

Qualitative and quantitative estimation of rare and dominant tree species in an urban diversity setting of Vallabh Vidyanagar campus, Gujarat

by

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Abstract

The estimation of rare and dominant species is important for many conservation strategies and priorities. The rank-abundance plot can be used to visualize species abundance distributions and thus helps in categorization of species. In this plot, the numbers of individuals of each species are arranged in descending order, and the proportion of the total number of individuals for each species is then plotted on the log scale against the species rank. The analysis of graph showed that the most dominant species found in the Vallabh Vidyanagar area of Gujarat are *Peltophorum pterocarpum* and *Azadirachta indica* sharing first and second rank in the plot followed by the rare and ecologically sensitive species shown in the extreme tail of the graph.

Key words: Abundance, Rank-abundance plot, Dominant and rare species

Introduction

The concepts of evenness, diversity and dominance have been used traditionally regarded as basic parameter of community structure in interspecific competition. The analysis of species-abundance patterns within communities has a long and venerable history in ecology (McGill et al., 2007). Species diversity is studied by ecologists who are interested in understanding the mechanisms and effects of certain ecological

phenomena, such as pollution, environmental disturbances, etc. It is a function of the number of species present (i.e. species richness or number of species) and the evenness with which the individuals are distributed among these species (i.e. species evenness, species equitability, or abundance of each species) (Pielou 1969; Spellerberg 1991). The degree of overlap of the two distributions corresponds to species evenness whereas the degree of separation of the two distributions corresponds to species dominance. Thus, species dominance may be regarded as the complement of species evenness (or vice versa)(Camargo, 1995). Abundance-rank diagram is a simple approach to demonstrate the species number, species abundance and species diversity in an integrated manner (Bhatt and Sanjit, 2005). The shape of the rank/abundance plot can provide an indication of dominance or evenness. Steep plots signify assemblages with high dominance and shallower slopes indicate higher evenness (Magurran, 2003). Ecologists are encouraged to use rank abundance curves to visualize and analyze species abundance patterns (Nekola et al., 2008). The simple random sampling was more appropriate to estimate the total number of trees than the stratified random sampling in urban area (Alvarez et al., 2005).

Study area

This study was conducted in Vallabh Vidyanagar town (central coordinate 72 55 05.64 E and 22 33 28.60 N) of Anand district in Gujarat state. It has an average elevation of 39 metres (127 feet). It is bounded by Kheda District to the north, Vadodara District to the east, Ahmedabad District to the west, and the Gulf of Cambay to the south.

