THE DETERMINANTS OF INDIGENOUS FOREST SPECIES DISTRIBUTION AND ABUNDANCE ON TABLE MOUNTAIN, CAPE PENINSULA, SOUTH AFRICA

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ABSTRACT

The indigenous forest patches on Table Mountain were mapped and the abundance of 40 pre-chosen forest species was estimated in them. The species log area regression for the 68 forest patches was significant ($r^2 = 0{,}64$). The regression for the 30 drier forests on north- and west-facing slopes was not significant ($r^2 = 0{,}27$). This is explained in terms of differential proness to fire of the forest patches and the varying susceptibility to fire of the species with subsequent effects on the rates of colonization and extinction between the forest patches. The intercepts between wet and dry forest regressions were significantly different, indicating that drier forests were poorer in species.

Species and environmental data were analysed by Canonical Correspondence Analysis (CCA) and TWINSPAN analysis. With a few exceptions, the first dichotomy of the TWINSPAN dendrogram, seperated out drier forests from wet forests. The four basic forest types recognized by TWINSPAN at the second dichotomy correlated well with the spread of forests on the ordination diagram. Moisture and substrate type were recognized as the most important determinants of forest species distributions. Explanations for borderline or outlying forests suported this result. Possible differences in the structure and dynamics of the different types are discussed and suggestions are made for future research in this field.

INTRODUCTION

Ecological biogeography is concerned with problems of species diversity and the principles underlying coexistence in communities. Historical biogeography has, in the past, been treated as a separate discipline, but recently ecological biogeographers have realised that history can have an important role in explaining the distribution of species (Ricklefs, 1987).

In this report an attempt is made at answering two major questions of ecological biogeography with respect to species and environmental data collected from 68 forest patches occurring on Table Mountain. Firstly, what determines the variation in species number between the different forest patches? Secondly, what limits the distribution of Table Mountain forest species? More specifically to what extent can the physical environment explain the distribution and abundance of species or must other factors such as dispersal capabilities, competition or past disturbance (history) be considered as well?

Campbell & Moll (1977) classified the forest communities on Table Mountain by analysing 105 relevés placed in different forest patches and community types. They suggested moisture conditions, degree of rockiness and soil depth to be the major factors influencing the type of forest. In Mckenzie *et al.*'s (1977) phytosociological study of Orange Kloof, Table Mountain, eight different forest communities were recognised. Apart from some of McKenzie's (1978) work and a recent investigation carried out by Masson (1990), there is very little available information on the structure and dynamics of the forest communities in the south western Cape. This paper provides suggestions or hypotheses that may enhance our understanding of the structure and functioning of the various forest types that are recognised.

STUDY AREA

The Table Mountain Nature Reserve is an area of approximately 6 500 hectares (see Figure 1). More than 10% of the area consists of patches of indigenous Afromontane forest. This vegetation type is restricted to sheltered ravines and scree slopes on all sides of the mountain.

The climate of Table Mountain is typical of a mediterranean region, with hot, dry summers and cool, wet winters. Newlands and Kirstenbosch receive an average annual rainfall of 1666mm and 1424mm respectively (The Weather Bureau). In the last five years Newlands has recieved over 2000mm of rain a year. Average annual rainfall figures on the western side of the mountain are 571mm for Sea Point, 615mm for Camps Bay, and 725mm for Tamboerskloof (The Weather Bureau). Thus, because the higher rainfall correlates with shaded southern and eastern facing slopes, there exists a dramatic moisture gradient acrosss Table Mountain.

Geologically, the area consists of Basement Granite which forms deep, relatively clay rich soils below an altitude of about 350m. This is overlain by a thin layer of relatively soft finely textured shale rock of the Table Mountain Group, Graafwater formation, between about 525 and 600m. The rock above this is Table Mountain Group,Peninsula formation, sandstone (hereafter refered to as TMS*), from 550m up to 1 086m. This geology is constant for the whole area except for Devil's Peak and Signal Hill where the granite is replaced by Malmesbury Shale (Hartnady & Rogers, 1990). Sandstone debris overlies granite, especially on the eastern slopes. The size and depth of the scree slopes can generally be correlated with the size of the TMS cliffs above them (pers. obs.). The most extensive scree slopes occur between Newlands and Kirstenbosch.

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*TMS is arenaceous rock or quartz arenites of the Peninsula formation,Table Mountain Group (Hartnady & Rogers,1990).

A large number of streams drain Table Mountain, many of which have worn deep ravines into the TMS. Examples include Disa Gorge in Orange Kloof, Skeleton Gorge in Kirstenbosch and Blinkwater Ravine above Camps Bay.

METHODS

Field Work

The indigenous forest patches on Table Mountain were demarcated on 1:10 000 aerial photographs. Each of the 68 forest patches identified was visited and the outlines on the aerial photographs were refined. Field work was started in November, 1990, and most sites had been sampled by mid-December, 1990.

The occurrence of a total of 51 forest species were recorded, and an estimate of the abundance in each forest patch was made (Appendix 1) Eleven of these species were excluded from the analysis (Appendix 2), either because they did not occur on Table Mountain or they were considered to be marginal species that were under - sampled. The abundance of each species was ranked on the scale of R = very rare; + = sparse; 1 = common; 2 = very common; 3 = dominant canopy tree; 4 = co-dominant with one other species; 5 = completely dominant. No species ever received a ranking of 5, and rarely a ranking of 4. Forest marginal and bushy species (e.g. *Polygala myrtifolia* and *Clutia pulchella*) and vines and lianes usually received a ranking of + unless they were exceptionally common.

In the field each forest patch was visited, and the entire altitudinal range was traversed. The occurrence of each species was recorded on a data sheet. I searched for additional species while observing the relative abundances of those already found. The species were ranked once I was confident that all species present in a particular forest patch had been found and I had a clear picture of their relative abundances in my mind. This subjective method worked very well in the smaller patches, but was more difficult in the larger forest patches. Several days were spent walking in the larger forests and species were ranked at the end of each day. These were later combined to provide one general ranking for the entire forest. A problem with this sampling procedure is that the different kinds of forest communities associated with different aspects and substrates within a large forest were blurred. However, I believe the estimates were appropriate for comparing species occurrences and abundances between the 68 forest patches.

In addition to these data, the diameter at breast height (DBH) of tree species were recorded in 10 x 10m plots that were subjectively chosen in the different forest patches. A total of 107 samples were completed. These data have not be analysed for this report. However, by collecting the plot data I increased my understanding of the dynamics, floristics and structure of the various kinds of forests found on Table Mountain. Knowledge accumulated from these plots will be used in the discussion. Other information recorded while doing the plots included substrate type, slope, altitude, aspect, canopy height, and notes on evidence of fire and alien or human disturbance and exploitation.

Analysis

To examine the relationships among broad environmental variables and forest patch community composition, as well as species distributions, Canonical Correspondance Analysis (CCA) was selected from the CANOCO program of ter Braak (1987b). CCA is a mulivariate technique developed to relate community composition directly to known variation of the environment. It is a form of Direct Gradient Analysis, in which ordination axes are chosen to be linear combinations of known environmental variables (ter Braak, 1986, 1987a, 1987b).

Twelve environmental variables were compiled in the following way (see Appendix 1):

1. Area - ranked from 1 to 5 (the log values of areas being used). 1 = less than 3.5; 2 = between3.5 and 4; 3 = between 4 and 4.5; 4 = between 4.5 and 5; 5 = greater than 5.
2. Moisture - ranked from 1 to 3. 1 = dry; 2 = medium; 3 = wet. Forest patches on north- and west-facing slopes were ranked 1, except for forests occurring in obviously wetter situations, in which case they were ranked 2.
3. North aspect - 1 = presence; 0 = absence.
4. South aspect - same as above.
5. East aspect - same as above.
6. West aspect - same as above.
7. Alien plant and human disturbance - ranked from 0 to 3. 0 = none; 1 = present but of little consequence to floristics; 2 = detrimental effects present; 3 = large sections of forest recovering from major unnatural disturbances. This ranking was done by referring to the notes on my data sheets, as well as the occurrences and abundances of exotic species which were recorded for each forest patch.
8. Rivers - presence or absence of perenial streams and the associated riverine forest.
9. TMS scree - ranked on a scale from 0 to 3. 0 = none; 1 = little scree in forest; 2 = majority of forest on scree; 3 = entire forest occurs on scree.
10. Granite derived soil - ranked on a scale from 0 to 3.
11. Shale derived soil - ranked on a scale from 0 to 3.
12. TMS derived soil - ranked on a scale from 0 to 3.

