THE SYSTEMATIC DESCRIPTION OF PLANT COMMUNITIES BY THE USE OF SYMBOLS*

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(*With Plates* 5 *and* 6)

I. Introduction

A series of potentiality surveys of undeveloped regions of Northern Australia was commenced in 1946. The aim of these surveys is to describe and map the inherent land characteristics of the regions and from these to assess the possibilities and likely forms of development.

The areas covered each field season are between 30,000 and 60,000 square miles. To sample adequately a region of this size several thousand miles of land traverses are necessary.

On these land traverses continuous records of the vegetation communities are noted against mileages and more complete detailed records are made at selected sites. The continuous records made from the moving vehicle are necessarily brief. They are limited to names of dominant species, the main characteristics of the plant communities, and to changes in the vegetation and environment. The more detailed records at selected sites include lists of associated plants and a more comprehensive description of the community and the environment. Initially the adequate recording of the variations in, and differences between, vegetation communities over such large areas presented a problem. It was found that the use of such terms as 'savannah woodland', 'forest' or 'scrub' did not always convey the same impression to different people, nor was it always possible for the observer to picture adequately the communities and their differences several months after the notes had been taken.

In order to overcome these difficulties a method of describing the appearance of vegetation communities by means of symbols has been developed during the past four years. This method has enabled the notes of several botanists to be more closely correlated and gives a clearer impression of the appearance of any community when examining field notes even years later.

The method presented in this paper is in several respects similar to that proposed by Stamp (1934), who first drew attention to the possibilities of, and need for, such a combination of symbols.

A vegetation community is composed of one or more types of plants growing in association. The different plant forms, such as trees, shrubs and herbaceous plants, usually constitute distinctive stories giving to each community a characteristic profile.

Plant communities can be described either according to these stories and their characteristics or according to the species present. The first is a description of the visible structure of the community, the latter is a description based on floristics. It is relatively

* The general principles of this method were presented to Section M of the Australian and New Zealand Association for the Advancement of Science at the meeting in Hobart in January 1949.

simple to make a list of species, but classification on a floristic basis depends upon the recognition of relatively constant 'associations' of plants recognizable as distinctive communities. This requires numerous observations, and finality cannot be reached until a community has been examined in a number of localities and the records from these subsequently collated.

Apart from being useful for this subsequent collation of floristic data, a precise description of a structure is a valuable record in itself, as it enables the broad differences in vegetation to be recognized and related to the environment, irrespective of the species present.

The method described is a logical development of the concept that the appearance of a community is an expression of the number and type of plant stories and the density and height of each.

II. STRUCTURE

A. *Stratification*

In this system letters and figures are assigned to the tree, shrub and ground stories, their component layers, and the density of each. Thus the tree story is indicated by the letter 'A', the shrub story by 'B' and the ground story by 'C', and the recording of some or all of these letters immediately imparts some information about the appearance and structure of a community. Further information can be given by designating the layers present within each of these stories. Three layers (low, mid-height and tall) within each story have proved adequate to describe the vegetation in Northern Australia. This number is not always present. Frequently a story is composed of only one or two layers. These layers are indicated by the subscripts '1', '2' and '3' following the letters 'A', 'B' and 'C'. Thus A_1 is used for low trees, A_2 for trees of medium height and A_3 for tall trees. Similarly B_1, B_2, B_3 and C_1, C_2, C_3 are used for low, mid-height and tall shrubs and herbs respectively. Although three layers within each of the stories are adequate in Northern Australia, additional layers may be added where necessary. Thus, if there are four tree layers in a community, A_4 can be used for the tallest, and A_3, A_2 and A_1 for the lower layers.

In Northern Australia lianas and epiphytes are not often important components of the vegetation, but where they occur they are represented by the letters 'L' and 'E' respectively. Similarly, an additional 'D' story may be added to the formula to represent very small plants such as mosses and lichens if these are significant.

Where a community is characterized by a very distinctive life form not adequately described by the foregoing stories, an alternative symbol may be added to the formula. For example, the letter 'M' could be used more appropriately than 'A' or 'B' to indicate the distinctive life form of mallee. The addition of such symbols has not been necessary so far in the description of communities in Northern Australia. For simplicity, it is desirable to limit the number of symbols to a minimum, depending upon the known characteristics of the listed dominants to convey further information.