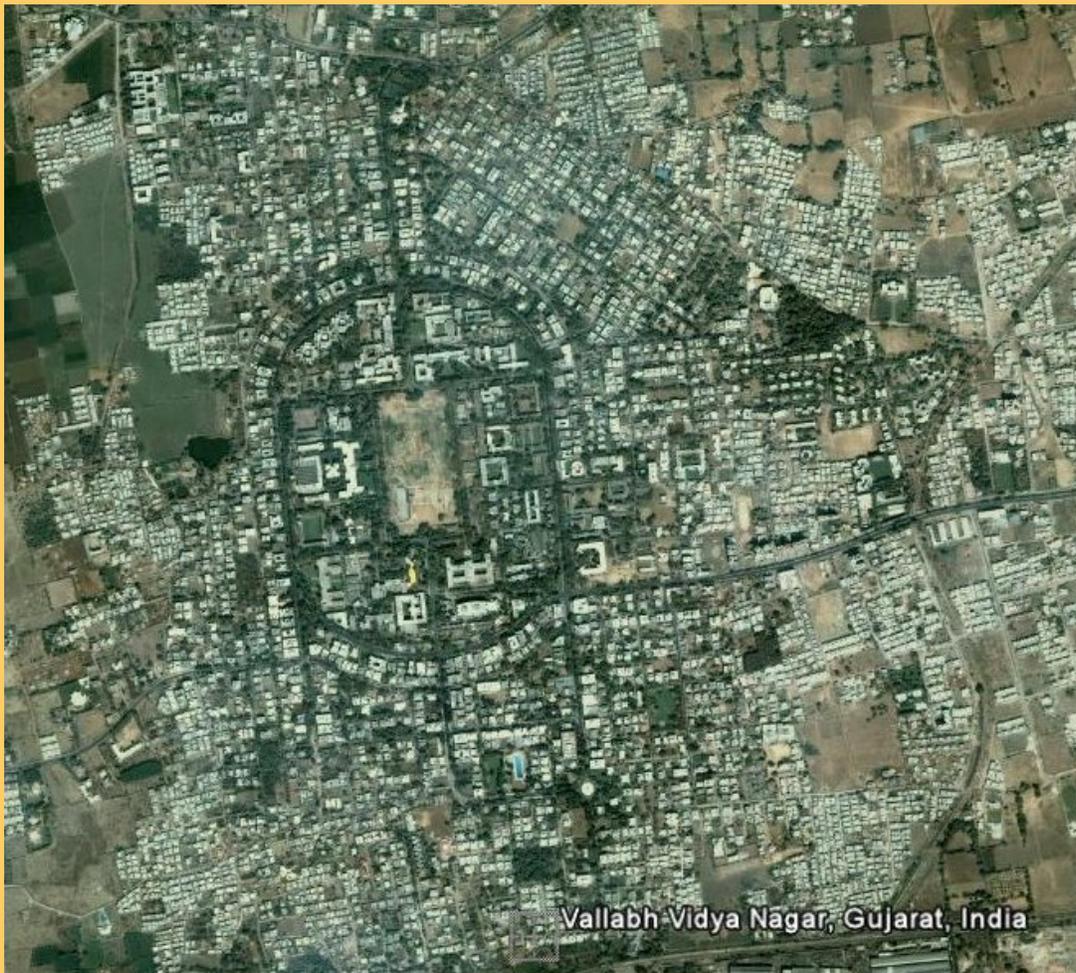


Fig.1 Layout of the study area

Methodology

The simple random sampling method was used to estimate the total number of trees in per kilometer sidewalk of the Vallabh Vidyanagar campus. Every tree with a diameter at breast height >20cm was identified and, its species were recorded. For a rank/abundance plot, the numbers of individuals of each species were sorted in descending order and the proportion of the total number of individuals for each species was then plotted on the log scale against the species rank. A total of 61 species was recorded in the campus with 1061 individuals, planted by the local bodies, institutes and trusts.

Result & Discussion

The species rank abundance plot is a line diagram, where y-axis represents number of individuals and the x-axis represents species rank. Species ranks are based on the number of individuals for each species. The species that has the largest number of individuals is ranked first and the species that has the least number of individuals is ranked last. The slope of resultant best fit line in the plot represents species diversity qualitatively which is used to compare the two hypothetical species diversity lines (maximum diversity line and minimum diversity line). Thus, the change in slope of the best fit line decides the biodiversity status of the area. If y-intercept is kept constant, higher slope would imply less biodiversity as it would show its affinity towards the minimum diversity line and vice versa would be the case for maximum diversity line. In the present study, the outcome of the sampling of each species was expected to be 51 ($\log_{10}51=1.70$) but the observed value showed a large deviation from the expected value, resulting in formation of two categories i.e. species dominance and species evenness. The graph of the study area shows that maximum species come under species evenness category shown in the larger box in the plot and smaller box shows species dominance category. This indicates a high biodiversity in the region. The intermediary species may have to strive in near future and come under rare or dominant category depending upon the prevailing ecological conditions. The species abundance curve shows the presence of 14 rare species that have less than two individuals in the study area and the dominance is shown by few abundant species that may act as an ecological indicator of the city changing ecosystem. Rare and ecologically sensitive species found in the region are shown in the extreme tail of the graph. These species share the lower ranks in the plot because of their equality in existence in the area (fig.2). The detail of all species with their rank and category is shown in Annexure I.