10, 11 and 12 were determined by referring to van der Merwe's (1963) geological map of Table Mountain. Some forests occurred on soil derived from all three rock types while others are restricted to only one soil type.

CANOCO assumes that the species abundances were sampled in a standard size plot. In this case the sample size varies between the sites and area itself is considered a variable. However, the sampling method of abundance ranking is such that assuming a standard forest size does not affect the abundance ranking, i.e. large forests cannot be assumed to have high species abundance values. The abundance of a species was ranked according to the relative abundance of the other species in that forest.

To coroborate the results displayed by CCA in the forest patch-environment biplot and the species-environment biplot, the program TWINSPAN (Hill, 1979) was run on the species composition of the 68 forest patches. This community classification based on two-way indicator species analysis, is displayed as a dendrogram and the groups of forests defined were applied to the ordination diagram.

The demarcated forest patches on the arial photographs were transfered onto orthofilm t phoographs. This facilitated the use of a digitizer to enter the forest patches into the Geographical Information System (G.I.S.) which gave the areas (m^2) of each patch. Unfortunatly, forest patch 61 (Fig. 1) was not digitized and was therefore excluded from the species area regression.

RESULTS

Forest Map and Size Distribution

Figure 1 shows the locations and identity numbers of the 68 forest patches that were sampled on Table Mountain. The largest forest patch (8) has an area of 858 121m^2 or 85,8 ha. The smallest forest patch (47) is 585m^2 or 0,06 ha. Total forested area is estimated at 3 651 511m^2 or 365,2 ha, which makes up approximately 13,5% of the total area of Table Mountain Nature Reserve. 55% of all the forest patches are smaller than 1 ha and of these, 72% occur on the northern and western facing slopes of the mountain (Fig. 2). Of the 31 forest patches larger than 1 ha, 29 of them occur on the wetter, southern and eastern facing slopes.

The total area of the forests on north- and west-facing slopes (38-68) is 233 614m^2 which makes up only 6.4 percent of the total forested area. Forests in the Orange Kloof area (17-37) make up 32,5 percent of the total forested area while forest patches 4,5,6 and 8 in Newlands and Kirstenbosch account for 53 percent.

Species-Log Area Regressions

Log-area versus species number is plotted for each forest patch (Fig. 3). Area accounts for 64% of the variation in species number between all the forest patches (see mean regression line, Fig. 3). However, a separate regression line for the 30 patches occurring on the northern and western slopes of the mountain has a coefficient of determination of only 0,27, i.e. 27% of the variation in species number can be accounted for by area. The 37 wetter forest patches on the southern and eastern slopes of the mountain maintained a relatively high coefficient of determination of 0,66.

A test of the significance of difference between the slopes and intercepts of the dry and wet regression lines (Zar, 1984) indicated that the intercepts were significantly different from each other ($t = 2.664$; $df = 64$; $p < 0.01$). The slopes were not significantly different from eachother.

Canonical Correspondence Analysis

Environmental Variables

The site (forest patch) - environment biplot (Fig. 4) shows the relations of the 68 forest patches and the 12 environmental variables with the ordination axes. The direction of greatest variation in each environmental variable is indicated by an arrow. The length of the arrow indicates the relative importance of the variable in determining the axes; the angle between an arrow and its closest axis is an inverse measure of their correlation (ter Braak,1987).

Canonical and correlation coefficients (Table 1) indicate that moisture explains much of variation along the horizontal axis or axis 1. Moisture is strongly positively correlated with south aspect and, to a lesser degree, with the presence of rivers and east aspect. Correlation coefficients for axis 1 (Table 1) indicate that these four variables (moisture, south aspect, east aspect and rivers) are strongly negatively correlated with western and northern aspects. The vertical axis can be related to substrate type, notably TMS and scree. The extent to which forest patches occur on scree slopes with a TMS substrate is negatively correlated with forests occurring on granite. Alien and human disturbance may also be related to the vertical axis. Area is the least important variable and is not strongly correlated with any of the other variables. Thus moisture and substrate type are apparently the most important correlates of forest species distribution on Table Mountain.

The arrows for environmental variables in Figure 4 account, in conjunction with the species points, for 80,9% of the variance in the weighted averages of the 40 species with respect to the 12 environmental variables, the sum of the eigenvalues being 0,588. The ranked environmental variables are sufficient to explain a major part of the variation among the species distributions within Table Mountain.

Twinspan Analysis and Ordination Diagrams

The 68 forest samples were divided hierarchically using the TWINSPAN alogorithm (Hill, 1979) so as to provide forest groupings (Fig. 5) that would facilitate groupings on the biplot (Fig. 6).

With a few exceptions, the first dichotomy separates forests on the north- and west-facing slopes of the mountain from those on the south- and east-facing slopes. This split is clearly shown in the biplot (Fig. 4) with respect to the horizontal axis. The exceptions, or borderline forests, as indicated by TWINSPAN, are 40, 53, 55 and 18, to which I have added 42, 39 and 41. The borderline nature of these forest patches is indicated by their fairly isolated distributions on the ordination diagram (Fig. 4).

Figure 7 shows the distribution of 40 forest species with respect to the same environmental variables as in Figure 4. The positive preferentials as indicated by TWINSPAN at the first dichotomy (groups C and D on Fig. 5), were *Euclea racemosa*, *Phylica buxifolia*, *Clutia pulchella*, *Maytenus heterophylla*, *Maytenus oleoides* and *Olea africana*. These species are all grouped in the bottom right-hand quadrat of the species-environment biplot, correlating strongly with drier northern and western aspects.

Four groups, A, B, C and D, present at the second dichotomy of TWINSPAN (Fig. 5) are applied to the forest patch-environment biplot (Fig.6). Forest communities in group A occur predominantly on moist scree slopes that are mostly undisturbed by humans or alien invasions. According to TWINSPAN, some species closely associated with this general forest type include *Adodytes dimidiata*, *Podocarpus latifolius*, *Maytenus accuminata* and *Hartogiella schinoides*. These species are distributed in the bottom left-hand quadrat of the species-environment biplot (Fig. 7).

Forest communities in group B are correlated with granite and alien and human disturbance. The indicator species for this group are *Canthium inerme*, *Grewia occidentalis*, *Scutia myrtina* and *Canthium mundianum*. These species, together with the other positive preferentials for the group are distributed above the horizontal axis. The positions of *Brabejum stellatifolium*, *Celtis africana*, *Scolopia mundii* and *Rhoicissus tomentosa*, are more likely to be correlated with granite than with disturbance. The association of *Virgilia oroboides*, as a classical pioneer species, with disturbance is appropriate.

It is also worth noting that this group includes almost all the large forests. Appendix 1 indicates that the rarer speices, positioned in the top left-hand quadrat (Fig. 7), are largely restricted to the larger forest patches.

The forest communities of group C are highly correlated with north- and west-facing slopes and occur on dry, scree slopes (Fig. 6). *Clutia pulchella*, the most important indicator for this group is also correlated with the northern and western aspects (Fig. 7). The other indicators *Diospyros whyteana* and *Halleria lucida* are close to the origin which might indicate that they are generalist species with little preference for any of the environmental variables. The other indicator *Maytenus acuminata* positioned in the bottom left-hand quadrat of the biplot indicates that the forests in group C are more highly correlated with TMS scree slopes than group D. Forest patch 18 is an outlier.

Group D represents the smallest and most species-poor forests which occur on dry northern and western aspects. The positioning of forests above the horizontal axis within this group indicates correlations with both disturbance, and granite or shale substrates. Forest patch 44 is grouped together with forest patches 61, 68 and 67 by the TWINSPAN alogarithm (Fig. 5). However, it seperates out from the group quite distinctly on the ordination diagram (Fig.6) Species closely associated with group D include *Canthium mundianum, Euclea racemosa, Grewia occidentalis* and *Virgilia oroboides*. The positions of *Virgilia oroboides, Grewia occidentalis* and *Canthium mundianum* on the biplot (Fig. 7) indicate correlations with a granite substrate and disturbance. *Euclea racemosa* is strongly correlated with dry north- and west-facing slopes.