B. *Height*

The average height of each layer in metres is estimated and is shown by writing this figure as an index to the letter used to indicate the layer. Thus A_3^{15} would represent a tall tree layer 15 m. high.* In practice it has been found desirable not to set down rigid height

* In countries, such as Australia, where the foot is the common unit of measurement, the use of this unit may have local advantages, especially where the formula is to be used or interpreted by non-technical persons.

limits for each story or layer. Frequently the same number and comparable layers may occur in different localities, but the actual height of the layers may be greater in one case than the other. Thus one may describe a fairly low community containing three layers by the formula A_3^{10}, A_2^6, A_1^3, in which the tall trees are 10 m., mid-height trees 6 m. and low trees 3 m. high. Another community in which three comparable layers are equally distinctive but with heights of 20, 12 and 6 m., respectively, would be described by a similar formula differing only in the height indices.

The general height ranges for the various stories and layers in different communities in Northern Australia are:

A_3	10–25 m.	B_1	0·3–1 m.
A_2	5–15 m.	C_3	1–3 m.
A_1	3–8 m.	C_2	0·3–1·3 m.
B_3	2–5 m.	C_1	0–0·5 m.
B_2	1–3 m.		

It will be observed that the height of the corresponding layers in different communities varies considerably, and the height of different layers in different communities may overlap.

Where a single tree layer occurs the symbol applied to it is the one appropriate to the general height class. However, these height classes are of significance only within a defined region; for example, the A_2 layer height-range for many Northern Australian communities, i.e. 5–15 m., may be the more normal height-range for an A_1 layer in a tall forest community elsewhere. It would not be practicable to adopt a fixed universal series of height classes.

C. *Density*

In the absence of any rapid practical method of actually measuring density this is estimated by visual impressions only. However, fairly consistent records are possible by different observers if the number of density classes is restricted to five. These are indicated by the symbols 'x', 'y', 'z' for dense, mid-dense and sparse, with 'xx' and 'zz' for the occasional very dense or very sparse layer.

These letters are placed after the symbols indicating the layers, thus A_3^{15}x represents a dense tall tree story 15 m. high and $B_1^{0·6}$zz indicates the presence of very scattered, low shrubs 0·6 m. high.

III. Floristic composition

The formula record of structure is a useful description of vegetation without the addition of a floristic list. For the further differentiation of communities reference must be made to floristics. Where possible a complete floristic list is desirable, but this is not possible where notes are made from a moving vehicle on traverse. In such circumstances recording of the dominant species with the structural formula is sufficient if complete lists are made at type localities.

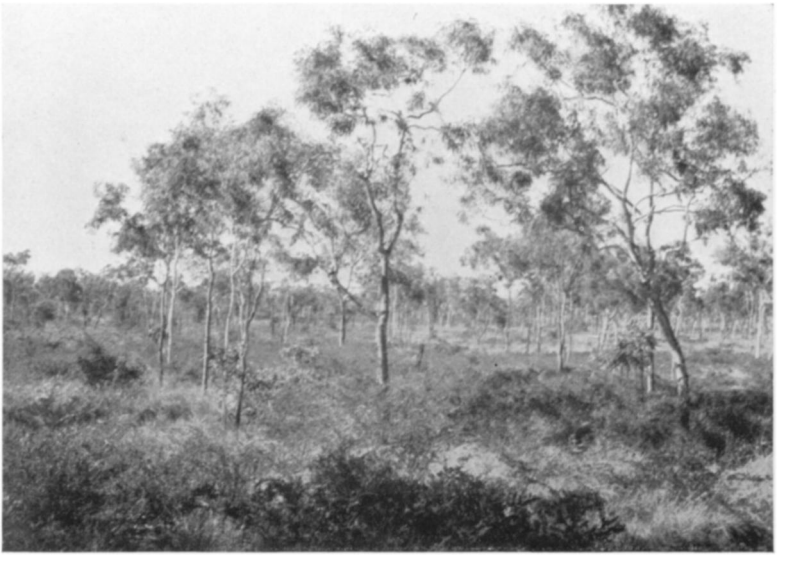
The floristic composition of a community is shown by writing the species names (or abbreviations for commonly recurring plants) under the appropriate layer symbol in the formula. The dominants in each layer are preferably listed first and underlined. The relative density of each species is indicated by the symbol 'x', 'y', 'z', 'xx' or 'zz' preceding the species name.

