



Assessment of Plant Diversity and Soil Carbon Sequestration of Alice Garden and Department of Environmental Sciences in Savitribai Phule Pune University Campus

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Abstract

The present study was carried out for quantitative assessment of plant diversity and carbon sequestration of soil along with water content of Savitribai Phule Pune University (SPPU), Pune campus, Maharashtra. The study was conducted during June to September, 2019 laying 5 line transect and 5 list quadrats (10×10 m) followed by random visits, a total 121 plant species were recorded included 27 species at front site of Environmental Science Department, 20 species at its backside and 18 species in Alice garden located in the campus. The highest density and abundance was recorded near Environmental sciences Department e.g. *Dalbergia melanoxylon*, *Cassia tora* and *Synedrella nodiflora*. The highest distribution pattern were recorded of *Cynodon dactylon* (7.5%) *Synedrella nodiflora* (15.25%), *Dalbergia melanoxylon* (13.2%). This following six plant species were common in all three study area *Pongamia pinnata*, *Bauhinia sp.*, *Cassia sp.*, *Phoenix sp.*, *Synedrella nodiflora* and *Bambusa sp.* (Similarity index 1.886%). Species of plant showed random to contagious pattern. Water content and organic carbon observed were similar in (31% and 20 %) all studied areas. Natural and anthropogenic activities are responsible for destruction of the plant diversity in this SPPU. Present studies gives overall understanding of diversity, soil carbon and its various types including water content which may be helpful in conservation of plant species in SPPU.

Keywords: plant diversity, diversity index, soil characteristics

1. Introduction

Biodiversity is the variety of life forms on an earth which includes total sum of genes, species and ecosystem in a particular area (Dangwal *et al.*, 2012) [2]. It has been proved that the plant diversity at a particular area is mainly influenced by species distribution and abundance pattern (Sarkar and Devi, 2014) [6]. Diversity of a species has been used for the assessment of pattern, species diversity, relative abundance, distribution, frequency, relative frequency, density, relative density etc. (Sorecha *et al.*, 2017) [9]. However, soil plays a very crucial role in ecosystem and it has the strong influence on the vegetation diversity of ecosystem (Sarkar and Devi, 2014) [6]. The development of plant diversity is mainly depends on Edaphic factors. The Species diversity has been considered as an indicator of the distribution of individual among the species in a particular habitat. Moreover quantitative assessment and analysis of community structure is an important tool for evaluation of biodiversity (<http://shodhganga.inflibnet.ac.in>). It have been

estimated that there are approximately 300,000 to 500,000 species of vascular plants, of which approximately 3,69,000 are flowering plants (http://www.bgci.org/cultivate/plant_diversity). As the structure of soil is essential to its function (including delivering critical ecosystem services, such as nutrient cycling, carbon storage and flood prevention), this represents a significant gap in understanding. It is especially important to investigate in this connection between these parameters because soil degradation is affecting to one third of the earth's soil and is largely due to deterioration in soil physical structure. The main focus of present study was investigated, how the plant diversity affects soil structure and its functioning (Gould *et al.*, 2016). The very important issue is the invasive species. The invasive species are considered to be very harmful to native plant diversity. In the present area there are many invasive species are present. The aim of our study is to assess plant biodiversity and soil interactions.

2. Materials and Methods

2.1 Composition of Plant species in Savitribai Phule Pune University campus and Soil carbon sequestration

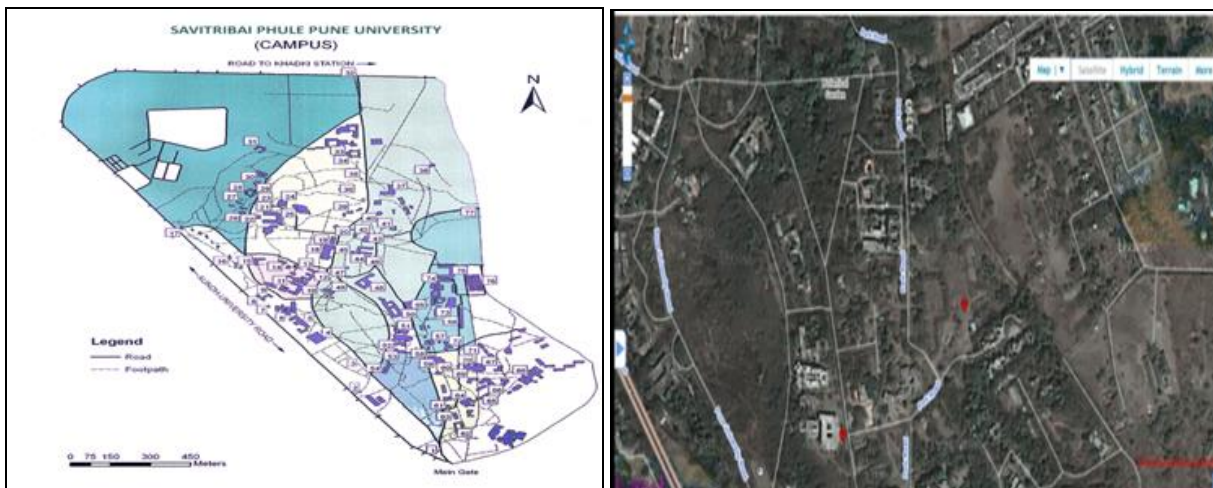


Fig 1: Map of Savitribai Phule Pune University Campus (www.unipune.ac.in, www.isro.gov.in)

