Vegetatio Vol. 33, 1: 61-64, 1976

# THE DECIMAL SCALE FOR RELEVES OF PERMANENT QUADRATS*

G. LONDO**

Research Institute for Nature Management, Leersum, The Netherlands

**Keywords:** Abundance, Coverage, Permanent quadrats, Scales, Vegetation analysis

## Problems with usual scales in studying permanent quadrats

Estimating the coverage and abundance of plant species on arbitrary scales is one of the methods of vegetation description. It has been proved to be a quick method which causes relatively little disturbance of the vegetation.

The most widely known of the scales is that of Braun-Blanquet (1928, 1964). This scale is suitable for synmorphological and syntaxonomical purposes, but its intervals are as a rule too broad for the study of community dynamics. Small changes in the coverage cannot be properly measured. Only when changes are considerable such as in the early stages of a succession, its use can be satisfactory. The author himself realised this after he had begun his succession research into dune slack vegetation in 1958.

One way in which this difficulty can be overcome is to refine the existing scale. Segal & Barkman (1960), for instance, subdivided the Braun-Blanquet scale, halving the higher intervals (indicated by a and b), and at the low end distinguishing intervals of $< 1\,\%$, 1–3 % and 3–5 % (indicated by p, a and b respectively). Shortly afterwards they modified some of the details (Barkman, Doing & Segal 1964). The 11-division scale of Domin (1923, see also Bannister 1966, McLean & Ivimey-Cook 1973) running from +, 1, 2, etc. to 10, is a refinement over the Braun-Blanquet scale.

The Segal & Barkman modified scale has been widely used in the Netherlands. The author applied it for many years. It was satisfactory as long as it was used only in making sample plot records and arranging them in tables. Difficulties arose when they were subjected to numerical analyses. When difference quotients, changeability quotients, or life form and other spectra of syntaxonomical groups are to be calculated (see Londo 1971), the scale has to be transformed to give the actual coverage percentages.

Values of the Segal & Barkman scale, however, cannot be converted satisfactorily into values which are convenient to use in calculations; the conversion values 1 to 10 given by Barkman, Doing & Segal (1964) cannot be used for this purpose either. The Domin scale is similarly disadvantaged. In addition, conversions have the drawback that they take time and increase the likelihood of errors.

## Requirements of a scale for succession research

Where succession research is concerned, the logical solution calls for a scale that meets the following requirements:

1. The scale should be sufficiently refined.
2. Its points should be related to the actual coverage values.
3. Coverage and abundance should be strictly separated. It is not logical to combine such dissimilar features in a single quantitative scale.
4. The symbols should be as simple as possible.

## The decimal scale

The scale presented in Table 1 is one that conforms to the requirements.

This scale (Schmidt 1974, Londo 1975) is a modification of the decimal scale which was suggested earlier by Doing Kraft (1954) and which has been used for many years by

* Nomenclature of species follows Heukels-van Oststroom (1975).

** The author wishes to thank Dr J. F. Hope-Simpson for his remarks and for reviewing the manuscript.

Table 1. Decimal scale for recording coverage in vegetation analysis

| DECIMAL SCALE | | | Braun-Blanquet scale |
|---|---|---|---|
| symbol | coverage | supplementary symbols | |
| .1 | <1% | . = r (raro), = rare, sporadic<br>p (paululum) = rather sparse | + |
| .2 | 1-3% | a (amplius) = plentiful<br>m (multum) = very numerous | 1 |
| .4 | 3-5% | | |
| 1 | 5-15% | 1- = 0.7 = coverage 5-10%<br>1+ = 1.2 = coverage 10-15% | 2 |
| 2 | 15-25% | | |
| 3 | 25-35% | | |
| 4 | 35-45% | | 3 |
| 5 | 45-55% | 5- = coverage 45-50%<br>5+ = coverage 50-55% | |
| 6 | 55-65% | | 4 |
| 7 | 65-75% | | |
| 8 | 75-85% | (coverage >5%: abundance not indicated) | |
| 9 | 85-95% | | 5 |
| 10 | 95-100% | | |

The decimal point in the symbols .1, .2 and .4 stands for one of the letters r, p, a or m

a number of Dutch succession researchers in many types of vegetation. The symbols in Table 1 are different from those in the Doing Kraft paper; 1, 2, 3, etc. instead of 01, 02, 03, etc.

Three coverage intervals are created below 5 %. Together with the four abundance symbols, a total of twelve combinations is possible. The decimal point in the symbols .1, .2 and .4 is not written as a dot but is replaced by one of the letters r, p, a or m. Above a coverage of 5 %, no abundances are recorded. The indication of abundance by a letter is convenient and prevents false interpretations. In the Braun-Blanquet scale as modified by Barkman et al. (1964) letters and figures may relate to abundance as well as to coverage.