A simple example is the formula for the *Eucalyptus brevifolia* association (Pl. 5, phot. 1), which occurs on skeletal soils in the Barkly Region of Northern Australia. This community has only three important layers of plants and only a few species in each, so that

Phot. 1. *Eucalyptus brevifolia* association. A community of simple structure having scattered mid-height trees, a mid-dense mid-height grass layer and a sparse, short grass layer. Formula $A_2^6zz\ C_2^1y\ C_1^{0\cdot3}z$.

Phot. 2. *Eucalyptus tetrodonta-E. miniata* association. A complex community with two tree layers, three shrub layers and two grass layers. Formula $A_2^{13}z\ A_1^6z\ B_3^5z\ B_2^3y\ B_1^1z\ C_2^1zz\ C_1^{0\cdot3}zz$.

Phot. 3. *Eucalyptus papuana-E. tectifica* association. A woodland community with two tree layers. Formula $A_2^{13}z\ A_1^6z\ B_2^{1\cdot3}zz\ C_2^{1\cdot3}zz$.



Phot. 4. *Eucalyptus dichromophloia* association. A simple community with a prominent mid-height shrub layer. Formula $A_2^8z\ B_2^{1\cdot3}y\ C_2^{0\cdot6}y\ C_1^{0\cdot3}zz$.

the description is relatively simple. The following is the descriptive formula with abbreviated species names:

A_2^6zz	C_2^1y	$C_1^{0\cdot3}$z
zE.brev.	yTr.pung.	zTrich.alop.
	zzCy.bom.	zGom.can.
		zEr.cil.
		zPoly.sp.
		zInd.trit.

E.brev. = *Eucalyptus brevifolia*
Tr.pung. = *Triodia pungens*
Cy.bom. = *Cymbopogon bombycinus*
Trich.alop. = *Trichinium alopecuroides*
Gom.can. = *Gomphrena canescens*
Er.cil. = *Eriachne ciliaris*
Poly.sp. = *Polycarpaea* sp.
Ind.trit. = *Indigofera trita*

The *E. tetrodonta-E. miniata* association (Pl. 5, phot. 2) is an example of a more complex community. A typical formula for this community is:

A_2^{13}z	A_1^6z	B_3^5z	B_2^3y	B_1^1z	C_2^1zz	$C_1^{0\cdot3}$zz
yE.tet.	zT.can.	zAc.plec.	y–zJack.od.	zAc.gal.	yTr.sp.	zAr.br.
zE.min.	zEry.chl.		y–zCal.mic.	zzCas.pum.	±Plec.sp.	zAr.hyg.
zzE.di.	zAlph.ex.		zDis.fil.	zzTrium.sp.	zzHet.con.	zzSchiz.ob.
±Cal.int.	zPet.ban.		zBos.phyl.	zzTeph.st.	zzChry.sp.	zzPoly.spp.
	zGrev.chry.				zzCy.sp.	zzGom.can.
	zPla.car.					zzEv.als.

E.tet. = *Eucalyptus tetrodonta*
E.min. = *E. miniata*
E.di. = *E. dichromophloia*
Cal.int. = *Callitris intratropica*
T.can. = *Terminalia canescens*
Ery.chl. = *Erythrophleum chlorostachys*
Alph. ex. = *Alphitonia excelsa*
Pet.ban. = *Petalostigma banksii*
Grev.chry. = *Grevillea chrysodendron*
Pla.car. = *Planchonia careya*
Ac.plec. = *Acacia plectocarpa*
Jack.od. = *Jacksonia odontoclada*
Cal.mic. = *Calytrix microphylla*
Dis.fil. = *Distichostemon filamentosis*
Bos.phyl. = *Bossiaea phylloclada*
Ac.gal. = *Acacia galioides*
Cas.pum. = *Cassia pumilio*
Trium. sp. = *Triumfetta* sp.
Teph.st. = *Tephrosia stuartii*
Tr.sp. = *Triodia* sp.
Plec.sp. = *Plectrachne* sp.
Het.con. = *Heteropogon contortus*
Chry.sp. = *Chrysopogon* sp.
Cy.sp. = *Cymbopogon* sp.
Ar.br. = *Aristida browniana*
Ar.hyg. = *Aristida hygrometrica*
Schiz.ob. = *Schizachyrium obliquiberbe*
Poly.spp. = *Polycarpaea* spp.
Gom.can. = *Gomphrena canescens*
Ev.als. = *Evolvulus alsynoides*

Illustrations of two other typical Northern Australia communities are given in Pl. 6, phots. 3 and 4. The appropriate formulae are shown beneath the figures.

