyros montana* Roxb.	Makrod, Dheki	Ebanaceae
41	*Dolichandrone falcata* (Wall. ex DC.) Seem.	Medshingi	Bignoniaceae
42	*Ehretia laevis* Roxb.	Nani vadhvardi	Boraginaceae
43	*Erythrina variegata* L.	Panaravo	Fabaceae

Table 1. Continued.

No.	Scientific name	Local name	Family
44	*Eucalyptus globulus* Labill.	Nilgiri	Myrtaceae
45	*Fernandoa adenophylla* (Wall. Ex G.Don) Steenis	Katsagon	Bignoniaceae
46	*Ficus amplissima* Sm.	Payar	Moraceae
47	*Ficus arnottiana* (Miq.) Miq.	Khad Piplo	Moraceae
48	*Ficus benghalensis* L.	Vad	Moraceae
49	*Ficus carica* L.	Anjir	Moraceae
50	*Ficus racemosa* L.	Umaro	Moraceae
51	*Ficus religiosa* L.	Pilpo	Moraceae
52	*Flacourtia indica* (Burm.f) Merr.	-	Salicaceae
53	*Garuga pinnata* Roxb.	Kakad	Burseraceae
54	*Gmelina arborea* Roxb.	Sevan	Verbenaceae
55	*Grewia tiliifolia* Vahl.	-	Malvaceae
56	*Gymnosporia emarginata* (Willd.) Thwaites	Vicklo	Celastraceae
57	*Gymnosporia senegalensis* Loes.	Kankayo, Viklo	Celastraceae
58	*Holarrhena pubescens* Wall. Ex G.Don	Kadvo indrajav	Apocynaceae
59	*Holoptelea integrifolia* (Roxb.) Planch.	-	Ulmaceae
60	*Lannea coromandelica* (Houtt.) Merr	Moyno .	Anacardiaceae
61	*Leucaena leucocephala* (Lam.) de Wit	Pardeshi Baval	Mimosaceae
62	*Mallotus philippensis* (Lam.) Mull. Arg.	Kapilo	Euphorbiaceae
63	*Mangifera indica* L.	Aambo	Anacardiaceae
64	*Manilkara hexandra* (Roxb.) Dubard	Rayan	Sapotaceae
65	*Manilkara zapota* (L.) var royen	Chickoo	Sapotaceae
66	*Melia azedarach* L.	Bakan Limdo	Meliaceae
67	*Miliusa tomentosa* (Roxb.) J. Sinclair	Umph, Umbho	Annonaceae
68	*Mimusops elengi* L.	Borsalli	Sapotaceae
69	*Mitragyna parvifolia* Korth.	Kadamb	Rubiaceae
70	*Monoon longifolium* (Sonn.) Benth. & Hook.f. ex Thwaites	False ashoka	Annonaceae
71	*Moringa concanensis* Lam.	Kadvo Saragvo	Moringaceae
72	*Moringa oleifera* Lam.	Saragvo	Moringaceae
73	*Morus alba* L.	Shetur	Moraceae
74	*Murraya koenigii* L.	Mitho Limdo	Rutaceae
75	*Phoenix dactylifera* L.	Khajur	Arecaceae
76	*Phyllanthus emblica* L.	Amla	Phyllanthaceae
77	*Pithecellobium dulce* (Roxb.) Bth.	Goras Amli	Fabaceae
78	*Plumeria obtusa* L.	Champo	Apocynaceae
79	*Plumeria rubra* L.	Champo	Apocynaceae

Table 1. Continued.