Plant species diversity, particularly in ecosystems is complicated by the huge range of size and life expectancy of different plant species. The complete and clear understanding of distribution and diversity of different plant species, study of individual species is necessary. In the following study, quantitative structure and diversity of plant species were calculated separately. The study for the assessment of composition of plant species and quantitative characteristic feature was conducted during 2018-19 using random samplings extensively. The study was carried out through stratified random list quadrat and line transects sampling methods (Mahajan and Fatima, 2017) [12].

A total 13 sample plots were taken for a plant species each having 10×10 meter and 20× 20 meter in size. Within each plot the number and name of all the plant species were recorded. Density (D), relative density (RD), Frequency(F), % Frequency, Relative Frequency (RF), abundance (A), Distribution Pattern (DP), Margalef’s diversity index (Dmg), Similarity Index (SI) and Dissimilarity Index (DI) were calculate (Sarkar and Devi, 2014). Study of water content from soil by using oven dry method and the soil sample were collected from sampling sites at 0-15 cm depth and soil was placed in oven at 105°C for complete water elimination and carbon content was measured using modified Walkley and Black method (APHA, 1998) [15].

3. Result

3.1 Composition of Plant species in Savitribai Phule Pune University campus

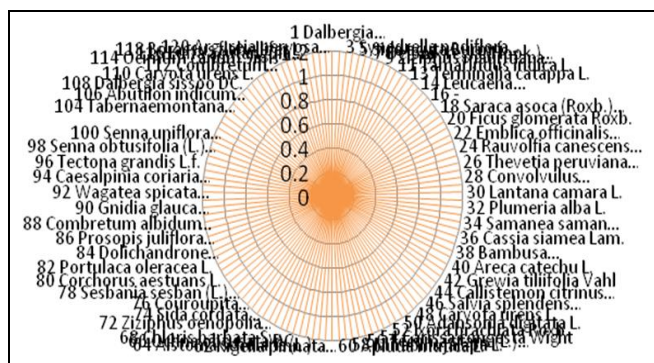


Fig 1: Radar Chart of Plant species Composition

Total 121 species of plant was recorded in a Savitribai Phule Pune University campus through random sampling. (Fig 1). Highest 47 plant species were found near Environmental Science (EVS) Department followed by 34 plant species recorded are of medicinal important and 18 species were in Alice garden. Other 22 species are documented from the campus of SPPU (Fig: 1, 2, 3).

3.1.1 Distribution pattern

The most distributed plants species were recorded in study area No.1 Front Side of EVS Department such as *Cynodon dactylon* (7.5%), *Parthenium hysterophorus* (6%), and *Cassiatora* (4%) (Fig: 5) and in a study area No.2 Backside of EVS Dept. *Sesabenia sesban* (15.25%), *Cynodon dactylon* (11.5%), *Dalbergia melanoxylon* (13.2%), *Cassia tora* (11%), *Synedrella nodiflora* (17.5%), *Euphorbia sp* (11%) (Fig: 6) and in study area No.3 Alice garden *Synedrella nodiflora* (14%). (Fig: 7).

3.2 Study of vegetation by using Line transect and List Count Quadrat method

3.2.1 Line transect study and list count quadrat method

The following most frequent plant species were recorded in study area No.1 Front Side of EVS Department such as *Parthenium hysterophorus*, *Cassia tora* and Least frequent plant species. *Pentas lanceolata*, *Plumeria alba.*, *Punica granatum.*, *Syzigium cumini*, *Azadirachta indica.*, *Pongamia pinnata*, *Nyctanthes arbor-tristis*, *Muntingia calabora.*, *Terminalia cattapa.*, *Grevillea robusta*, *Spathodea campanulata*, *Ficus religiosa*, *Bauhinia purpurea*, and *Millingtonia hortensis* were also present. Most frequent plant species was recorded in study area No.2 Backside of EVS Dept. *Dalbergia melanoxylon*, *Lantana camara*, *Cassia tora*, *Sesabenia sesban*, *Synedrella nodiflora* while, Least frequent plant species *Azadirachta indica*. *Syzigium cumini*, *Ziziphus abysinica*. *Alternanthera aculis*, *Acacia abbreviate*, *Bahunia purpurea* also were present. The most frequent plant species was recorded in study area No.3 Alice Garden and these were *Cassia uniflora*, *Synedrella nodiflora*, *Bambusa affinis*, *Phoenix dactylifera*, *Putranjiva roxburghii* and Least frequent plant species *Brousonettia paperifera*, *Plumeria obtuse*, *Araucaria angustifolia* and *Caesalpinia coriaria*. The most dense and abundant plant

species was recorded in this site no. 1 *Cassia tora* (Fig: 3) and site no.2 *Dalbergia melanoxylon* (Fig: 3) *Cassia tora*, *Synedrella nodiflora*. And site no.3 *Synedrella nodiflora* (Fig: 4).

