CHAPTER 4
MATERIALS AND METHODS
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4.1 Assessment of Plant diversity

Biodiversity has been definite as “the diversity and unpredictability of living organisms” (IUCN General Assembly, Costa Rica 1988) or “the entirety of genes, species and ecosystems” (Global Biodiversity Strategy, UNEP, 1992).

The diversity of life enriches the excellence of our life in ways that are not easy to quantify. Biodiversity is essentially precious and is important for our affecting, psychological and religious wellbeing. Some consider that it is an important human accountability to be stewards for the world’s living organisms.

Plant variety is calculated by a number of variety indices. There has been a lot of expansion and explosion of diversity indices over the years. These indices are mathematical expressions that join three components of community arrangement, i.e. richness (number of species present), evenness (the distribution of individuals among species) and abundance (total number of plants present). Diversity indices have been used throughout the world in biological assessment programmes for many types of habitat.

The most widely used diversity indices have been the Simpson’s Index, Shannon-Wiener Index and Evenness Index. In this study for the evaluation of plant diversity, the value of $P_i^2$ is considered to be up to 0.001 and takes the unhelpful of the sum $\log(P_i)$ because $P_i$ being the proportion of a given category, its greatest value is 1 and its minimum approaches 0. The log of 1 is 0 and the log of any value between 0 and 1 is a negative number. By reversing the sign, the Index becomes positive and is easier to understand. In the assessment of plant diversity for each site, the phytosociology data has been used for the purpose of calculations.
Assessment of plant diversity and soil-microbial diversity of Bara Hills were measured using the following diversity indices:

A. Species Richness (S)
B. Simpson’s Index (D)
C. Simpson’s Index of diversity (1-D)
D. Simpson’s reciprocal Index (1/D)
E. Shannon-Wiener Index (H)
F. Evenness Index (E)

A. Species Richness (S)

This is single of the oldest and most essential diversity measurements, based openly on the total number of species at a site. The term species richness is often favorite since the exact number of species in a community is rarely known. However, this method depends on sample size and does not consider the relative abundance of different species. It has thus a limited environmental value. As environmental concept, “abundance” is another important part of diversity (Hurlbert, 1971). Peet (1974) referred to this as heterogeneity, on behalf of the equability or evenness of allotment of individuals among the species.

A larger number of species increase species diversity, and a more even or evenhanded division among species also represents a greater diversity. Various indices have been developed in this regard but there is little point in calculating all of them, as they are all strongly correlated (Gray et.al.1992). The species “richness” was measured simply as the number of species per unit area (Mac Arthur, 1955 and Whittaker, 1965 and 1967).
B. Simpson’s Index (D): $D = \sum (P_i^2)$

Simpson’s Index is a calculate of the prospect that any two individuals chosen randomly from a given population are of the same species.

This is based on the prospect that two erratically selected individuals in the community belong to the same category (eg, species). least amount value: $1/($# of categories). Greatest value: 1.

C. Simpson's Index of Diversity (Index of Similarity): $1 - D$

This is based on the possibility that two arbitrarily preferred individuals in a community belong to different categories (eg, species). This directory ranges from zero to one. An Index close to zero means low diversity and close to one means high diversity (Simpson, 1949 and Pielous, 1969). Smallest amount: 0 and greatest value: $1 - 1/ ($# of categories), approach 1 as the number of categories increase.

D. Simpson's Reciprocal Index (Reciprocal Index): $1 / D$

This is based on the premise that the figure of evenly common categories (eg, species) will create the experiential Simpson's Index with Minimum value: 1 and Maximum value: # of categories.
E. Shannon-Wiener’s Index (H)

The Shannon-Wiener’s (Wiener also known as a Weaver) Index (H) is measure of the standard amount of indecision in predict as to which species an individual drawn at random from a set ‘s’ species and ‘n’ individual would belong.

This vagueness increases as the number of species increase and distribution of individual among the species becomes even. ‘H’ is 0 only if a single species is present in a sample (Shannon and Wiener, 1963).

Shannon-Wiener’s Index value cans series from 0 to ~4.6 using the natural log (versus log10). Values of the Index are use of between 1.5 to 3.5, although in excellent cases, the value can exceed 4.6 (Vala, 1999). Value between 0 to 1.5 indicates low diversity, 1.5 to 3.5 indicates high diversity, and 3.5 to ~4.6 indicate species highly diverse in a community.

This Index is a simple mathematical expression in use for comparing species and important relationships between two areas. It is reasonably independent of sample size (Odum, 1971), and is also normally distributed (Bowman et al, 1970; Hutcheson, 1970; and Gopal, 1994).