No.	Scientific name	Local name	Family
80	*Prosopis cineraria* (L.) Druce	Khijado, Shami	Fabaceae
81	*Prosopis juliflora* (Sw) DC.	Gando Baval	Fabaceae
82	*Pterocarpus marsupium* Roxb.	Biyo	Fabaceae
83	*Punica gratanum* L.	Dadam	Punicaceae
84	*Putranjiva roxburghii* Wall.	Putranjiva	Euphorbiaceae
85	*Salvadora oleoides* Decne.	Piludi,Vagdo	Salvadoraceae
86	*Salvadora persica* L.	Piludi	Salvadoraceae
87	*Santalum album* L.	Chandan	Santalaceae
88	*Sapindus trifoliatus* L.	Aritha	Sapindaceae
89	*Saraca asoca* (Roxb.) Willd.	Ashok	Fabaceae
90	*Senegalia pennata* (L.) Maslin	-	Fabaceae
91	*Senegalia senegal* (L.) Britton	Goradiyo Baval	Fabaceae
92	*Senna siamea* (Lam.) H.S.Irwin & Barneby	Kasheed	Fabaceae
93	*Simarouba glauca* DC.	-	Simaroubaceae
94	*Sterculia urens* Roxb.	Kadayo	Malvaceae
95	*Syzygium cumini* (L.) Skeels	Jambu	Myrtaceae
96	*Tamarindus indica* L.	Amli	Fabaceae
97	*Tecomella undulata* (Sm.) Seem.	Ragat Rohido	Bignoniaceae
98	*Tectona grandis* L.	Saag	Verbenaceae
99	*Terminalia arjuna* (Roxb. ex DC.) Wight & Arn.	Arjun	Combretaceae
100	*Terminalia bellirica* (Gaertn.) Roxb	Baheda	Combretaceae
101	*Terminalia catappa* L.	Desi Badam	Malvaceae
102	*Thespesia populnea* (L.) Soland ex. Corr.	Paras Piplo	Mimosaceae
103	*Vachellia leucophloea* (Roxb.) Maslin, Seigler & Ebinger	Hermo Balval	Mimosaceae
104	*Vachellia tortilis* (Forssk.) Galasso & Banfi	Israeli Baval	Apocynaceae
105	*Wrightia arborea* (Dennst.) Mabb.	-	Apocynaceae
106	*Wrightia tinctoria* R. Br.	Kudi, dudhlo	Rhamnaceae
107	*Ziziphus jujuba* Mill.	Bor	Combretaceae

followed by Mimosaceae and Moraceae with 8 and 7 species respectively. 10 families were recorded with single species.

The data on tree species composition, diversity and ecological indices are presented in Table 1. Table 1 shows that the number of individuals, species, and

Table 2. Tree species diversity and richness of experimental sites in Satlasana taluka, Mehsana district, Gujarat.

Sl. No.	Name of site	Name of the area	No. of individuals	No. of species	No. of families	Shannon index (H)	Simpson index (1-D)	Menhinick index	Margalef index
1	A	Sudasana	222	25	18	3.015	0.94	1.678	4.442
2	B	Dharoi	152	23	14	2.903	0.932	1.866	4.379
3	C	Taranga hills	946	73	30	4.082	0.978	2.373	10.51
4	D	Timba	180	28	18	3.149	0.947	2.087	5.199
5	E	Aankaliyara	162	31	18	3.209	0.948	2.436	5.897
6	F	Mumanvas	69	17	14	2.68	0.921	2.047	3.779
7	G	Umari	117	23	14	2.94	0.937	2.126	4.62
8	H	Gamanpura	57	18	16	2.688	0.918	2.384	4.205
9	I	Umrecha	84	22	14	2.922	0.937	2.4	4.74
10	J	Chelana	65	17	11	2.732	0.928	2.109	3.833

families varied across the sites. The highest number of individuals (946) and species (73) were recorded at site C (Taranga hills), while the lowest number of individuals (57) and species (17) were recorded at site F (Mumanvas) and site H (Gamanpura), respectively (Table 2).

The Shannon index (H) ranged from 2.68 (site F) to 4.082 (site C), indicating a significant variation in species diversity across the sites, The Simpson index (1-D) ranged from 0.918 (site H) to 0.978 (site C), indicating a high level of species dominance at site C. The Menhinick index ranged from 1.678 (site A) to 2.436 (site E), indicating a significant variation in species richness across the sites. The Margalef index ranged from 3.779 (site F) to 10.51 (site C), which indicates a high level of species diversity at site C (Fig. 1).

DISCUSSION

The results of the present study indicate a significant variation in tree species diversity across the sites in Satlasana taluka. The highest species diversity was recorded at site C (Taranga hills), which is a forest area. The low species diversity at sites F (Mumanvas) and H (Gamanpura) may be attributed to human activities such as agriculture, grazing and urbanization.

The Shannon index (H) values indicate a high level of species diversity at sites C, E, and A, which are characterized by mix of forest and scrubland habitats. The Simpson index (1-D) values indicate a high level of species dominance at site C, which is attributed to the presence of a few dominant tree species such as *Vachellia nilotica, Senegalia senegal, Vachellia tortilis, Gymnosporia senegalensis, Wrightia tinctoria.*

The Menhinick's index values indicate a high level of species richness at sites C and E, which may be attributed to the presence of a mix of forest and scrubland habitats. The Margalef's index values indicate a high level of species diversity at site C, which may be attributed to the presence of large number of species present in the forest area.

Satlasana region has specific forest type called dry deciduous forest, which consist the deciduous plant species. The majority of the species created a diverse plant community in nature and were widely distributed over the region. With the maximum number of tree species, Taranga hill forest supported the dominant and ecologically established tree species.