In performing the calculations the symbols .1, .2 and .4 of course become 0.1, 0.2 and 0.4. The value 0.1 is certainly too high for coverage < 1 %, but considering that the coverage estimate cannot be exact, the inconvenience of using another decimal place, e.g. by using 0.05, is not worth-while. Similarly 95–100 % is slightly overvalued by giving it 10 in the calculations but 9.75 would be needlessly cumbersome. The symbol 10, though rarely used, has significance for species covering (almost) the entire surface in places where the vegetation usually comprises only a small variety of species. Smaller intervals (in this case 5 %) are more easily estimated where coverage percentages are very high than where they are lower, 70 % for instance. In such cases it is the percentage of the surface not covered by the species in question that is estimated.

Since the scale directly describes the coverage percentages, it is very easy to compare the sum of the coverage values of the plant species in a quadrat with the total cover of the vegetation layer in question. For instance, when the latter is 60 %, the sum must be at least 6. It may be higher, because the plant species usually overlap.

Although it is not practical to make a reliable visual distinction between intervals of 5 % within the range between 15 % and 95 %, one can distinguish whether a species covers less or more than 50 % of an area. So, the symbol 5 can be written as 5− or 5+ in order to make the scale fully comparable with that of Braun-Blanquet. So the decimal scale can always be converted into that of Braun-Blanquet, a fact that has advantages for syntaxonomical research. For mathematical operations, the + and − signs have no significance.

A brief explanation of the term *decimal scale* follows. Doing Kraft (1954) used this term for the scale which has 10 divisions above 5 %. The creation here of coverage intervals below 5 % has made the scale a 13-division one as regards the coverage. However, all coverage symbols of the scale correspond with the values of the figures in our decimal system. The term decimal scale is therefore appropriate.

*Possible modifications of the decimal scale*

It is possible to use the decimal scale in modified form. If, for instance, the interval between 5 and 15 % is found to be too large, it can be further subdivided (see Table 1). When performing calculations one can either count 1− and 1+ as 1, or quantify 1− as 0.7 and 1+ as 1.2. If these intervals of 5 % are applied consistently, 0.7 and 1.2 can be written as symbols instead of 1− and 1+. Otherwise the scale no longer comes up to requirement 2. The coverage values 0.1, 0.2, 0.4, 0.7, 1.2, 2 constitute a more or less logarithmic progression. Above 2 the scale is linear.

When the scale is used for isolated sample plot records and there is no need to distinguish coverage intervals below 5 % (below value 1), only the abundance symbols are required, as in the original Doing Kraft scale.

For certain species, e.g. *Orchidaceae*, it is recommended that the number of individuals be recorded alongside the symbols for coverage and abundance. This is done by placing that number in brackets after the symbol, e.g. *Ophrys apifera* pl (7).

*Use of the decimal scale*

Part of a relevé in dune slack vegetation (size of quadrat 4 $m^2$) is given below to illustrate the use of the decimal scale. Other symbols, including those for vitality and fertility, have been omitted. The Braun-Blanquet scale symbols are also given for comparison.

| | Decimal scale | Braun-Blanquet scale |
|---|---|---|
| *Salix repens* | 2 | 2 |
| *Prunella vulgaris* | 1 | 2 |
| *Dactylorhiza praetermissa* | a2(86) | 1 |
| *Sagina nodosa* | a1 | 1 |
| *Holcus lanatus* | p1 | + |
| *Betula verrucosa* | r4 | + |
| *Lycopus europaeus* | r1 | + |

Since 1967, the decimal scale has been used generally by the Research Institute for Nature Management, and subsequently also by various other researchers working on permanent quadrats in the Netherlands. At the meeting of the 'Arbeitsgruppe für Sukzessionsforschung auf Dauerflächen' (Working Group for Succession Research on Permanent Plots) of the International Society for Vegetation Science, held in Rinteln (West-Germany) on 10 April 1974 (Schmidt 1974), it was decided to introduce the decimal scale into the research program.

Adoption of a common scale has the great advantage that the various research data can be far more easily compared than when different scales are used side by side.

*Changing over to the decimal scale from another scale*

Generally speaking, once a method has been chosen in succession research it should be changed as little as possible. Changing over to the decimal scale from another scale is advisable when it offers substantial advantages, particularly in the long term, as in the case of succession research. In the 1967–1974 period the author used the decimal scale and the Braun-Blanquet scale as modified by Segal & Barkman (1960) side by side, the latter scale for the older quadrats for which it had already been used long since. It was found that because of its more logical intervals the decimal scale was also more convenient to be used in the field. Partly in view of the decimal scale's other advantages it was decided in 1974 to change over to it in the case of the older quadrats as well. In that year both scales were used for these quadrats, to enable a satisfactory comparison to be made with the preceding year and the succeeding year. It must be borne in mind, therefore, that in the year of the change-over the quadrats should be recorded twice, by the two scales.