Table 1 attempts to correlate the occurrence and abundances of species on Table Mountain with their growth form, structure and whether they are sensitive to fire. The vast majority of the most common species on Table Mountain are not killed by fire, and have a multi-stemmed structure. The rarer or less widespread species tend to be single-stemmed and fire prone. The percentage occurrence of species in the wetter or first 37 forests also corroborates the positioning of species on the ordination (Fig. 7). Common species tend to be clustered around the origin. Those species that have less than 50% occurrence in wet forests are positioned in the bottom right-hand quadrat of the biplot (Fig. 7). While rarer species with 100% occurrence in the wetter forests are positioned in the top left-hand quadrat of the biplot.

DISCUSSION

Forest Locality and Size Distribution

I think that the overriding factor determining the size and distribution of forests on Table Mountain is TMS scree. Only 4 out of the 68 forests were entirely unassociated with scree slopes. They are forests 15,16,67 & 68 which occur on granite substrates at low altitudes (Fig 1). The most likely reason for the close association of forests with scree is the sparseness of inflammable material occurring on scree. However, increased moisture and nutrients in scree could also be possible factors contributing to the association of forests with scree (Moll, pers. comm.)

Unlike some southern Cape forests (van Daalen, 1981), I do not believe that fire has reduced the size of the forests on Table Mountain. Thus, since fire has been the major disturbance factor in fynbos, the forest-fynbos ecotone has been largely determined by the presence of scree slopes (McKenzie,1978 ; Masson,1990). Van Daalen (1981) suggested that for six southern Cape forests, in the absence of fire, soil moisture was the most important factor limiting the spread of forest into fynbos. Masson and Moll (1987) studied the factors affecting the colonisation of fynbos in Orange Kloof (Table Mountain). This valley has not been burnt for more than 55 years and has shown a 50% increase in forest size since 1945 (Luger & Moll, submitted). Masson and Moll (1987) concluded that edaphic factors such as parent rock material, degree of rockiness and soil nutrient status influence the rate of colonisation of an area. They did suggest, however, that a possible factor limiting the spread of forest into fynbos when fire was excluded was the lack of perch facilities for birds in fynbos,thus limiting seed dispersal.

The size of most of the forests on Table Mountain can be correlated with the size and continuity of a scree slope. This can probably be correlated with the extent of the TMS cliffs above the forests from which the scree slopes are derived. I think the primary reason why Afromontane forests are often associated with ravines is not because of the increased moisture, but because this is where the build up of scree slopes is most common. However, the differences in the floristics and structure of forests associated with exposed scree slopes and those situated in sheltered ravines can be dramatic.

Species-Area Curves

Explanations for the relationship between species number and area are diverse and highly contraversial (Connor & McCoy, 1979).

The forest patch size distribution on Table Mountain presents a problem for the interpretation of the species-area curve. The mean species-log area regression may be a coincidence because the smaller patches on the north- and west- facing slopes may support fewer species, not because of area, but because of the moisture gradient that exists across Table Mountain. In other words, moisture or some other factor may be exerting a stronger influence on species distributions than area itself. For this reason, I created two separate species-log area regressions, one for 30 forest patches occurring on the northern and western side of the mountain (hereafter referred to as dry forests), and another for the remaining 37 patches occurring on the southern and eastern side of the mountain (hereafter referred to as wet forests).

The fact that the intercepts between wet and dry forest regressions are significantly different suggests that the dry forests are poorer in species. An explanation for the large difference in the species-log area correlation coefficients between wet and dry forests is open to speculation.

The simplest explanation for the species-area correlation is that as area increases so the diversity of habitats included in an area will increase, incorporating more species. This hypothesis is likely to explain a large part of the species-log area regressions for the mean and wet regression lines. However, if habitat diversity is important in explaining species-log area regressions, we can infer that there is little or no correlation between the number of habitat types and area in the 'dry' forests. This may be true because the range of forest sizes are not large enough to incude the full variety of habitat types.

The predictions of MacArthur and Wilson's (1967) equilibrium theory would suggest that the dry forests represent non-equilibrium communities, while the wet forests are closer to equilibrium. Why or how could this be a valid explanation? In terms of this theory, the answer lies in differential rates of colonisation and extinction of forest species within and between the wet and dry forests. Forest species that are killed by fire may become locally extinct in forest patches that are prone to being burnt. Small forest patches that are surrounded by fynbos are more prone to fire than larger patches. Charcoal remnants were commonly observed in the forest patches on northern and western aspects, while charcoal was usually only evident on the margins of the larger forests. The low canopy height of many of the dry forests also increases the ability of a fire to burn through them. Further , the build up of dead and dry material is much greater in these dry forests because decomposition rates are slower. Thus, fire would seem to be an important factor in either preventing the colonisation of, or eliminating, fire prone species from small forest patches situated on exposed slopes.

How does this explain the poor species-area correlation for dry forests? Some of the smallest forest patches, containing more than 10 species , for example 47, 48 and 59 (see Fig. 3) are situated on rocky outcrops or scree slopes and appeared to be completely protected from fire, while other, larger patches supporting less than 10 species, e.g. 60, 67 and 68 and 57 are prone to fire.Forest patches 67 and 68 were recently burnt in the Devil's Peak fire. Thus it would appear that the rates of local extinctions vary to a greater degree between the dry forest patches as compared with those of the wet forest patches. Or, even if the wet forests did burn, their relatively large size would increase the chance that some part would be saved.

What about colonisation? The main factors that limit the colonisation of a species are dispersal and environmental factors. I have not correlated species number with distance from the mainland pool, because I believe that environmental factors are more important. I will now explore the contention that environmental variables can explain the distribution of forest species on Table Mountain.

X

Ordination Diagram and Twinspan Analysis

In the ordination diagram, the main direction of variation occurs along the horizontal axis which can be interpreted as a moisture gradient. This environmental variable can be regarded as the major determinant of forest community composition on Table Mountain. The vertical axis can be seen as a substrate type and disturbance gradient, with forest patches below the horizontal axis being associated with scree slopes and those above the horizontal axis being associated with granite or shale derived soils and disturbance. A possible explanation as to why disturbance should correlate strongly with granite is altitude. Low altitude forests often occur on gentle slopes with deep, rich soils with a high clay (derived from granite and/or shale) content. The high accessibility of the low altitude forests makes them more prone to exploitation. In the past, all eastern slopes and the Orange Kloof area down to Hout Bay were forested. These were exploited by the first settlers in the Cape and have since been replaced by non-indigenous trees (Campbell & Moll, 1977).

Further, rock cover may be low and the build up of organic soil may be high, especially on moist south- and east-facing slopes. Thus, the availability of establishment sites for aliens such as oaks, pines, poplars and gums is high. Higher up, where the percentage rock cover is often much greater, alien trees are relatively rare. I attribute the alien infestation of Groote Schuur Estate to the sparseness of scree slopes and the rich clay soils, derived from Malmesbury shale, in the area.

If the groupings of the forests made up by the TWINSPAN algorithm match up closely with groups on the ordination diagram, we can infer that the environmental variables are in fact responsible for the differences between the forest communities. Of interest, then, are the outliers, or those patches which are grouped together by TWINSPAN but are spread apart on the ordination diagram. Also, examining the position of forest patches, identified by TWINSPAN as borderline forests, on Figure 6, will help explain why they are borderlines.

The most distinct outlier on the ordination diagram is forest patch 44 of group D (see Fig. 6), which is grouped together with forest patches 61, 68 and 67 by TWINSPAN (see Fig. 5). Forest patch 44 lies near the top of Woody Ravine and occurs on a fairly gentle scree slope (Fig. 1). Forest patches 61, 68 and 67 occur on shale and granite, and are disturbed by aliens. They are related to each other on the basis of high abundance of *Kiggelaria africana* and *Olea europea* subsp. *africana*. Patch 44 has a high abundance of *Podocarpus latifolius*; a single young specimen of this tree was found in patch 61, but it was probably planted there. These forest patches are separated out on the ordination diagram on the basis of substrate type and disturbance. Another more probable reason for their being grouped together is their very low species numbers (see Fig. 3).

