CHAPTER - IV

COMPOSITION AND STRUCTURE OF FOREST VEGETATION OF DANGS

METHODS OF STUDY

General vegetation of Dangs has been given in Chapter III. Details of structure and composition of the forests in the area under study will now be dealt with, which entails an account of only the woody vegetation and does not embrace herbaceous one. The present investigations are restricted to Reserved Forests only, where biotic operation is not permitted.

Entire Dangs, including Reserved and Protected forests, was divided into 20 blocks of almost equal sizes around each Forest Rest House in such a way that even farthest point in a block does not exceed 8-10 km from Rest House and could be covered on foot (Map II).

Structure and composition of the forests were estimated by usual analytic and synthetic characteristics as given by Braun-Blanquet (1932), Oosting (1958), Misra and Puri (1954), and Pandey, Puri and Singh (1967).

The entire area was surveyed by sampling technique.
Size of the unit sample (quadrat) and minimum number of quadrats to be employed were first determined by 'species-area-curve' and 'minimum-quadrat-number' methods, respectively. Suitable size of the quadrat arrived at was 5 X 5 m. For vegetation showing visual homogeneity of physiognomy on plains, minimum number of quadrats worked out to 10 (no doubt, absolute homogeneity is foreign to vegetation - Goodall, 1954). In a heterogeneous vegetation, and where vegetation showed variation, minimum 5 (b) of at least 10 quadrats each were studied systematically. In each block 6-7 localities (demarcated by local name of the place) were studied.

Thus, analytic characters were obtained by belt transect in case of undulating physiography and random samples in case of more or less uniform physiography. In each locality position of belts was previously fixed on topo sheets so that quadrats are uniformly spread with respect to the area and physiography. Belts were laid at right angles to the contours.

In total, about 3.3% of the Reserved Forests were sampled. In each quadrat following characteristics were studied.

A. ANALYTIC CHARACTERS:

I. Qualitative characters:

(1) Listing of the species - Tree and shrub vegetation was listed.

(2) Stratification - For each species on an average.
II. Qualitative characters:

(3) Abundance — number of individuals of a species. From this, Density was calculated; which is average number of individuals out of the total number of quadrats examined.

(4) Basal cover - For every tree and shrub (measuring more than 7.5 cm in girth) in a quadrat, circumference at breast height was taken. Though it is customary to express the basal cover in sq cm, in the present studies, however, it has been found essential to denote the same in sq m of actual basal cover for proper rating of growth index.

(5) Frequency - calculated for each species on each aspect.

B. SYNTHETIC CHARACTERS:

(6) Fidelity - calculated from constance values (obtained from frequency).

Whittaker (1953) stresses that each feature of a community is important in relation to its environment and that a single approach is not adequate. In a series of papers Poore (1955 a, b, c and 1956) has carefully tested and analysed Braun-Blanquet's system and has reached the conclusion that "the more accurate and detailed the information, the more valuable the description." Pandeya (1963) opined that detailed quantitative analysis is useful
as far as the structure of the community is concerned, and many times yields important notes on the habitat and microclimate. It is for these reasons that detailed analytic and synthetic characters were obtained.

CLASSIFICATION OF PLANT COMMUNITIES

Only limited advances are possible in any science without the orderly arrangement of phenomenon, which is known as classification (Poore, 1962).

Gilmour (1951) has stated that classification is an essential pre-requisite of all conceptual thoughts.

Vegetation is among the most difficult phenomena to classify (Goodall, 1954). The difficulties are of two kinds:

1. In the construction of the classes.
2. In the principle to be applied to the later grouping of the classes.

According to Hanson and Churchill (1961), the classification of plant communities may be based on one or more of the following criteria: floristics (species composition), ecological relations (habitat), successional status, physiognomy or geographical characteristics.

In this connection, Poore (1962) has put two great difficulties in classification of vegetation and to establish
relationships between vegetation and its habitat. They are:

1. lack of clear cut boundaries between communities.

2. the prevalence of complex spatial pattern in vegetation.

According to Whittaker (1962) communities do not have definite limits; but integrate with one another; the species that seem to characterize them extend into other communities although in different proportions; no two stands of a community are exactly alike, vegetation is continuous though differing from place to place. Thus vegetation changes continuously and is not differentiated except arbitrarily, into sociological entities (McIntosh, 1959 & 67; Ponyatovskaye, 1961; Poore, 1962; Goodall, 1963; Anderson, 1965; Daubenmire, 1960 and 1966; Curtis and McIntosh, 1951).