IV. Complex communities

The formula can also be used where two or more communities are intermixed in a more or less constant pattern, as, for example, in gilgai country where the ground layer of the gilgai depressions differs from that of the rises. The formula for the major community is followed by a formula for the minor community, but this latter is enclosed in brackets to indicate patchiness. Some indication of the frequency of the patches of the minor community can be given by using the density symbols after the brackets. The *Acacia cambagei-Cassia* spp. association of the Barkly Region is an example. A formula for this association would be as follows:

A_2^5z	B_2^1z	$C_1^{0\cdot3}$y	+	(C_2^1y	$C_1^{0\cdot3}$y)z
zAc.c.	zCas.ol.	yEnn.spp.		yEu.f.	zMal.spic.
	zCas.stu.			zAs.p.	zMars.sp.

Ac.c. = *Acacia cambagei*
Cas.ol. = *Cassia oligophylla*
Cas.stu. = *Cassia sturtii*
Enn.spp. = *Enneapogon* spp.
Eu.f. = *Eulalia fulva*
As.p. = *Astrebla pectinata*
Mal.spic. = *Malvastrum spicatum*
Mars.sp. = *Marsilea* sp.

This formula describes a fairly sparse shrub woodland community with a low grass ground story in which there are scattered patches with a mid-dense layer of taller grasses.

V. Discussion

The present method has much in common with that proposed by Stamp. It differs in that the formula is based specifically on structure. The floristic data are added as a relevant but separate piece of information. On the other hand, Stamp attempts to combine some floristic information with structural information in the one formula which thereby may become more complex. A more exact feature in Stamp's method is the expression of number of plants per unit area. The proposed formula is concerned with only five estimated density classes. It is intended that these will later be related to actual frequency ranges, but for the general comparison of communities the five classes are usually adequate once a mental impression of relative densities is established.

The method described has been used for a period of four years over a wide area and range of plant communities in Northern Australia. It has been found to be a convenient, accurate and rapid method for recording observations on plant communities. The use of such simple sequences as A, B, C; 1, 2, 3; x, y, z soon becomes automatic, so that uniformly complete records are made at each observation point. It enables variation in the structure of a community as well as the variation in floristics to be adequately recorded. It has been found that even after short periods of experience with the method, records by different workers are consistent, and this is true whether or not the individual had had previous training in describing plant communities. As a result field notebooks are of equal use to other workers and to the individual making the observations. The method has proved to be a reliable system of recording voluminous data for subsequent analysis and collation.

A second feature of the method is that with a little practice the appearance of a community can be easily pictured from the record. The formula enables a far greater variety of appearances and structures to be recorded and subsequently mentally pictured than is possible by the use of such generalized formation terms as 'woodland' and 'forest'. This is valuable when numerous observations on a variable vegetation are to be grouped for general descriptive and analytical purposes. Finally, the description of communities by this method, which records the essential components of appearance and structure, is a logical basis for a more systematic classification of communities according to structure than is possible by current nomenclature.

VI. Summary

A field method for the rapid and systematic description of plant communities in respect to appearance, structure, height, density and floristic composition is described.

A formula of figures and letters is built up from symbols representing the stories, their component layers, and the density and height of each in the community. The floristic composition is shown by lists of abbreviated species names placed under the appropriate portions of the formula. The dominant species are indicated.

The formula has been used successfully on a series of broad-scale ecological surveys in Northern Australia and has proved to be a reliable, accurate and rapid method of recording observations on plant communities, and of summarizing voluminous data for subsequent collation.

This method of description is a logical beginning for the classification of plant communities into structural categories.

The method described was developed during the course of investigations in Northern Australia by the Land Research and Regional Survey Section of the Commonwealth Scientific and Industrial Research Organization, Australia.

REFERENCE

Stamp, L. D. (1934). Vegetation formulae. *J. Ecol.* **22**, 299–302.