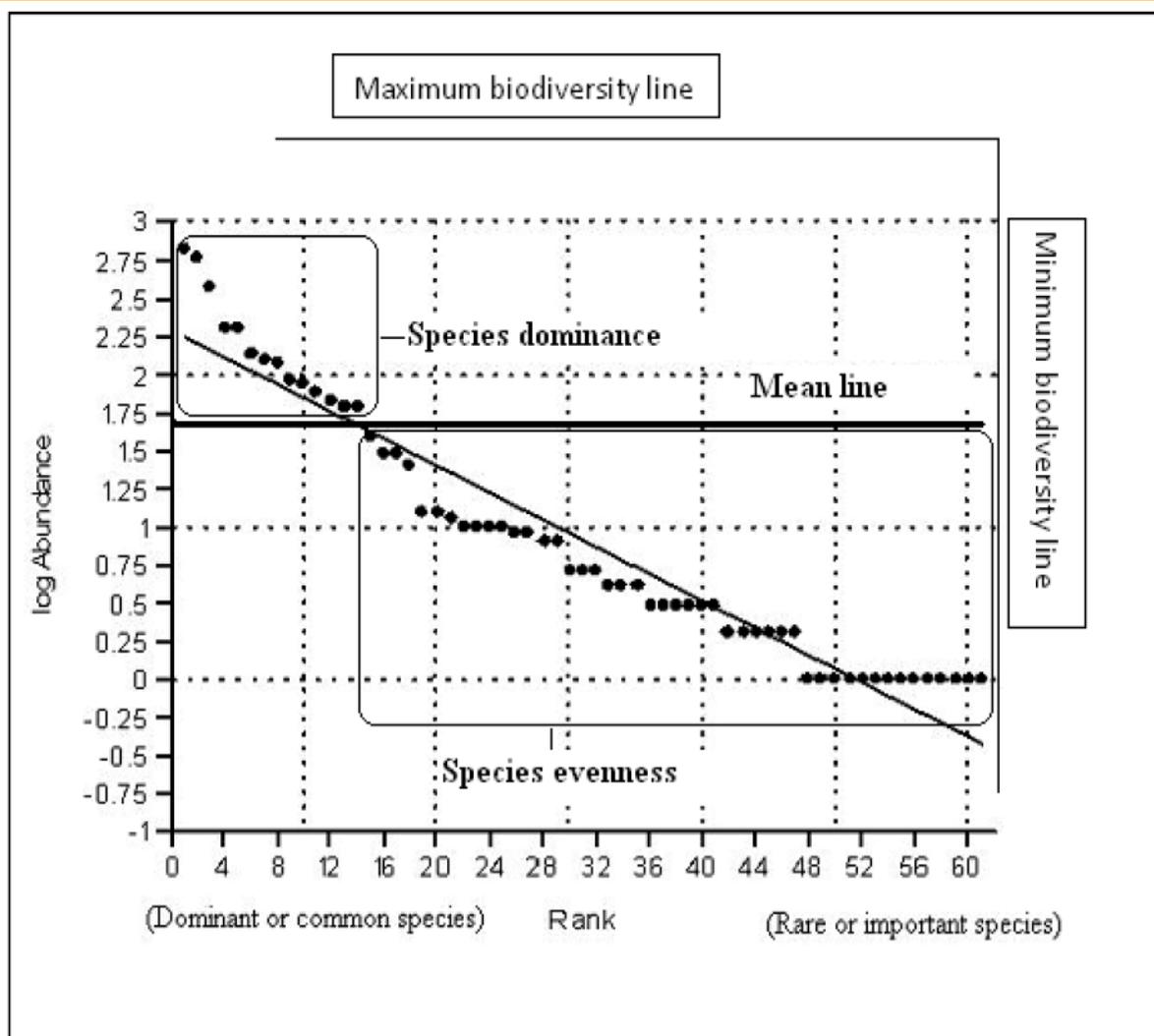


Fig.2 Log-abundance species rank plot for the various tree species

Conclusion

The rank abundance plot can be considered as a promising approach for estimation of rare and dominant species and extended to the natural ecosystems where conservation of rare species should be given a priority as they are more vulnerable to extinction. This technique would be helpful in maintaining the diversity and balance of the ecosystem even in the urban campus where it can be used to quantify the planted species.

Acknowledgement

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Annexure I

RANK	SCIENTIFIC NAME	FAMILY	COMMON NAME	CATEGORY
1	<i>Peltophorum pterocarpum</i>	Caesalpiniaceae	Golden flame	D
2	<i>Azadirachta indica</i>	Meliaceae	Morgosa tree, Neem	D
3	<i>Kigelia pinnata</i>	Bignoniaceae	Sausage Tree, Balam khira	D
4	<i>Mimusops elengi</i>	Sapotaceae	Bullet wood, Maulser	D
5	<i>Cassia siamea</i>	Caesalpiniaceae	Kassod	D
6	<i>Cassia roxburghii</i>	Caesalpiniaceae	Red cassia	D
7	<i>Samanea saman</i>	Mimosaceae	Rain Tree	D
8	<i>Cassia fistula</i>	Caesalpiniaceae	Golden Shower, Amaltus	D
9	<i>Pongamia pinnata</i>	Fabaceae	Indian Beech, Panigrahi	D
10	<i>Albizia lebeck</i>	Fabaceae	Siris tree, Saras	D
11	<i>Mangifera indica</i>	Anacardiaceae	Mango	D
12	<i>Delonix regia</i>	Fabaceae	flame tree, Flamboyant	D
13	<i>Parkia biglandulosa</i>	Fabaceae	Badminton Ball Tree	D
14	<i>Ficus bengalensis</i>	Moraceae	Banyan tree, Barh	D
15	<i>Callistemon lanceolatus</i>	Myrtaceae	Bottle brush	ID
16	<i>Ceiba pentandra</i>	Bombacaceae	Kapok tree, silk cotton tree	ID
17	<i>Polyalthia longifolia</i>	Anonaceae	Ashok	ID
18	<i>Alstonia scholaris</i>	Apocynaceae	Milky pine, Dita	ID
19	<i>Dalbergia sissoo</i>	Fabaceae	Indian Rosewood, Shisham	ID
20	<i>Ficus racemosa</i>	Moraceae	Indian Fig	ID
21	<i>Ficus glomerata</i>	Moraceae	Cluster fig tree; Gular	ID
22	<i>Aegle marmelos</i>	Rutaceae	Wood Apple, Bael	ID
23	<i>Prosopis cineraria</i>	Fabaceae	Khejri ,Jhand	ID
24	<i>Streblus asper</i>	Moraceae	Tooth Brush Tree	ID
25	<i>Syzygium cumini</i>	Myrtaceae	Black Plum, Jaman	ID