3.3 Margalef Diversity index and Similarity, Dissimilarity index

The study site no.1 EVS Dept. plant species showed the Constant rate of Species Richness i.e. (121%) (Fig: 8) while study site No.2 backside of EVS Dept. Plant species *Acacia*

abbreviata, *Santalum album* and *Bahunia purpurea* showed similar rate of Species Richness i.e. 390% (Fig: 9) and study site No.3 Alice Garden *Araucaria angustifolia* possessed species richness (Fig: 3). According to (Odum, 1971) the Contagious Classification of Distribution was observed in all the study areas i.e. the Value is Greater than 0.05. Similarity and Dissimilarity index that means there was six common species observed in all three study sites such as *Pongammia pinnata*, *Bahunia sp.*, *Cassia tora*, *Phoenix dactylifera*, *Synedrellanodiflora*, *Bambusa affinis* (Fig:12).

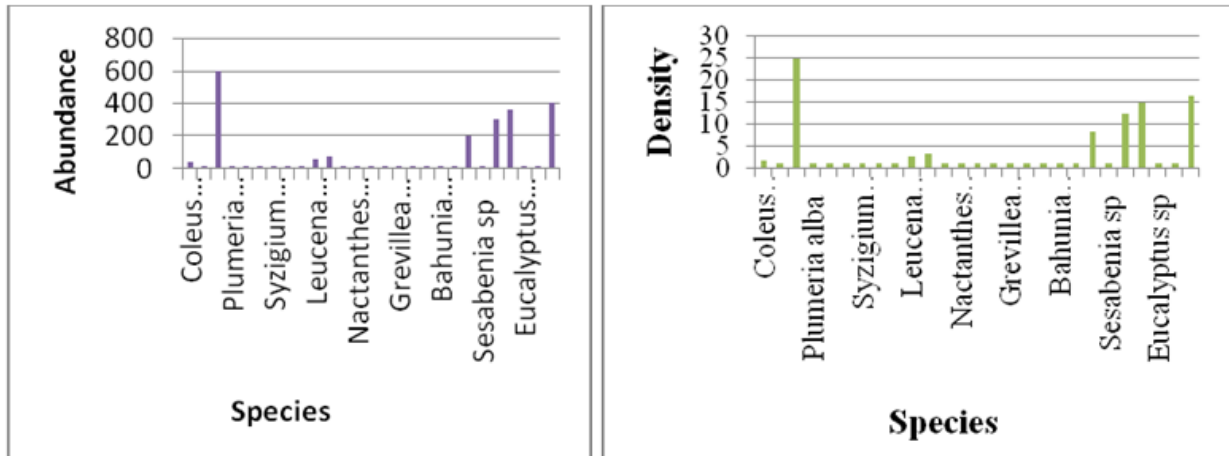


Fig 2: Study area- 1

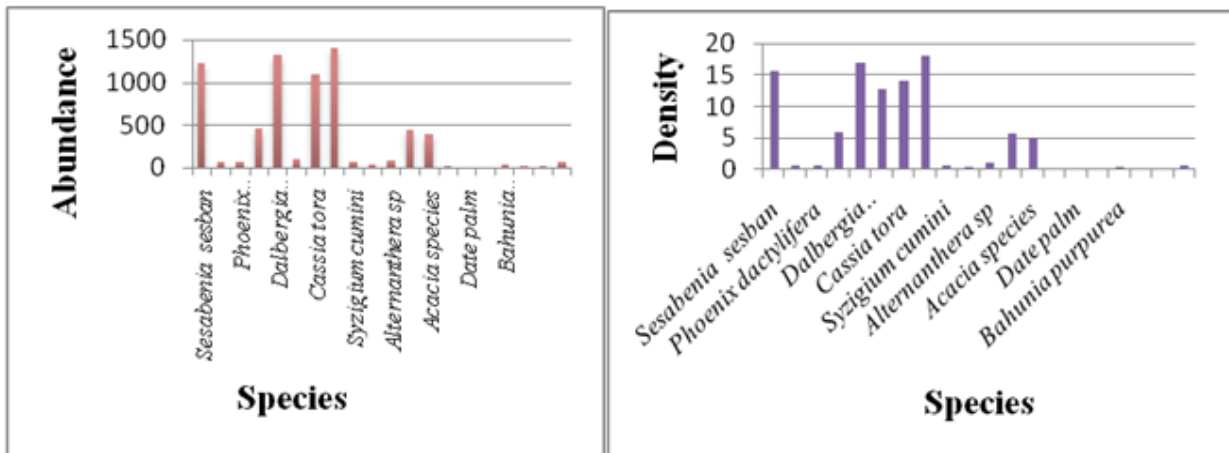