The local population uses 36% of all known plant species to meet their domestic needs, including building a home, preparing food, fodder, medicine, and other household necessities. For instance, the flowers of *Butea monosperma* are used for bathing because it provides coolness during summer and helps in skin problems.

Conservation implications

This study also reveals the presence of Rare, Endangered and Threatened (RET) tree species in the region. In which, *Commiphora wightii* is Critically

Endangered, *Tecomella undulata* is Endangered and *Pterocarpus marsupium* is Near Threatened. These species are categorized based on IUCN Red List categories. The majority of species, including more plants of conservation importance, were located in a few regions of Satlasana such as Taran Mata temple, Taranga hills, Timba were designated as areas of high biodiversity. The following strategies are recommended as conservation measures for RET plant species in light of the well-established ecological, social and environmental components pertaining to the vegetation formation in Satlasana taluka and the abundance of management options.

A thorough status survey of threatened plant species needs to be conducted to identify the habitats supporting high floristic diversity. These areas has to be strictly protected from grazing, wood cutting and the collection of other natural resources.

Restoration programs involving endangered species and their companion species should be used to rehabilitate degraded ecosystems.

Developing plantations for fodder and fuel wood, distributing fuel-efficient stoves, and providing employment opportunities for low-income villagers are all ways to involve them in management planning for the overall preservation of the threatened biological diversity.

It is necessary to identify the regions where the threatened species are most prevalent. The local population should be made aware that the possible tree-cutting and grazing areas should be avoided.

The establishment of village level forest and resources management committees are recommended, as are strict prohibitions on grazing and wood cutting in all areas having high species diversity. The dependent villagers should be linked to these organizations to receive socio-economic benefits and to minimize the biotic pressure on the identified hot spot areas.

CONCLUSION

The present eco-floristic study of tree species in Satlasana taluka provides a comprehensive understanding of the diversity, distribution and ecological characteristics of tree species in the region. The study recorded a total of 107 tree species belonging to 36 families, indicating a significant level of floristic diversity. The findings of this study highlight the importance of conserving and sustainably managing the forest resources in the region, which is essential for maintaining ecosystem balance, supporting biodiversity, and ensuring the well-being of local communities.

The results of this study have implications for forest management practices, conservation efforts, and sustainable development initiatives in the region. Further research is recommended to investigate the ecological and socioeconomic factors influencing the distribution and abundance of tree species in Satlasana taluka. Additionally, efforts should be made to engage local communities in conservation and sustainable management practices to ensure the long-term health and resilience of the region's forest ecosystems.

Overall, this study contributes to the existing body of knowledge on the flora of Gujarat and highlights the need for continued research and conservation efforts to protect the region's unique and valuable botanical resources. The findings of this study have implications for policy, conservation, and sustainable management of forest resources in the region.

REFERENCES

Champion, H. G., & Seth, S. K. (1968). A revised survey of forest types of India. FRI*,* Dehradun, 1-404.

Joshi, S., & Shringi, S. K. (2014). Floristic Diversity with Special Reference to Rare and Threatened Plants of Jawahar Sagar Sanctuary area near Kota Rajasthan. *Biological Forum-An International Journal,* 6(1), 84-91.

Margalef, R. (1958). Information Theory in Ecology. *General Systems,* 3, 36-71.

Myers, N. (1990). Threatened Biotas: Hotspots in tropical forests. *The Environmentalist,* 20(10), 243-256.

Nayar, M. P., & Shastry, A. R. K. (1987). Red data book of Indian plants. Botanical Survey of India, Calcutta.

Raunkiaer, C. (1934). The life form of plants and statistical. Plant Geography. *Open Journal of Ecology*, 5(9), 632.

Saxton, W. T., & Sedgwick, L. G. (1918). Plants of Northern Gujarat. *Record. Botanical Survey India,* 6, 207-323.

Shah, G. L. (1978). Flora of Gujarat State. Volume I & II. Sardar Patel University Vallabh Vidhyanagar, Gujarat, India, 1074.

Shahid, M., & Joshi, S. P. (2016). Phytosociological assessment and distribution pattern of tree species in the forests of Doon

Valley, Shivalik hills of Lower Himalaya. *Tropical Plant Research. An International Journal*, 3(2), 263- 271.

Shannon, C. E., & Wiener, W. (1963). The Mathematical Theory of Communication. University of Illinois Press, Urbana, 127 pp.

Simpson, E. M. (1949). Measurement of diversity. *Nature,* 163: 688.

Yogi, D. V. (1970). A contribution to the Flora of North Gujarat." PhD thesis. Submitted to Sardar Patel University, Vallabh Vidyanagar, Gujarat.