26	<i>Ficus religiosa</i>	Moraceae	Bodhi Tree, Peepal Tree	ID
27	<i>Melia azedarach</i>	Meliaceae	Chinaberry tree, pride of India	ID
28	<i>Bauhinia purpurea</i>	Caesalpiniaceae	Mountain Ebony, Kachnar	ID
29	<i>Gliricidia sepium</i>	Fabaceae	Mother of cocoa, Quickstick	ID
30	<i>Cordia dichotoma</i>	Boraginaceae	Bird Lime Tree, Indian cherry	ID
31	<i>Millingtonia hortensis</i>	Bignoniaceae	Indian cork tree, Akash neem	ID
32	<i>Plumeria rubra</i>	Apocynaceae	Nosegay, Frangipani	ID
33	<i>Acacia nilotica</i>	Fabaceae	Gum Arabic, Babul	ID
34	<i>Morus alba</i>	Moraceae	White Mulberry	ID
35	<i>Pithecellobium dulce</i>	Fabaceae	Manila Tamarind, Monkey Pod	ID
36	<i>Erythrina variegata</i>	Fabaceae	Indian Coral Tree, Tiger claw	ID
37	<i>Holoptelea integrifolia</i>	Ulmaceae	Monkey Biscuit Tree, Indian Elm	ID
38	<i>Leucaena leucocephala</i>	Fabaceae	White leadtree	ID
39	<i>Sapindus laurifolia</i>	Sapindaceae	Soapnut, Reetha	ID
40	<i>Spathodea campanulata</i>	Bignoniaceae	African Tulip Tree, Fountain Tree	ID
41	<i>Tabebuia rosea</i>	Bignoniaceae	Pink trumpet tree, Pink Poui	ID
42	<i>Cordia sebestena</i>	Boraginaceae	Cordia, Geiger tree	ID
43	<i>Eucalyptus citriodora</i>	Myrtaceae	Lemon scented gum	ID
44	<i>Manilkara hexandra</i>	Sapotaceae	Ceylon Iron Wood, Milk tree	ID
45	<i>Roystonea regia</i>	Arecaceae	Royal palm	ID
46	<i>Tectona grandis</i>	Verbenaceae	Teak	ID
47	<i>Terminalia Arjuna</i>	Combretaceae	Arjuna	ID
48	<i>Ailanthus excelsa</i>	Simaroubaceae	Maharukh	R
49	<i>Anogeissus sericea</i>	Combretaceae	Androk	R
50	<i>Casuarina equisetifolia</i>	Casuarinaceae	Whistling Pine	R
51	<i>Crescentia alata</i>	Bignoniaceae	Gourd Tree, Kamandal Tree	R
52	<i>Drypetes roxburghii</i>	Euphorbiaceae	Putranjiva, Lucky Bean Tree	R
53	<i>Emblica officinalis</i>	Euphorbiaceae	Amla, Indian Gooseberry	R
54	<i>Ficus elastica</i>	Moraceae	Rubber tree	R
55	<i>Gmelina arborea</i>	Verbenaceae	Gamhar, White Teak	R
56	<i>Gravellia robusta</i>	Proteaceae	Silver Oak	R
57	<i>Jacaranda mimosifolia</i>	Bignoniaceae	Jacaranda, Black poui	R
58	<i>Mitragyna parvifolia</i>	Rubiaceae	Kaim, Keli-Kadam	R
59	<i>Polyanthia angustifolia</i>	Anonaceae	Dwarf mast tree	R

60	Tamarindus indica	Caesalpiaceae	Imli	R
61	Zizipus mauritiana	Rhamnaceae	Indian plum, Ber	R
D=DOMINANT; ID= INTERMEDIARY DOMINANT; R= RARE				

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