Fig 3: Study area – 2

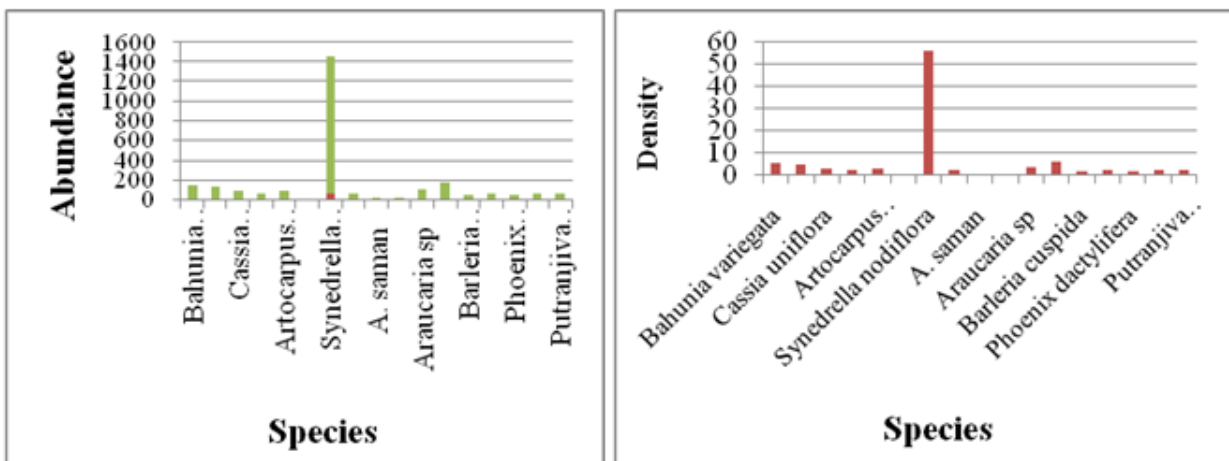


Fig 4: Study area- 3

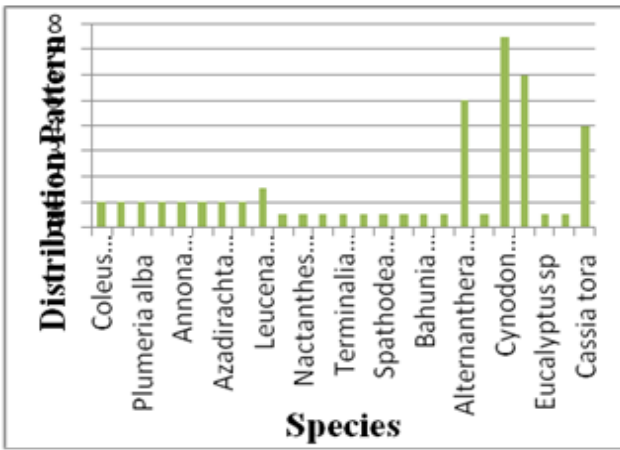


Fig 5: Study area -1

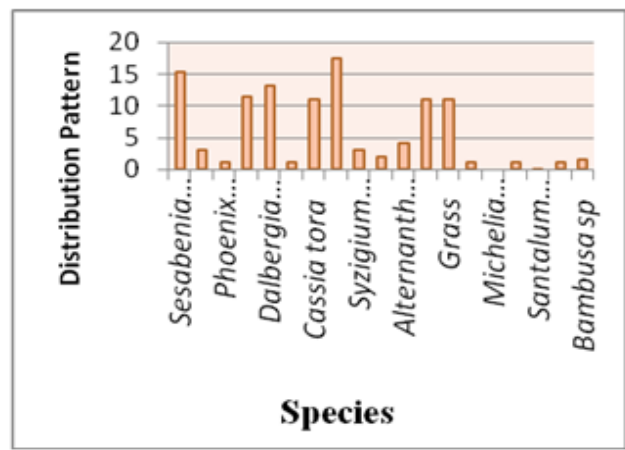


Fig 6: Study area -2

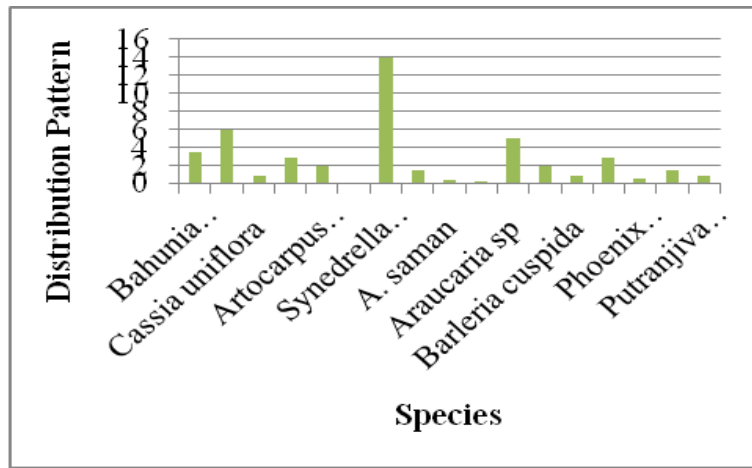


Fig 7: Study area -3

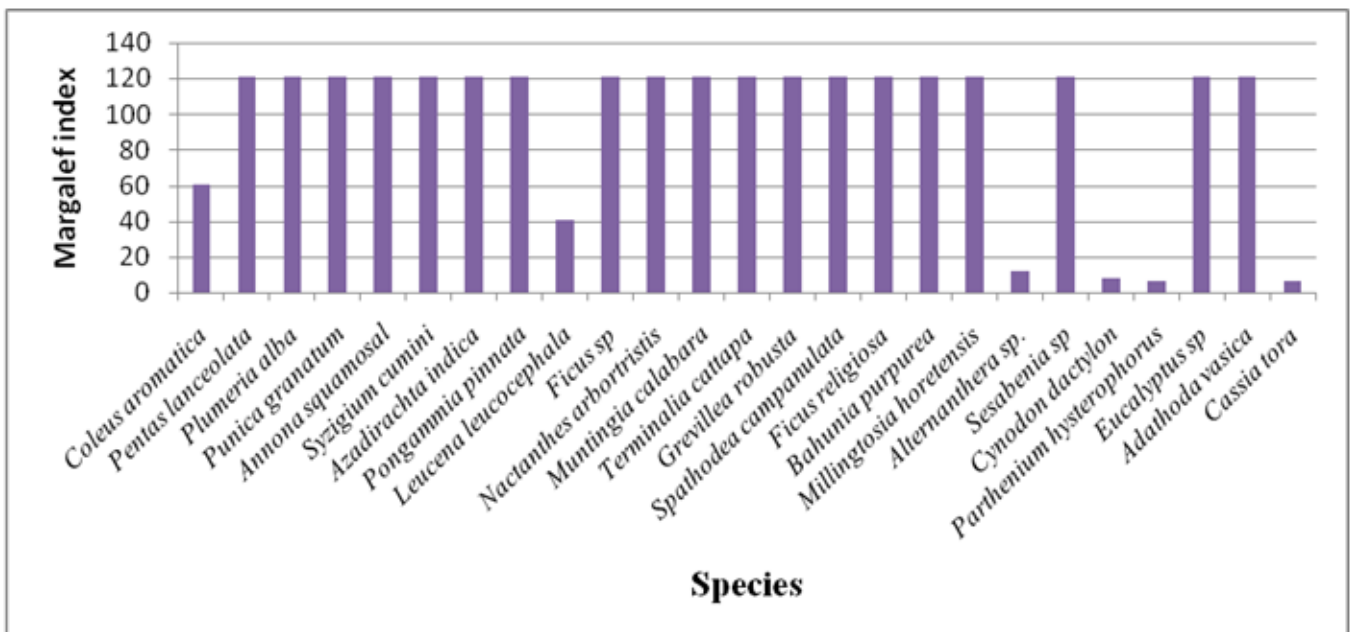


Fig 8: Study area -1

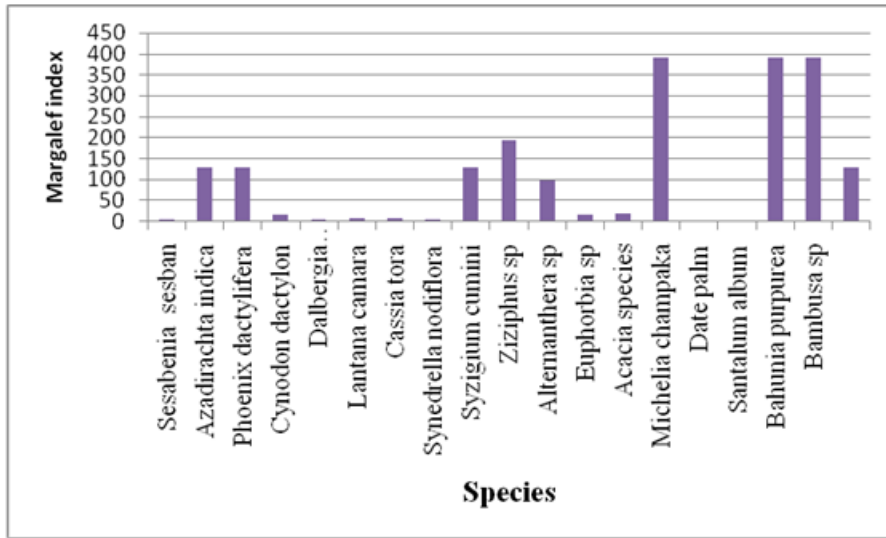


Fig 9: Study area- 2

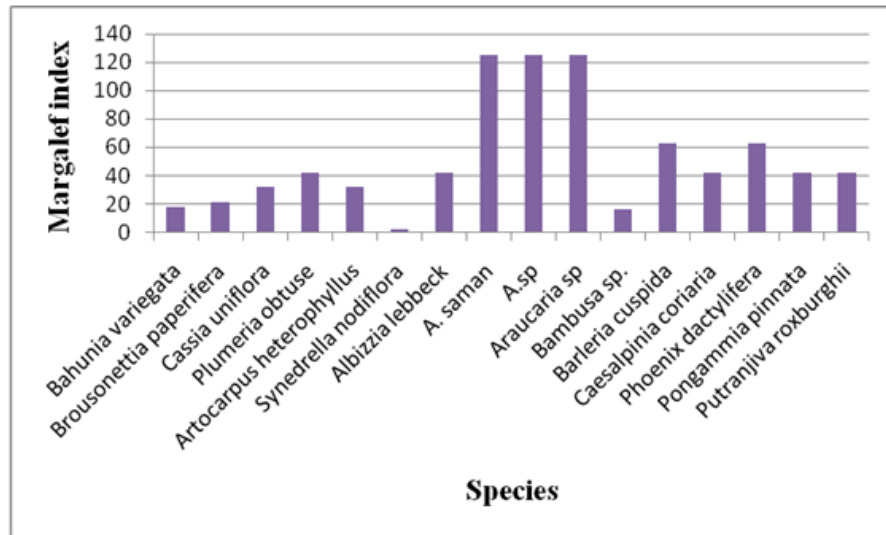