The equation for the estimation of Shannon-Wiener Index or Shannon Index was:

\[ H = -\text{sum} \left[\pi \log (\pi)\right] \]

where, \(\pi\) = the figure of given plants species divided by the total number of plant observed. The smallest amount value 0 and highest value \(\log (1/# \text{ of categories})\) for the Shannon- Wiener Index.
F. Evenness Index (E)

Evenness is a calculate of how comparable the abundance of different species is. When they are comparable in proportion to all species, then /evenness is one, but when the abundance is very dissimilar (some rare and some common species), then the value increases. The equation used in estimating Evenness was $E = \frac{H}{\log(S)}$, wherein $H =$ Shannon-Wiener Index, and $S =$ Value of Species richness.

4.2 Phytosociological studies

The special field of synecology, which is concerned with the organization and arrangement of plant communities, is known as phytosociology. Phytosociological studies give a clear image of community organization in quantitative terms. Coexistence and opposition are both affect directly by the number of individuals in the community. Therefore, it is essential to know the quantitative organization of the community.


An estimation of the organization and composition of plant life was made by means of the analytic and synthetic characters as given by Braun-Blanquet (1932), Misra and Puri (1954), Oosting (1958), and Pandeya et. al.(1967).
The area has been surveyed by Belt transact methods. The size of the quadrat (unit sample) was worked out to 5m x 5m. A total of one hundred such quadrats were studied in each site during this research work.

Five sites were chosen for uniform sampling of the entire area so that it was fully sampled. Each site, with a total area of 0.25 hectares, and aspects like foot, slopes, top, and the area between two hills was covered for the study.

Quantitative characters, i.e. Abundance (A), Density (D), Frequency (F), Relative Dominance (RDo), Relative Density (RD), Relative Frequency (RF), Importance Value Index (IVI), Coefficient of Variation (CV), and Relative Growth Index (RGI), were measured in Barda Hills.

The formulae used for different parameters are given below.

1. **Frequency (F):** \( F \% = \left( \frac{n}{Q} \right) \times 100 \), where, \( n = \) Number of quadrat of occurrence, and \( Q = \) Total number of quadrat studied.

2. **Density (D):** \( D = \left( \frac{n}{Q} \right) \), where, \( n = \) Total number of individual species, and \( Q = \) Total number of quadrat studied.

3. **Abundance (A):** \( A = \left( \frac{n}{Q} \right) \), where, \( n = \) Total number of individual species, and \( Q = \) Number of quadrat of occurrence.
4. **Basal Area (BA):** \[ BA = \pi r^2, \text{ where, } r = \text{Average diameter} \div 2, \text{ and } \pi = 3.14. \]

To review the ecological success of a species in a community, Importance Value Index (IVI) was estimated for each species by using Relative Frequency, Relative Density and Relative Dominance. The formula (Phillips, 1959) used for different variables are given below.

5. **Relative Frequency (RF):** \[ RF = \text{Number of occurrence of the species} \div \text{Number of occurrence of all species} \times 100. \]

6. **Relative Density (RD):** \[ RD = \text{Number of individuals of the species} \div \text{Number of individuals of all species} \times 100. \]

7. **Relative Dominance (RDo):** \[ RDo = \text{Total basal area of the species} \div \text{Total basal area of all species} \times 100. \]

8. **Importance Value Index (IVI) = RF + RD + RDo** For every species in a quadrat, Arithmetic mean (m) and Standard deviation (Sd) for density were worked out. The species having Coefficient of Variation (CV) value as follows:

9. **Coefficient of Variation (CV) = Sd \div m,** where, \( Sd = \text{Standard deviation of density, and } m = \text{Arithmetic mean.} \)

CV indicates homogeneity, and the lesser value of CV indicates that it is more uniformly distributed in the area and higher density.

CV value so calculated was then arranged into three classes for proper rating of characteristic species as follows:
Dispersion Class A – CV less than 1.0
   (Normal dispersion)

Dispersion Class B – CV from 1.0 to 1.20
   (Hypo-dispersion)

Dispersion Class C – CV from 1.20 to 1.50
   (Hyper-dispersion)

Indeed, a CV value of more than 1.00 indicates some irregular distribution. However, species with CV classes ‘B’ and ‘C’ (1.0 to 1.5 values) have been considered as less homogeneously distributed ones or species very near to the regular distribution. In this study, the species having Coefficient of Variation (CV) < 1.50 have been taken as characteristic species in a site (Pandeya et. al. 1967).

4.3 Collection and identification of Angiosperms

I have visited the study area three to five times and collected the angiospermic plant kept in the polythene lock bags. I put whole plant species and in tree habitat. I put only twig with flower. The plants were identified by using of deferent flora and confirmed the botanical name and family. I prepared the herbarium of species and labeled it. I arranged the identified plant species by Bentham and Hooker’s classification system.
4.4 Study of regeneration rate of dominant plants

During research will be survey of regeneration rate of dominant plants of Vansda National Park.

4.5 Biotic factors affecting on biodiversity of VANSDA NATIONAL PARK

During research will be survey of the biotic factors affecting the biodiversity and plant ecology of VANSDA NATIONAL PARK.