Still in group D, forest patch 54 is separated out on the ordination diagram and singled out by TWINSPAN at the fourth dichotomy (Fig. 5). This is probably as a result of its association with a stream and subsequent occurrence of species like *Cunonia capensis* and *Podalyria* *calyptrata*, which are absent from the other patches in group D. *Cunonia capensis*, a moisture loving species, was the indicator for patch 54.

Group C has a spread of forests on the ordination (Fig. 7) that correlates well with the TWINSPAN dendrogram (Fig. 6). Forest patch 18, a borderline forest recognised at the first dichotomy, is surrounded by tall pine plantations on a steep western facing slope in the Orange Kloof area. Its association with a stream and shading from the pine forest makes it a moist forest. It is separated out from the other scree slope forests at the fourth dichotomy on the basis of the absence of *Maurocenia frangularia*.

Forest patch 50 is a small forest occurring just below the Table Mountain shale band on a north-facing slope. I attribute its position on the ordination to its small species number of 10, as opposed to 20 and 21 for patches 38 and 43 respectively, with which it is grouped.

The high species richness associated with many of the forests in group B (e.g. 4, 5, 8, 30 and 31) appears to correlate with moisture, rivers and granite derived, clay rich soils. Rare species such as *Rhoicissus tomentosa, Celtis africana, Scolopia mundii, Brabejum stellatifolium* and *Ocotea bullata* (Fig. 7) are also associated with these variables and can explain the high species richness of these forests. Forest patches 15, 16, 13, 14, 6 and 7 (Fig. 6) all occur at relatively low altitudes and have all been subject to alien tree invasions as well as human exploitation in the past.

The position of borderline forest patches 55 and 53, recognised at the first dichotomy of the TWINSPAN dendrogram, on the ordination diagram can be explained by their northern and western aspects and subsequent dryness. Their situation in the relatively moist Blinkwater Ravine (Fig. 1) probably explains why they fall within group B. The presence of *Maurocenia frangularia*, a species that is almost entirely restricted to exposed scree slopes (Campbell & Moll, 1977; McKenzie, 1978) separates these forests out from the rest of group A. The species composition of patch 40, also recognised as a borderline forest to group B, is probably best explained in terms of the mass effect (S~~c~~hmida & Wilson, 1985). Although this patch occurs on a north-west-facing slope, it is situated alongside patch 41 (Fig. 1) which is on a relatively moist, south-west-facing slope. Species occurring in patch 40 may have been dispersed across from patch 41 and are not maintaining their population here. Forest patch 41, a borderline forest of group A, may act as an important source of species that are rare or absent from the drier forests on this side of the mountain. Forest patch 39, a misclassified forest of group A, is grouped together with patch 41 and also occurs in a sheltered ravine.

The three patches in group A that occur on the western side of the mountain (41, 42 and 39) are situated in sheltered ravines. Also, these forests are the nearest ones, on this side of the mountain, to the forests of Orange Kloof. This suggests that their species composition may be influenced by their distance from the Orange Kloof forests, which may act as a source of rarer and probably fire sensitive species.

The indicator species at the splits below the second division were often either species associated with moist conditions such as *Cunonia capensis*, *Ilex mitis* or *Brabejum stellatifolium* or species commonly axssociated with drier conditions such as *Maytenus heterophylla* and *Maurocenia frangularia*. This supports the contention that moisture is a major determinant of forest community composition on Table Mountain.

Forest Structure and Dynamics

Although my results do not convey conclusive information on the structure and dynamics of various forest types, I would like to suggest some possible differences that may exist between forest communities or groups defined by the ordination diagram. These ideas are discussed in the light of current theory on forest regeneration dynamics. It is hoped that these ideas may form hypotheses which can be tested by analysing my data collected on the DBH plots on Table Mountain.

Recent work on tropical forest dynamics emphasises the importance of the regeneration niche for determining the distribution and abundance of forest species. Some or most trees require gaps or openings in the forest canopy for successful establishment and maturation (Denslow, 1986; Hubbell & Foster, 1986). Thus, to understand the species composition of a forest one needs to understand the gap dynamics (i.e. their size, frequency, shape and rate at which they fill). The gap and regeneration dynamics of forest trees on scree slopes is likely to be very different from those on substrates where rock cover is low and soil depth is high. Masson (1990) has stated that species composition and substrate availability can determine the regeneration dynamics of different forest communities. This is because in forests where rock cover is very high, the availability of establishment sites is very low, with the reverse being true in forests where rock cover is low. This is reflected in the low number of seedlings found inside scree forests. Masson (1990) suggested that a static state existed within scree forests because the older individuals were no longer replaced by younger saplings. The question is, how long can a single recoppicing individual survive?

It is generally believed that multistemmedness is a consequence of burning or damage to the sapling or seedling (Scholtz, unpublished). However, some species such as *Cunonia capensis*, *Cassine peragua* and *Olinia ventosa*, appear to recoppice after their initial single stem has died, and in some cases maintain coppice shoots which apparently "wait" for gaps in the canopy into which they grow. I believe that over hundreds and possibly even thousands of years, the number of stems increase until the soil resource : light gradient is saturated. Competition would play an important role in regulating this process.

This has led me to believe that the degree of multistemmedness in a forest can either be an indication of past fire disturbance, or an indication of the successional age of that forest or both. What are the implications of this for forest community composition? In scree forests where regeneration via seedlings and saplings is low, recoppicing species should come to dominate in the canopy. This may ultimately lead to scree forests being species poor, through competitive exclusion of single-stemmed reseeding species. However, this does not end in the static state envisioned by Masson (1990) because as the forests age so does the accumulation of humus and organic rich soil. If the scree slope is not too deep, and the forest is in a moist place, organic soil may accumulate to the extent that the rock cover decreases and the availability of sapling establishment sites increases.

At this stage in the succession, the moisture content of the soil and the gap dynamics of the forest in question should determine the colonisation and establishment of new species into the forest. However, because most trees die standing (pers. obs., Geldenhuys & Maliepaard, 1983) and uprooting is virtually impossible on stable scree, the size of the gaps in scree forests tend to be relatively small. Thus, lateral ingrowth of multistemmed species seems to be the more predominant way of closing canopy gaps. In a hemlock-hardwood forest in Massachusetts, Hibbs (1982) estimated, by comparing rates of height growth with rates of lateral ingrowth by canopy trees, a critical gap size which determined whether gaps would be filled by lateral ingrowth or regenerating saplings. This suggegsts that species with differential growth rates and structures should have differential abilities to fill gaps, which could manifest itself in rather discrete species associations.

To summarise these speculations, I would predict that multistemmed forests, which could be a consequence of fire disturbance or successional age, should support fewer species than single stemmed forests occurring in similar environments. Further, the differences in floristics and species number between these two forest types should become more significant as the percentage rock cover increases. The analysis of growth form, life history attributes, and structure of co-occuring tree species in my 107 DBH plots may reveal finely tuned patterns in support of some of the theories of competition and coexistence in plant communities.

CONCLUSION

These results have categorised the forests into four main groups. The differences between these groups is explained in terms of differences in moisture conditions, substrate type and human or exotic plant disturbance. The species-area correlation that exists for the wet forests is probably best explained in terms of the habitat diversity hypothesis. However, the poor species-log area regression that exists between the dry forests may be explained by differential rates of colonisation and extinction between these forest patches because of their relatively small size, dramatic differences in moisture conditions, and differing degrees of vulnerability to fire.

The significantly lower number of species associated with the dry forests is best explained by the moisture gradient that exists across Table Mountain. However, fire may also be important for explaining the virtual absence of fire prone species on this side of the mountain.

The distributions and abundance of species is conveyed by their positioning on the ordination diagram. The more rare species tend to occur further away from the origin and correlate with the environmental variables with which they are mostly associated. For example, we can infer that *Podocarpus latifolius* and *Apodytes dimidiata* are restricted to relatively moist scree slopes; *Maurocenia frangularia* and *Cussonia thyrsiflora* are restricted to dry scree slopes; and *Brabejum stellatifolium* and *Scolopia mundii* are associated with granite derived substrates. Species positioned around the origin tend to be the most widespread and common species. These species also tend to be resprouters as well as reseeders and some of them are commonly multistemmed.