Fig 10: Study area -3

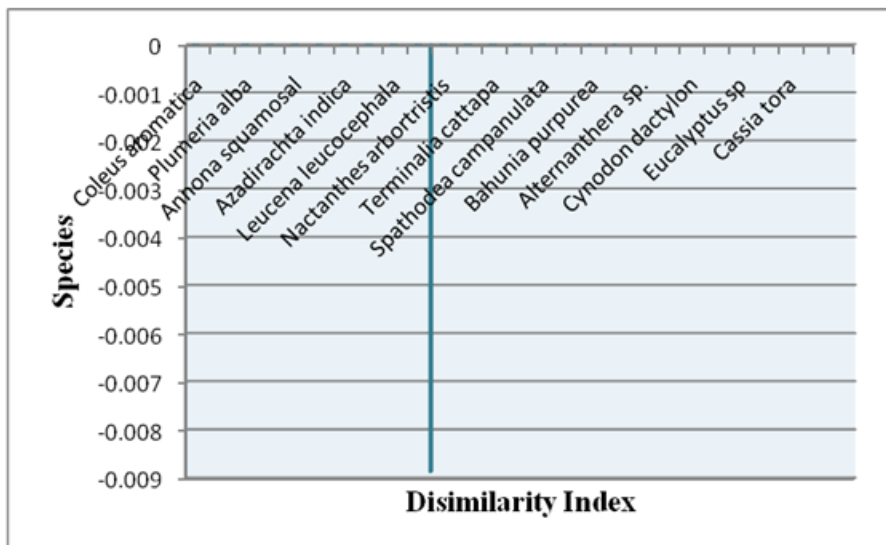


Fig 11: Species Vs Dissimilarity index

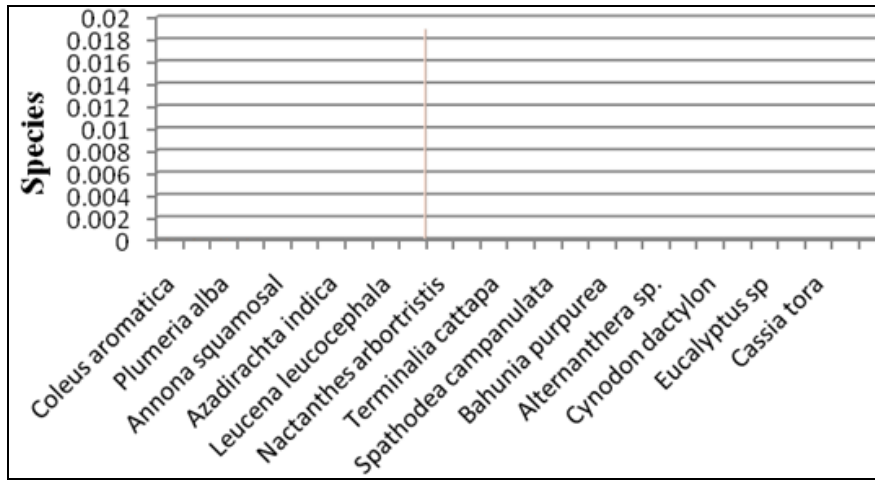


Fig 12: Species Vs Similarity index

3.3.1 Water content

The collected soil samples from site No. 1 front side EVS Dept. the value of water content (W) was observed to be

37% while in case site 2. Backside of EVS Dept. showed 31.46% and site no.3 Alice Garden showed 21.99%. (Table: 1, Fig: 13).