Indeed, the greatest amount of work done by ecologists in classifying ecosystems concerns one of its components: 'plant communities'. Nevertheless, the other components, too, can be classified. Classification of vegetation into communities on sound objective method thus becomes of paramount importance. In this direction, the present investigations make the following contribution:

The basic principles in classifying natural vegetation
is arrangement of plant communities invariably having common characters. Various methods have thus been evolved in this direction:

1. Braun-Blanquet's (1951) system concerning the hierarchy of floristic association and other units defined by diagnostic or characteristic species (based on dominance, constance and fidelity).

2. British (Tansley, 1913-1947) system based on the 'dominance types', as defined by one or two major species of a community.

3. 'Successional approach' to vegetation sponsored by the American Ecologists (Cowles, 1901 and Clements, 1916).

4. 'Successive approximation' proposed by Poore (1962).

5. 'Physiognomic classification' and ecological criteria, put forth by Penfound (1967) for much larger areas.

It is felt that in all these subjective views there is always a personal bias, because a worker selects and pre-establishes the communities which he thinks uniform of the area, representing the region. Next, the communities are 'successively approximated', or the data tabulated and
inspected (Nordhagen, 1928, 1943; Braun-Blanquet, 1951 and 1964; Poore, 1955 a, b and c, and 1956; Ellenberg, 1956), or various quantitative measures are calculated (Jaccard, 1902; Kulczynski, 1928; Sørenson, 1948), or some indices (like continuum index - Curtis and McIntosh, 1951; Austin and Orloci, 1966; McIntosh, 1967) are evolved, or results statistically computed (Goodall, 1963; Hughes and Lindley, 1955; Williams and Lambert, 1959, 1960, 1961; Lambert and Williams, 1962, 1966; Lambert and Dale, 1964; Williams, Lambert and Lance, 1966 and Orloci, 1967).

Frei (1963) proposed a method involving 'interspecific correlation coefficient' for determining the characteristic species in plant associations. Correlation of species is much stressed; however, dispersion is not considered, but occurrence of species (Frequency) is taken.

From theoretical considerations, Whittaker (1962) suggests certain principles which sound highly fitting to the concept of ecosystem. The theoretical 'landscape' approach involves practical consideration for the choice of particular property of a single aspect as a basis of defining community. Thus, two variables are concerned (Greig-Smith, 1964 and Lambert and Dale, 1964); the 'sites' which are individual positions on earth's surface and Vegetation. In vegetation, the unit of plant material is a community.
Indeed, ecosystem can be classified by many different properties of each of their major aspects: physical environment, soil, vegetation and animal communities (as reviewed by Whittaker, 1962). In addition to this, multifactorial or landscape approach to classification has been developed by Moresow (1928), Markus, (1929), Passarge (1929), Schmid (1961), Meusel (1954), Dice (1952) and others.

From the available literature it can be said that there are positive theoretical arguments in favour of 'landscape approach'. Under this, classificatory criteria could be a single aspect or site. Such treatment shows that:

(a) Populations are diversely distributed in the area;

(b) In most cases, the diversity tapers along the gradient so that stands are continuous with one another;

(c) Many community-characteristics may change continuously along gradients; and

(d) They show different patterns of variation in relation to the community pattern studied.

In the light of this discussion, a physiographic aspect or landscape site has been taken as a stand or 'local ecosystem'.

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In our objective view, community is arrived at from a statistical computation of the usual analytic characters studied by sampling technique of a number of sites, as follows:

The whole area is undulating and, as such, the aspects are: top, slope and foot of hills and lowlying areas or valleys. For every species in an aspect (or site or stand), arithmetic mean \( \bar{m} \) and standard deviation \( \sigma = \frac{1}{n-1} \left( m - \bar{m} \right)^2 \), where \( n \) is number of quadrats studied for 'density', (per quadrat) are worked out. The species having Coefficient of variation value \( CV = \sigma / \bar{m} \) of 1.5, have been taken as characteristic species in a site.