These results provide valuable information for the management and conservation of forests and forest species on Table Mountain by identifying which species and which forest types require conservation more than others. Alien trees and shrubs remain the biggest threat to indigenous forest, especially at lower altitudes where the soil is rich and deep and sapling establishment is important for forest regeneration. The results also provide a good basis around which to plan more detailed studies of forest structure and dynamics on Table Mountain.

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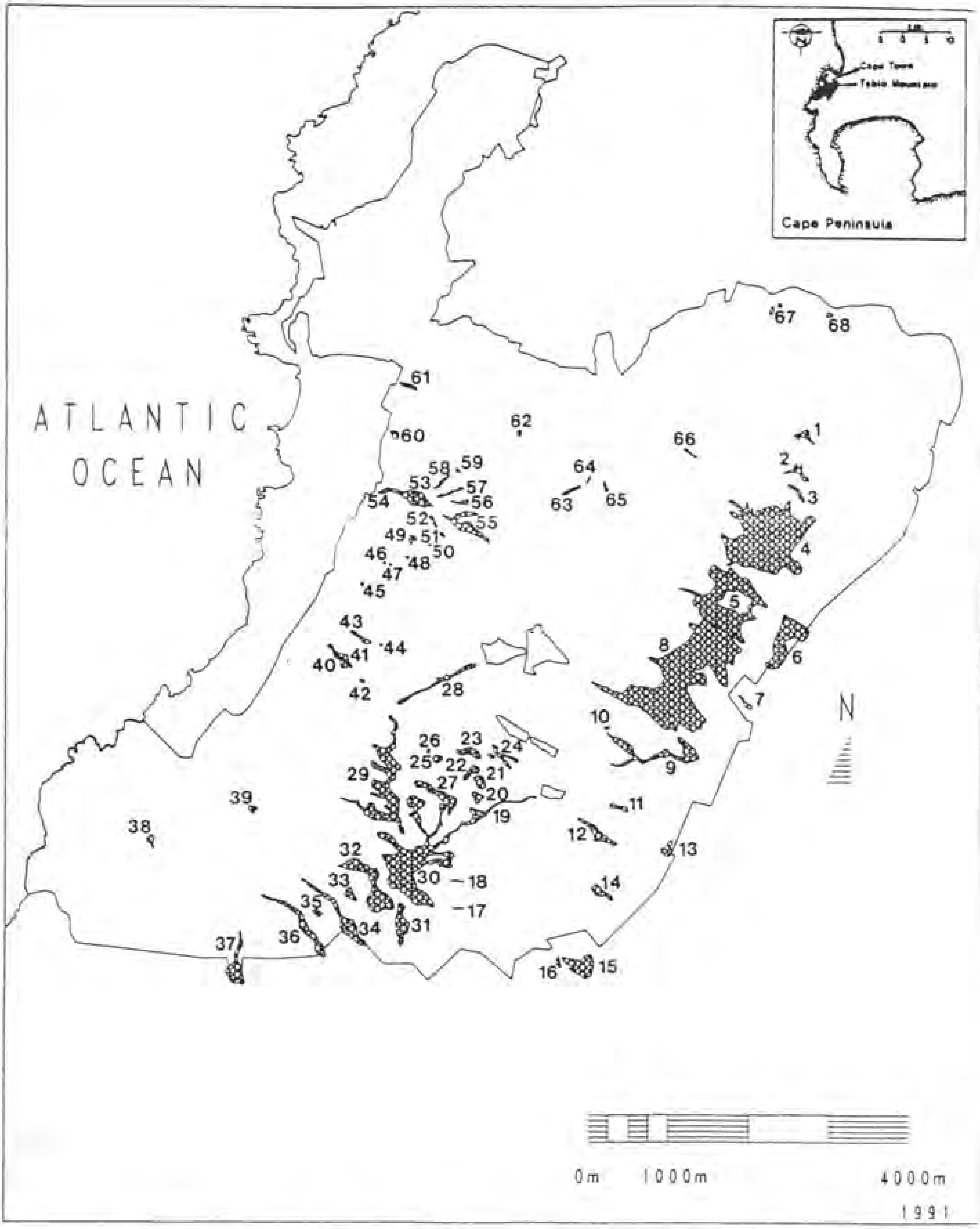

Figure 1: Map of Table Mountain showing location and identity numbers of the 68 forest patches. Forests are numbered in order starting from First Waterfall Ravine. The two forest patches around Wynberg Caves received only one number (24), as well as the two forest patches designated 67.

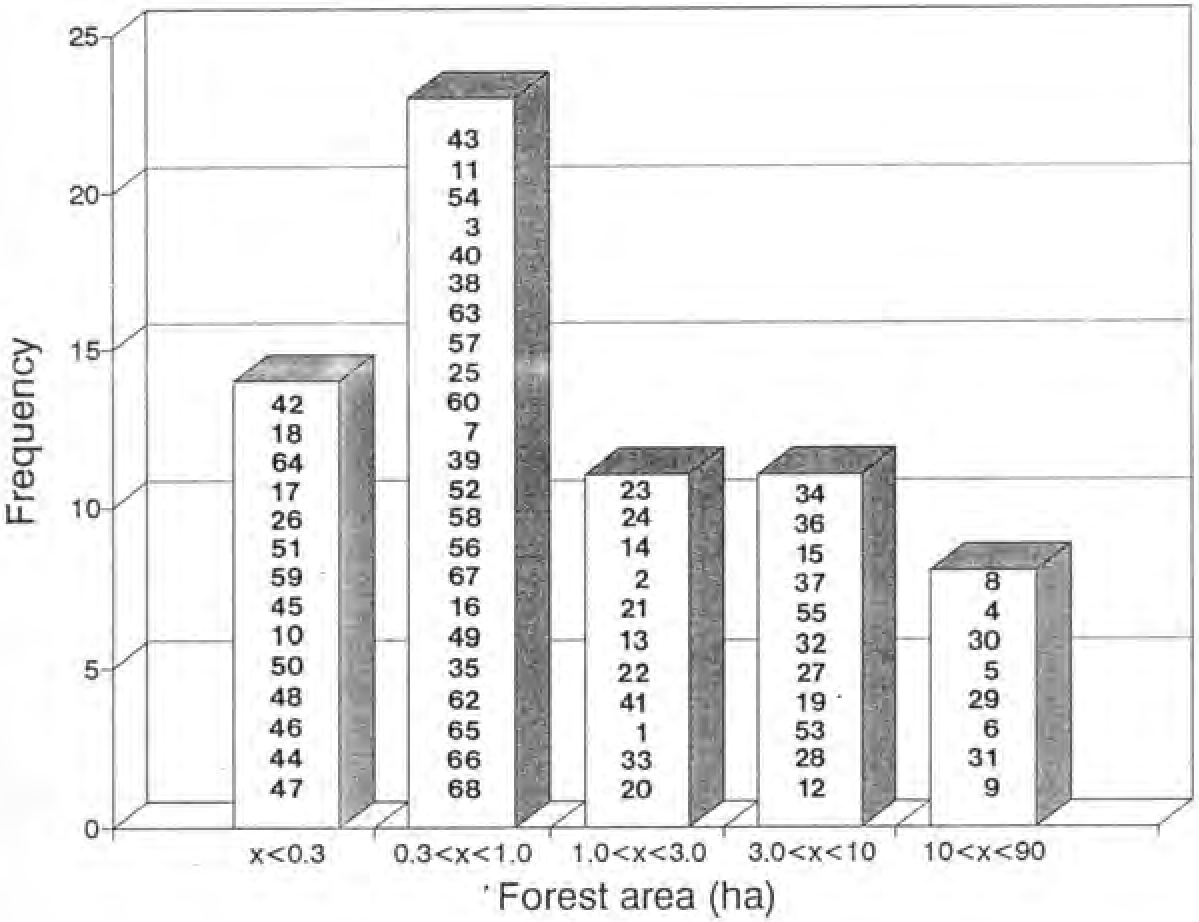

Figure 2: The size frequency distribution of 67 forest patches on Table Mountain. The size classes increase on a log scale. Forest patch numbers are shown in the bar graphs in order of increasing size from bottom up.