Table 1: Water contents in % all three study area.

S. R. No	Content	Sample 1 Front side Evs Dept.	Sample 2 Backside of Evs Dept.	Sample 3 Alice garden
1.	Water content in %=	37%	31.46%	21.99%

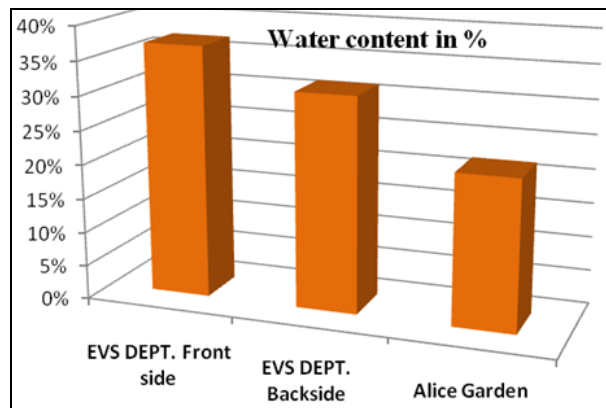


Fig 13: Water contents in % all three study area.

3.3.2 Carbon Sequestration Study

The various forms of Organic carbon were present in a both study area 1 and 2 (Fig: 14 Fig: 17)

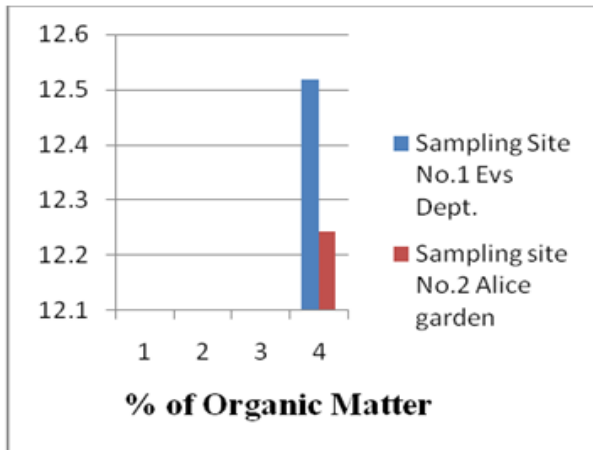


Fig 14: Organic Matter

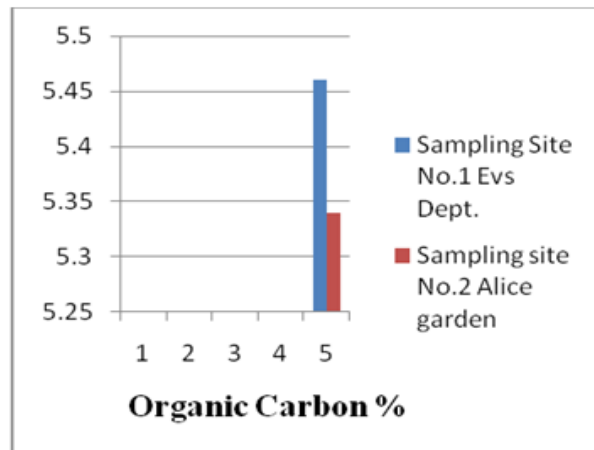


Fig 15: Organic Carbon

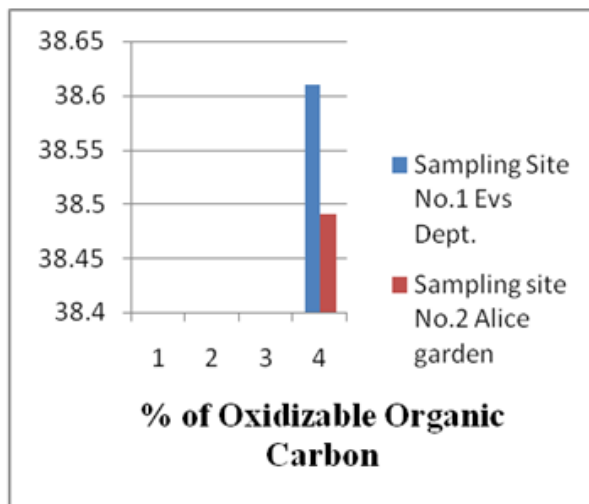


Fig 16: Oxidizable Organic Carbons

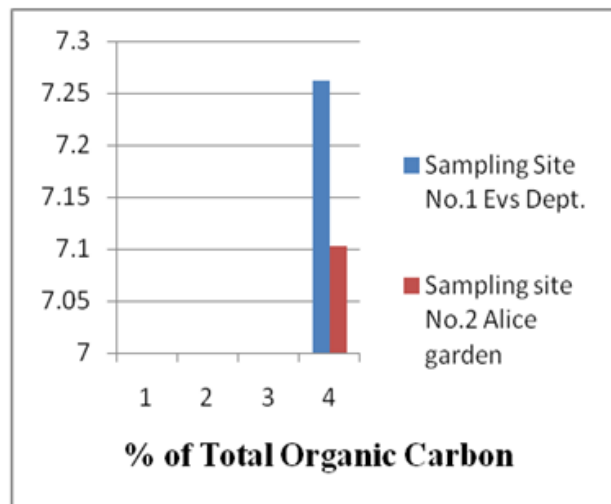


Fig 17: Total Organic Carbon

3.3.3 Threats to plants in Savitribai Phule Pune University campus

In the Savitribai Phule University campus there are several threats to plants has been observed during this study.

Deforestation for construction, road widening, stray cattle's, and invasive species are the major threat recorded during 3 Study period (Fig: 18).



Fig 18: Deforestation due to Construction activity like underground pipeline and Grazing of cattle's.

4. Discussion

Many studies have undertaken based on the present thesis point. Sobuj and Rahman, (2011) ^[7] studied the plant diversity in Khadimnagar in National park in Bangladesh and they have observed the value of Frequency and abundance of *Azadirachtaindica* (23.33 %) *Artocarpus albobrunneus* (30%) *Syzygium cumini* (33.33%) which observed to be similar in comparison with our study. The possible explanation could be that the environmental conditions and supply of nutrients was very high in both the cases (Sobuj and Rahman, 2011) ^[7].

In this study in total 121 species of plants was observed in Savitribai Phule Pune University, campus. In this study site *Dalbergia melanoxylon*., *Cassia tora*, *Synedrella nodiflora*, *Lantana camara*, *Parthenium hysterophorus* is dominant species and they have shown highest density, abundance and frequency, it may be due to the climate and soil condition are suitable for these plants. There was some species showed the contagious distribution pattern which was similar to our study (Mahajan and Fatima, 2017) ^[12].

Mawal *et al*, (2015) ^[13] and Mawal *et al*, (2019) ^[11] recorded the allelopathic potential of *Parthenium hysterophorus L.* and *Lantana camara L.*, used for agricultural crops treatment and it also been showed positive impact on soil fertility. However the phytochemicals which are present in both the