*Coarse scale for small sub-quadrats*

For observations on very small sub-quadrats, e.g. one or only a few $dm^2$ in size, a need arose for a coarser scale that could be directly compared with the decimal scale. The following 5-division scale meets this requirement and has the advantage that the symbols are simple.

When a 4-division scale with intervals of 25 % is used, the average coverage values cannot be expressed by simple single-figure symbols. The symbols have the same mean values on the fine decimal scale as on the coarse scale mentioned below. In both cases, for instance, 3 is the mean coverage 30 %. On the basis of the coverage in all the sub-quadrats it is easy to calculate the coverage (according to the fine scale) for each species in the entire quadrat. The coarse scale for small sub-quadrats (abundance not indicated) includes,

1 = coverage < 1– 20 %
3 = coverage 20– 40 %
5 = coverage 40– 60 %
7 = coverage 60– 80 %
9 = coverage 80–100 %

**Summary**

For vegetation analyses of permanent quadrats the author formerly used a modified scale of Braun-Blanquet with smaller intervals than in the original. For calculations of difference- and change quotients etc., on the basis of coverage, the symbols of this scale have to be converted to values proportional to the real coverage percentages. A conversion in simple terms is not possible; so the calculations are inconvenient.

For an efficient analysis of permanent quadrats a scale is needed that fulfils some requirements. The decimal scale fulfils these. For the analysis of small sub-quadrats of a permanent quadrat a coarse scale is proposed. This scale is directly comparable with the finer decimal scale.

**Zusammenfassung**

Für die Vegetationsanalyse von Dauerquadraten verwendete der Verfasser früher eine modifizierte Skala Braun-Blanquets mit kleineren Intervallen als in der originellen Skala. Bei mathematischen Berechnungen auf Grund der Deckungswerten für Differenz- und Änderungsquotienten u.s.w., ist eine Transformation notwendig in Werte die im

gleichen Verhältnis zur wirklichen Deckung stehen. Eine Transformation in einfache Zahlen ist nicht möglich wodurch Berechnungen schwierig sind.

Für eine zweckmässige Analyse von Dauerquadraten ist eine Skala notwendig welche verschiedenen Anforderungen entspricht:

1. Die Skala soll genügend fein sein.
2. Die Symbole der Skala sollen in gleichen Verhältnis zur wirklichen Deckung stehen.
3. Der Deckungsgrad und die Abundanz sollen getrennt bestimmt werden.
4. Es sollen soweit wie möglich einfache Symbole angewendet werden.

Die Dezimalskala entspricht diesen Anforderungen.

Für Aufnahmen von kleinen Teilquadraten innerhalb eines Dauerquadrat wird eine grobe Skala vorgeschlagen. Diese Skala ist unmittelbar mit der Dezimalskala zu vergleichen.

**References**


Bannister, P. 1966. The use of subjective estimates of cover-abundance as the basis for ordination. J. Ecol. 54: 665–674.

Barkman, J. J., H. Doing & S. Segal. 1964. Kritische Bemerkungen und Vorschläge zur quantitativen Vegetationsanalyse. Acta Bot. Neerl. 13: 394–419.

Braun-Blanquet, J. 1929, 1964. Pflanzensoziologie, Grundzüge der Vegetationskunde. 1. Aufl. Springer, Berlin X+330 pp; 3. Aufl. Springer, Wien-New York. XIV+845 pp.

Doing Kraft, H. 1954. L'analyse des carrés permanents. Acta Bot. Neerl. 3: 421–424.

Domin, K. 1923. Problemy a methody rostlinne sociologie. Praha.

Heukels, H. & S. J. van Ooststroom. 1975. Flora van Nederland, 18e ed. Wolters-Noordhoff, Groningen.

Londo, G. 1971. Pattern and process in dune slack vegetations along an excavated lake in the Kennemer dunes (the Netherlands). Thesis, Nijmegen. Verhandeling Nr. 2. Research Institute for Nature Management, Leersum, the Netherlands.

Londo, G. 1975. De decimale schaal voor vegetatiekundige opnamen van permanente kwadraten. Gorteria 7: 101–106.

McLean, R. C. & W. R. Ivimey-Cook. 1973. Textbookof Theoretical Botany 4. London.

Schmidt, W. 1974. Bericht über die Arbeitsgruppe für Sukzessionsforschung auf Dauerflächen der Internationalen Vereinigung für Vegetationskunde. Vegetatio 29: 69–73.

Segal, S. & J. J. Barkman. 1960. Enige opmerkingen over abundantie en dominantie bij het opnemen van kwadraten. Jaarb. Kon. Ned. Bot. Ver. 1960: 39–40.


Accepted 5 October 1976.