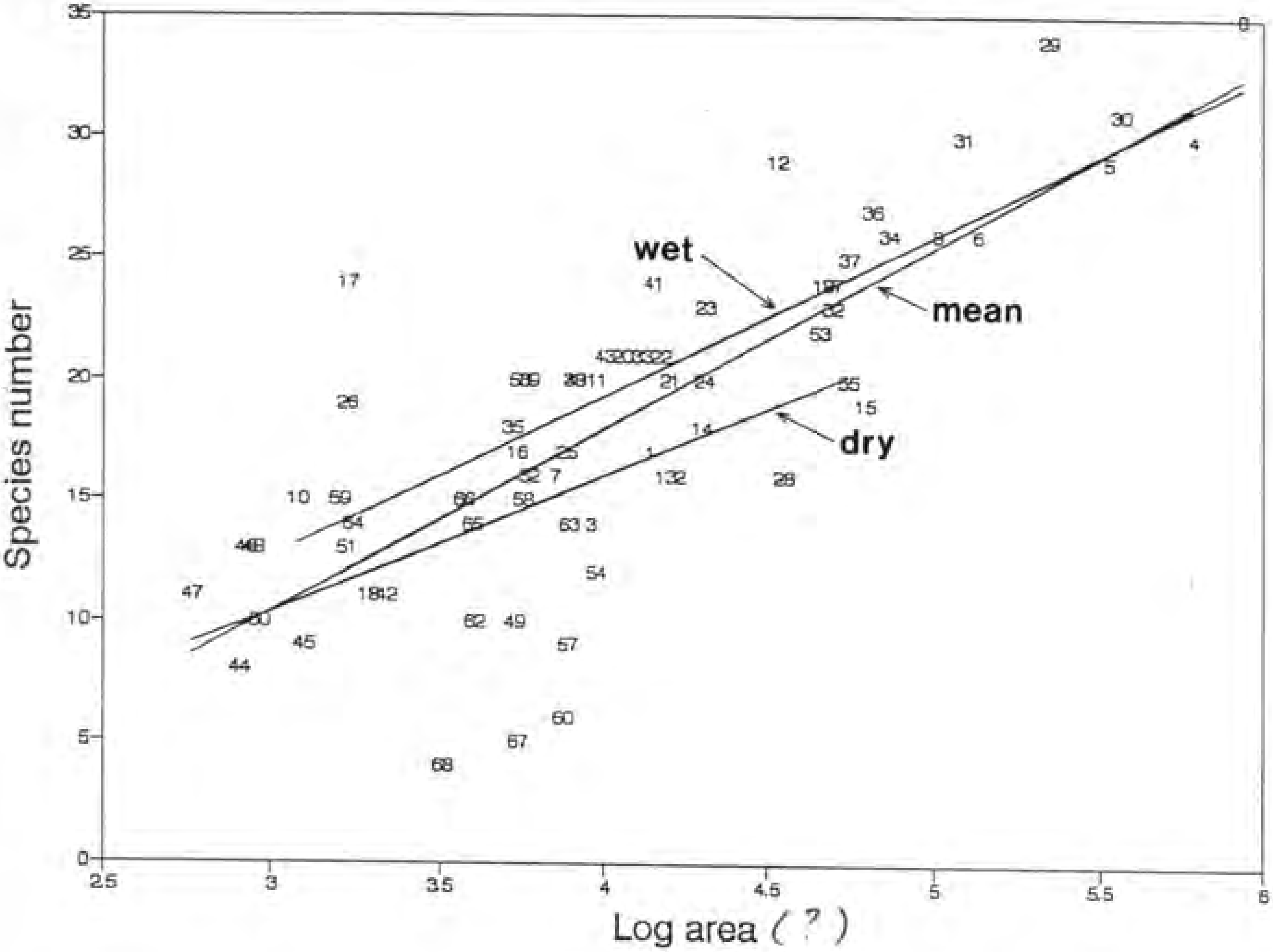

Figure 3: Log area against species number for 67 forest patches on Table Mountain. Numbers represent forest patches. The 'mean' regression line is for all 67 forests (df = 65, $r^2 = 0.644$, $y = 7.56x + 12.3$). The 'wet' regression line is for the first 37 forest patches which occur on wetter slopes (df = 35, $r^2 = 0.655$, $y = 6.67x + 7.4$). The 'dry' regression line is for the remaining 30 forest patches on the dry western and northern slopes (df = 29, $r^2 = 0.269$, $y = 5.63x + 6.5$). See text (section on results) for significance of difference between the slopes and intercepts of the dry and wet regression lines.

Table 1: The canonical and correlation coefficients, axis 1 and 2, for the 12 environmental variables analysed by CCA.

	Canonical coeff.		Correlation coeff.	
Environmental variables	Axis 1	Axis 2	Axis 1	Axis 2
Area	0.63	0.75	0.77	0.86
Moisture	-518	-127	-905	176
North aspect	-27	-11	522	-217
South aspect	-103	-40	-653	76
East aspect	63	130	-426	546
West aspect	61	-7	558	-118
Disturbance	3	81	-145	694
River	-5	73	-507	380
Scree	-140	-119	-63	-631
Granite	-6	164	-288	763
Shale	60	4	437	8
TMS	45	-7	-139	-539

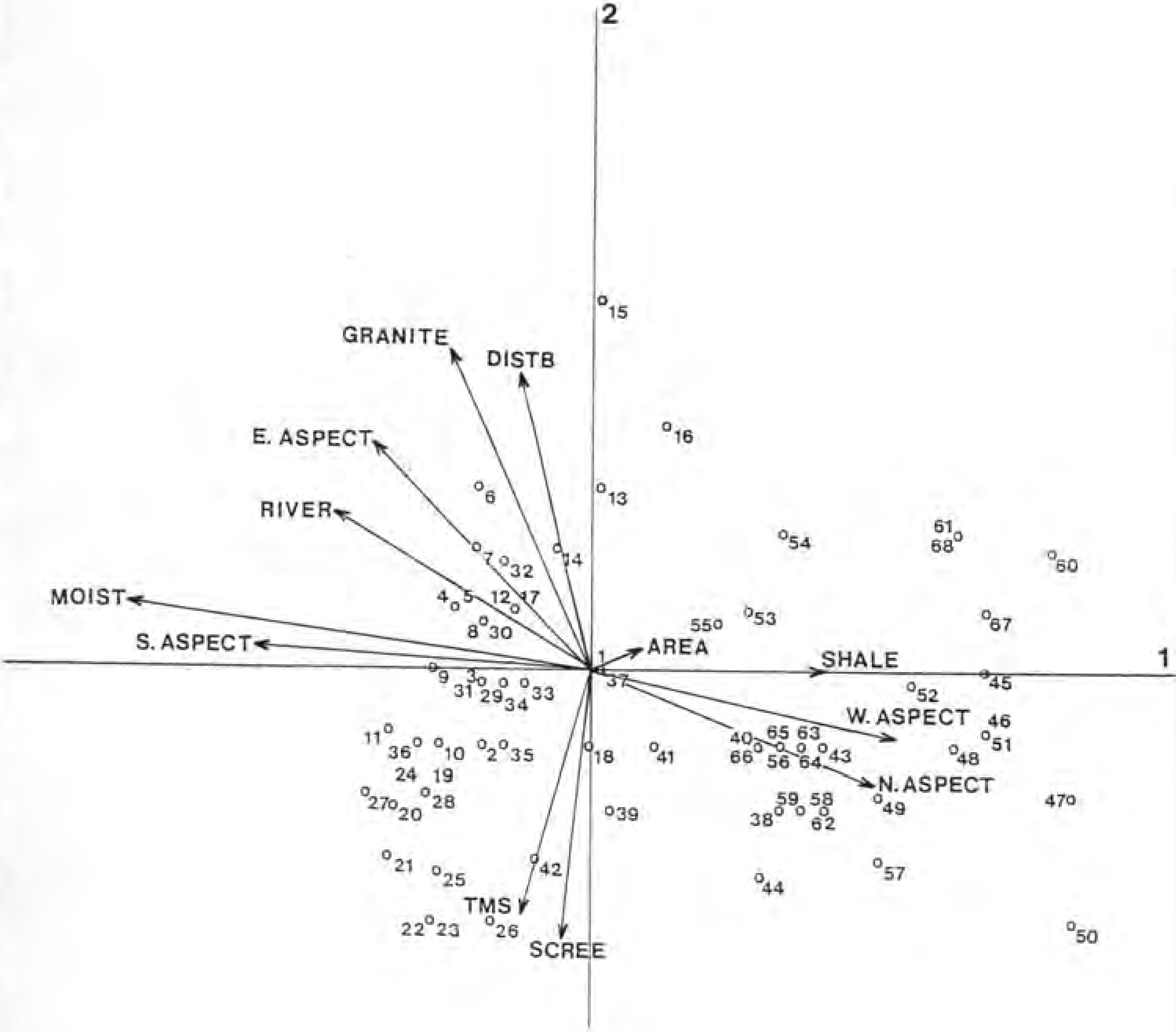

Figure 4: Ordination diagam, axis 1 and 2, of a Canonical Correspondence Analysis (CCA) of forest community and environmental data of 68 forest patches on Table Mountain. Numbers represent forest patches or sites. In some cases 2 or 3 forests occur on the same point (O). Arrows indicate the direction of maximum change of a site variable and length indicates the strength of correlation with ordination axes. RIVER = presence or absence of riverine forest; MOIST = moisture; DISTB = human and exotic disturbance.