Blackman (1942) has called the mean ratio as 'Coefficient of Dispersion', whereas Clapham (1936) named it as 'Relative Variance'. The test makes use of the equality of mean and variance (standard deviation) of the Poisson distribution. Accordingly, if the ratio of variance to mean is less than 1.0, a regular distribution is indicated, if greater than 1.0, contagious distribution. However, in the present studies, keeping in mind the continuity of vegetation, Coefficient of Variation of even upto 1.50 has been taken as 'characteristic species' for a stand or site. Here 'characteristic' is not meant in terms of Braun-Blanquet (1932); but it is used for a species which has uniform dispersal in a stand and thus characterizes a site with respect to its optimum growth value. Thus CV indicates
the homogeneity, and when the CV of a particular species is lesser, the more uniformly it is distributed in the area. CV values so calculated are arranged in three dispersion 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).

Name 'Dispersion class' was advised by Prof. R. Misra, Head of Botany Department, Banaras Hindu University, Varanasi - 5 (India).

Indeed, CV value of more than 1.0 does indicate some irregular distribution. However, species with CV classes 'B' and 'C' (1.0 - 1.5 values) have been considered as less homogeneously distributed or very near to regularly distributed ones.

Next, for every species in a stand or aspect, Relative Growth Index was calculated per quadrat.

RGI is calculated as follows:

\[
\text{RGI} = \frac{m^2}{sd} \times \frac{m^2}{sd} \times \text{(Basal cover)} \times \text{Average Height}
\]

RGI values so obtained for a species per unit area (quadrat) are put in the following grades:
Various sites or stands were then named after those characteristic species of Dispersion class A and/or B (of course, when species of both A & B classes are absent, then by the species of Class-C) values. This was done irrespective of stratification to which a woody species belongs. Thus in some cases an association has been named even after a second layer species, if otherwise it fulfils the requirements.

Finally an association was arrived at by grouping together all similar (to a reasonable degree only) stands or aspects that have the same characteristic species. An association is named after 2 or 3 such characteristic species which in turn are also characteristic in all the stands.

To gauge the validity of mixing of stands, variance of mean density of the characteristic species was determined, pooling their means from all the amalgamated stands. This variance has been called here as 'Community Variance Index' (CVI) for the characteristic species.

Thus, three steps are involved in the proposed method
of classification of natural communities:

1. Landscape, site or aspect approach is used to collect analytic data.

2. Calculating CV for Density of all species for all quadrats studied in a stand. Listing of characteristic species (with CV less than 1.50) and putting them in CV classes.

3. Naming a stand after those characteristic species that have higher grades of RGI, and lastly grouping all similar stands with the same characteristic species together to arrive at a community (called here an association) and confirming the amalgamation by Community Variance Index (CVI).

A community thus arrived at, has been called an 'association', after Braun-Blanquet (1932) and Pandeya (1961). It has not been used in the sense of climatic climax of Clements (1916).

The proposed method of computation makes a critical distinction between all species in a stand, and every species, howsoever small it may be, is given equal importance and treatment.

One point is very conspicuous in this method and that is 'Frequency' index has been completely deleted, because the
regularity of dispersal of a species in a particular stand is otherwise critically expressed from the Standard Deviation and Coefficient of Variation values of density. However, calculations were done for frequency, and the data used for arriving to 'Constance' values.

**REASONS AND ADVANTAGES OF CALCULATING RELATIVE GROWTH INDEX (RGI)**

Storey (1959 a and b) in his discussion on the control of erosion by vegetation and effects of forests on run-off, has emphasized that effects of forest on run-off is dependent on the inter-relationships of a large number of factors such as type and condition of forest, type and amount of precipitation, topography, soil and geology and various climatic elements. Further, in 1960 Storey concludes that, in any event management of forest land provides us with the 'very effective means' of making the most out of the precipitation that we receive. In this connection, extensive work was started in U.S.A. Trimble and Fridley (1963) have given progress report of 13 years of forest research in West Virginia. They have emphasized on evaluating a site index (y), which is dependent upon four variables of physiography and depth of soil. On somewhat parallel lines, in the present investigations, it was thought desirable to give a site productivity index. From the analytic data collected an index was wished, which may, however, give comparative estimates of the growth on a site.
This aim could be achieved under the present concept of Relative Growth Index (RGI). The index has the following advantages:

(a) Density of population and uniformity of dispersion are critically weighed.

(b) CV employed gives a good information of the regularity of dispersion.

(c) Basal cover and height of a plant give a good idea of the magnitude of its standing biomass.

(d) Mixing of stands is not arbitrary.

That the proposed RGI values greatly synchronize with the estimation of biomass and productivity on dry weight basis, has also been critically proved in our present studies (Pandeya and Kuruvilla, 1967).