A Numerical Study of the Distribution of Grasses in New Zealand

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I have here limited my treatment of the role of grasses in delimiting natural areas to their numerical distribution in relation to those areas where they occur. The basis of this treatment is the relation

$$S = K \log A$$

i.e., the number of species in an area is proportional to the logarithm of the area. The number of the species common to any two areas A_1 and A_2 can be expressed

$$S_1 + S_2 - S$$

and the estimated number

$$K (\log A_1 + \log A_2 - \log A_T)$$

The ratio of the actual to estimated number is the ratio of homogeneity. When the flora of the two areas is truly homogeneous the ratio is equal to one.

The success of the treatment depends in the first place on the adequacy of our knowledge of the distribution of the grasses. I am relying on the labels of some 10,000 specimens of our grasses in the New Zealand herbaria. In the second place, it depends on the basis upon which we draw the boundaries for the areas to be measured. We can readily recognise the well defined boundaries of the vertical zones: the subpolar (alpine), the cool temperate (montane), warm temperate (lowland). Throughout most of New Zealand the zones coincide closely with the contours of 6000-4000 ft., 4000-2000 ft., and 2000-sea level. It is a different matter to divide these zones into areas. We have one rather unsatisfactory boundary which is generally accepted, dividing the islands along the main mountain axis into east and west. Any other boundaries for major areas must always be purely arbitrary. New Zealand topography, climate and soils help to explain our problem.

Plant geographers for long relied heavily on presence or absence of species to demonstrate the extent to which an area is distinct from another. It is my purpose to draw attention to the fact that the mere presence or absence of any species or groups of species may be purely fortuitous and without any special significance. Unless the particular species have special ecologic or geographic characteristics they need not be taken into consideration.

For the purposes of this discussion I have divided the country into strips along the parallels of latitude one degree in width. The common logarithms of the square miles of the areas of each vertical zone are compared with the numbers of species found in those areas. This illustrates the numerical changes of the grass flora along the length of the land and also demonstrates the apparent lack of agreement between the logarithms of the areas and the numbers of species.

A reasonably good agreement between species and areas exists in the warm temperate belt. There is however an excessive rise in species in the strip 46°-45°, which corresponds to the main dry area of this zone. Subtracting the species in the zone in this strip east of the main divide and similarly any of these species occurring in the other strips we have new totals. These are in much better agreement with the areas. For all strips the percentage of species common to any two strips with their thus adjusted totals is about 90; the ratio of homogeneity is about one. That is, there does not appear to exist any natural break in the distribution. There is a slight discrepancy to be found in the strips north of 38°, to which I shall return.

Unlike the homogeneity to be observed between strips of the same zone no such homogeneity exists between any adjoining vertical zones. The number of species shared is less than 5 per cent. of their total. The same observation applies to the dry areas compared with the wet ones.

Somewhere along the main mountain axis of the South Island is a line dividing it into two major biological areas: east and west. Where grasses are concerned the present evidence seems to afford no justification for dividing the island in any other way, except perhaps for convenience of reference. The North Island is fundamentally uniform except for a small patch between Kaweka and Kaimanawa Mountains and perhaps also Onetapu, which are similar in every respect to east South Island.

The discrepancy mentioned as occurring north of 38° S. is relatively small, due to the low elevation of the land which passes almost wholly into the subtropical zone. Being of low elevation much of it lies in the tension zone where species of the adjoining zones mix. In the north there is present a distinct group of tropical grasses. Although only six in number they are characteristic of the zone rather than "area." The dividing line along 38° parallel is based on this fact.

Each natural group of grasses, whether a genus or its subdivision, or a group of genera, has its own characteristic distribution according to the zones and areas just outlined. Within these the numbers of species always relate closely to the size of the area in which the particular group occurs. In this respect the tropical element behaves in just this manner.

This evidence deduced from the distribution of our grasses suggests that we have two natural areas: the North Island and the western South Island, and the eastern South Island. The other subdivisions used by botanists appear to be largely a matter of convenience.

The Distribution of Beech Forests

A. L. Poole

An account of the distribution of any vegetation presupposes a satisfactory classification of it. Excepting a few small areas, no detailed analyses have been made of our plant communities; rather have we depended upon a somewhat general approach, following Cockayne who classified forests into communities named from their physiognomic dominants. He also drew attention to changes brought about by succession and maintained that changes, brought about by time, were the result of succession.

As a working classification Cockayne's forest communities serve their purpose but his theory of succession left much to be answered. J. T. Holloway introduced an hypothesis of comparatively rapid changes taking place within forests because of changes in climate ("Forests and Climate in the South Island of New Zealand," 1954) which must somewhat alter Cockayne's classification. Holloway who was working on a forest survey used "forest type" . . . "as being a simple forester's term denoting any clearly distinct unit of forest vegetation." According to his hypothesis a forest community or type could owe its presence to the invasion of one community by another, and not to succession "in situ."

The distribution of natural communities of plants is usually decided by the various factors (climatic, physiographic, edaphic or soil and biotic) of the habitat. Recently the importance of historic factors has been strikingly shown in the natural vegetation that occupied the pumice showers of the central North Island. These migration patterns of plant communities show that there is a certain amount of luck in deciding which community occupied an area immediately after eruption.

Another matter appears important as the genetic nature of species becomes better known; as individual species migrate, geographic variations, known by botanical terms according to their genetical nature, are separated out, and opportunity for species hybridisation occurs. These phenomena give rise to new communities.

The greatest concentration of beech forest lies in the South Island, where it forms, and probably always did form, the bulk of the forests. In the central Nelson area occurs