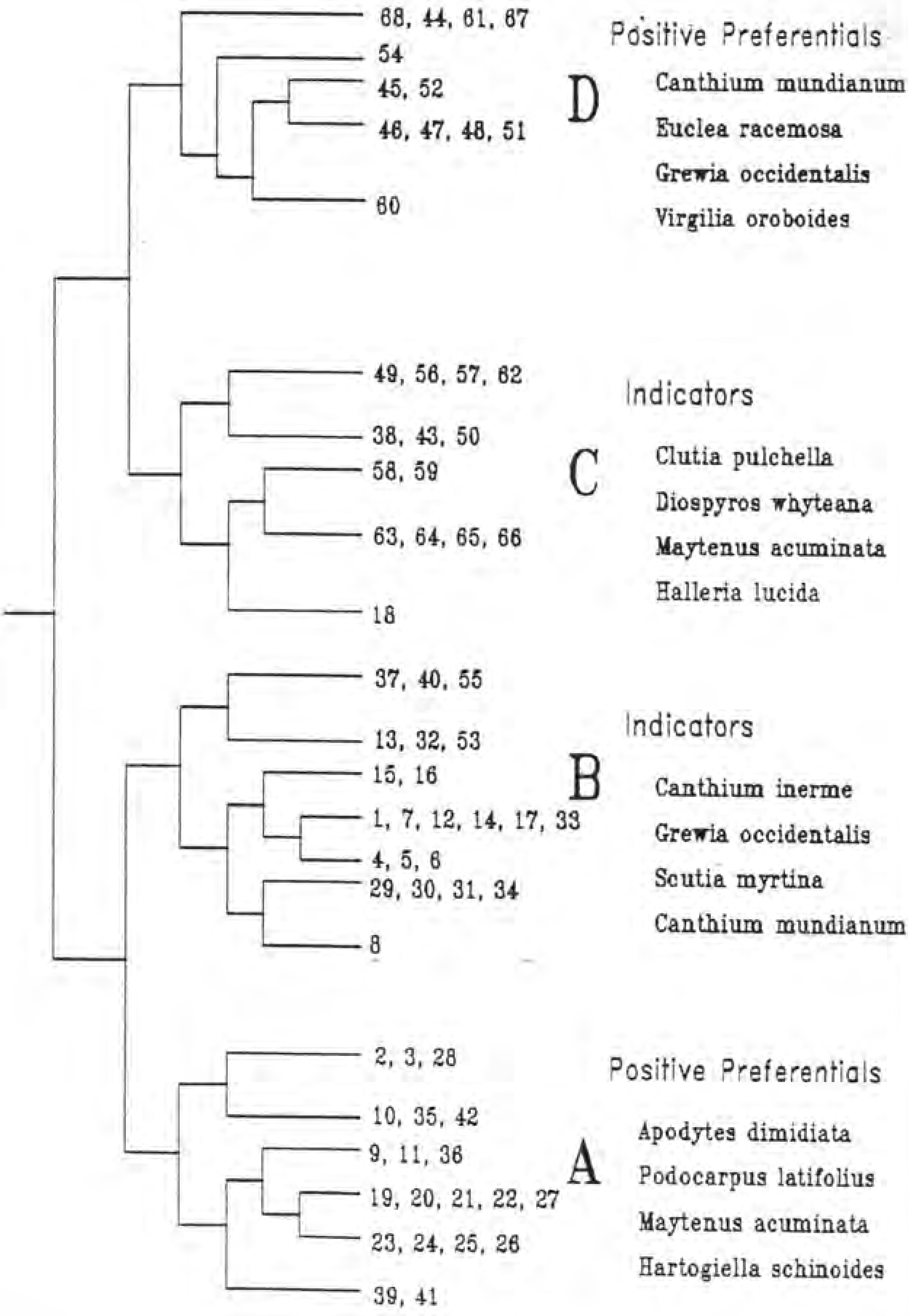

Figure 5: Dendrogram for a hierarchical classification for the 68 forest communities using the TWINSPAN algorithm. Four major community series are recognised at the second dichotomy (represented by A, B, C and D). Indicator and positive preferentials are given for each group.

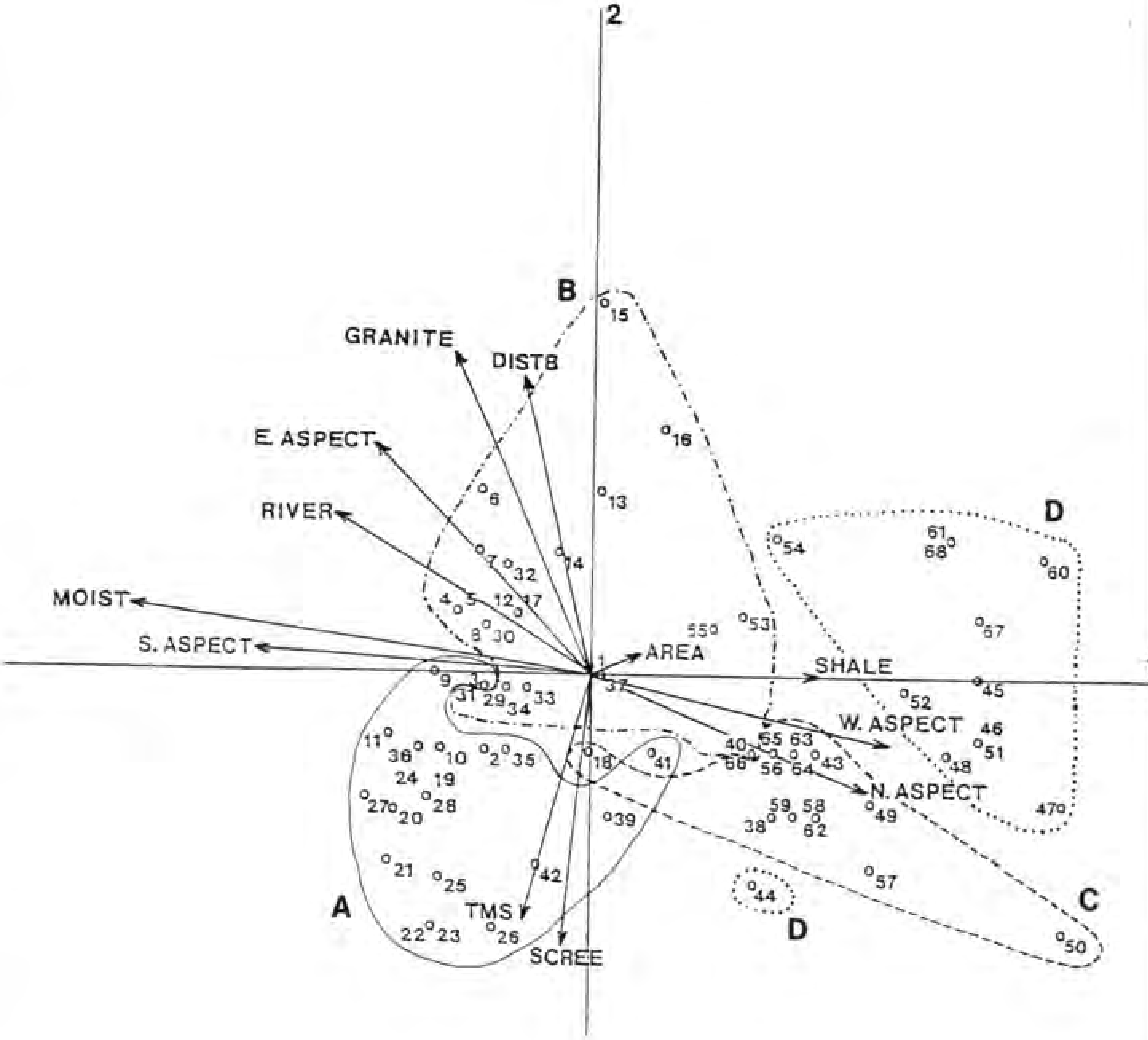

Figure 6: Same as Figure 4, with groups A, B, C and D derived from the TWINSPAN algorithm (Fig. 5).