species were responsible for causing allelopathic effects. Pourmajidian *et al*, (2017) observed the variation in soil organic carbon with respect to its depth. However, in our case the range of water content and organic carbon was recorded similar in all the selected sites there were no variations observed. We did observe that the major threat to plant diversity in present study area was anthropogenic activity like construction activities of buildings, roads and grazing of cattles, there was no any natural threat was observed.

5. Conclusions

Precise assessment and understanding of the dynamics of plant resources is important for their sustainable management, utilization and biodiversity conservation. Quantitative analysis of tree species diversity of study area will be useful in forest management and conservation. The presence of some old *Dalbergia melanoxylon* trees in the study area indicates the presence of *Dalbergia* forest in this area. The following most common species of plants observed in a Savitribai Phule Pune University campus such as *Dalbergia melanoxylon*, *Lantana camara*, *Cassia tora*, *Sesabenia sesban*, *Synedrella nodiflora* which was under the threats of various natural and anthropogenic activities like construction of underground pipelines, footpath, heavy

rainfall, grazing from cattles. So to minimize threats this could be useful. The soil of this study area was very fertile because in this study according to Agriculture Soil Testing Standard the organic carbon content is more than 1%. Therefore this soil is suitable for plant growth and conservation of Savitribai Phule Pune University campus diversity. According to Margalef diversity index and Similarity, dissimilarity index the given study area was possessed higher species richness and this always affected on Climate and soil nutrient in study area. Mawal *et al.*, (2015, 2019) recorded the allelopathic effect of *Parthenium hysterophorus* and *Lantana species* on selected agricultural crops and soil status. Hence it also indicates the medicinal value of plant diversity. However the tested phytochemicals which responsible for allelopathic effects was present all the plants. This study area was not following the Raunkiaers frequency of classification due to contagious type of plant diversity. Assessment and quantitative analysis of diversity, of tree species recorded from the present study may provide baseline information for formulating conservation and management strategies of the present study. There is need to minimize anthropogenic threats and control on cattles grazing it may be protect native as well as endemic plant species.

6. Acknowledgement

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