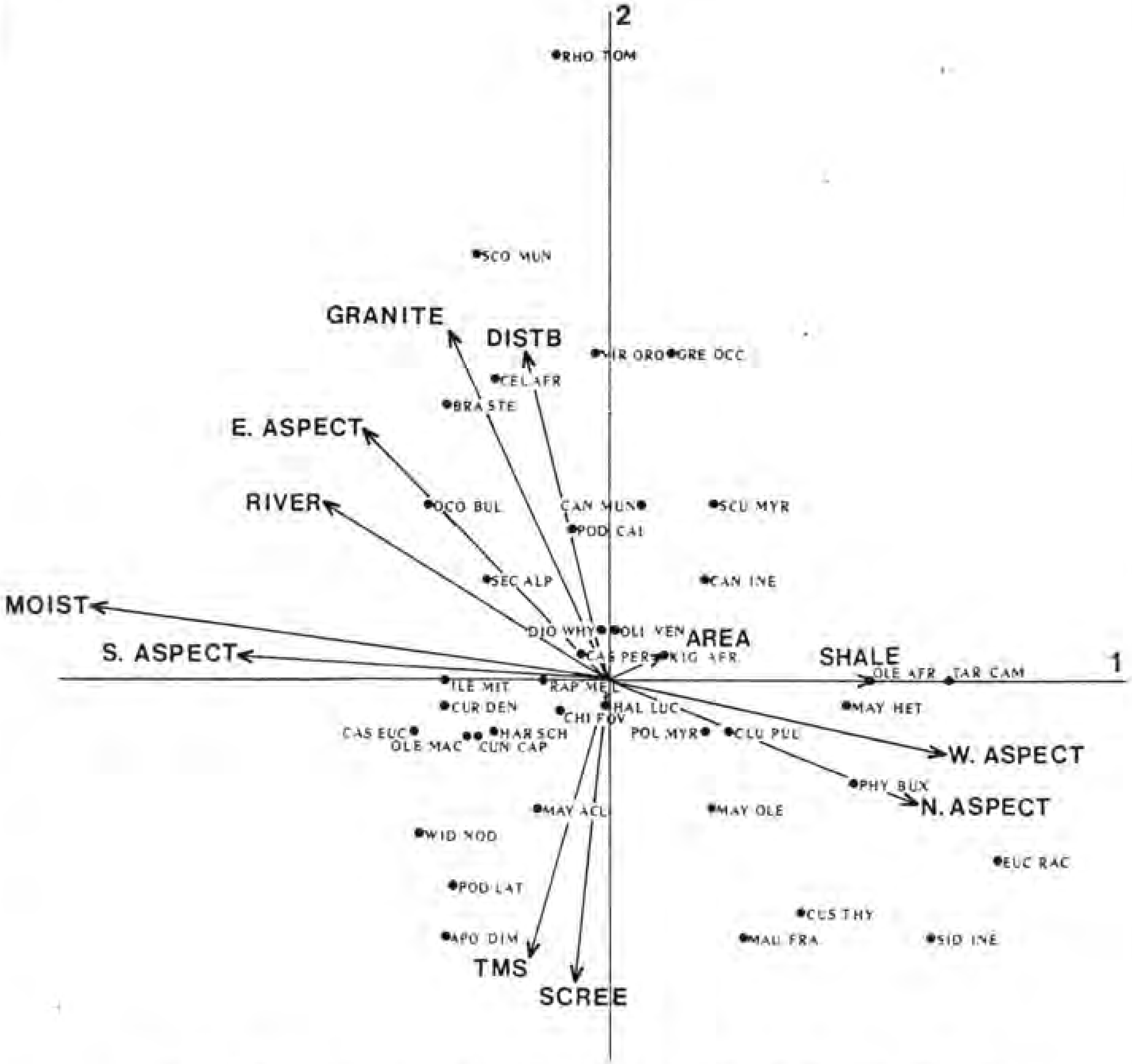

Figure 7: Ordination diagram, axis 1 and 2, of the same CCA as for Figure 4, showing the distribution of the 40 species sampled. KIG AFR = *Kiggelaria africana*; CAS PER = *Cassine peragua*; OLE AFR = *Olea europea* subsp. *africana*; MAY OLE = *Maytenus oleoides*; RAP MEL = *Rapanea melanophloeos*; HAL LUC = *Halleria lucida*; CLU PUL = *Clutia pulchella*; POL MYR = *Polygala myrtifolia*; OLI VEN = *Olinia ventosa*; DIO WHY = *Diospyros whyteana*; CUN CAP = *Cunonia capensis*; CAN INE = *Canthium inerme*; MAY ACU = *Maytenus acuminata*; MAU FRA = *Maurocenia frangularia*; HAR SCH = *Hartogiella schinoides*; OLE MAC = *Olea capensis* subsp. *macrocarpa*; MAY HET = *Maytenus heterophylla*; CAN MUN = *Canthium mundianum*; POD LAT = *Podocarpus latifolius*; CUR DEN = *Curtisia dentata*; CUS THY = *Cussonia thyrsiflora*; ILE MIT = *Ilex mitis*; POD CAL = *Podalyria calyptrata*; CHI FOV = *Chionanthus foveolatus*; PHY BUX = *Phylica buxifolia*; APO DIM = *Apodytes dimidiata*; SCU MYR = *Scutia myrtina*; SEC ALP = *Secamone alpini*; GRE OCC = *Grewia occidentalis*; VIR ORO = *Virgilia oroboides*; WID NOD = *Widdringtonia nodiflora*; SCO MUN = *Scolopia mundii*; OCO BUL = *Ocotea bullata*; CAS EUC = *Cassine eucliformis*; EUC RAC = *Euclea racemosa*; TAR CAM = *Tarchonanthus camphoratus*; RHO TOM = *Rhoicissus tomentosa*; BRA STE = *Brabejum stellatifolium*; SID INE = *Sideroxylon inerme*; CEL AFR = *Celtis africana*.

Table 2: Species list in order of occurrence and abundance values for 68 forest patches on Table Mountain (columns 1 and 2). Columns 3 and 4 are percentages of occurrence and abundance of species in the first 38 patches (see Fig. 1 for location of patches).

Key to other information in the table: GROWTH FORM: 1 = canopy tree; 2 = sub-canopy tree; 3 = woody shrub; 4 = creeper; STRUCTURE: 0 = single stemmed; 1, 2, 3 = species ranked according to degree of multistemmedness in Table Mountain forests; FIRE: Y = plants killed by fire; N = plants not killed by fire (i.e. resprouters).

SPECIES	% OCCURRENC	ABUND.VALU	% OCC WET	% ABUN.WE	GROWTH FO	STRUCTUR	FIRE
Kiggelaria africana	94.1	113.2	57.8	58.5	1	1	Y ?
Cassine peragua	82.4	87.8	66.1	74.8	1	3	N
Olea europea sub africana	80.9	79.1	45.5	17.8	1	3	N
Maytenus oleoides	80.9	49.4	58.2	44.3	1	1	N
Rapanea melanophloeos	79.4	111.3	68.5	80.0	1	2	N
Halleria lucida	79.4	78.2	68.5	69.3	1	3	N
Clutia pulchella	79.4	48.5	59.3	43.3	3	3	N
Polygala myrtifolia	73.5	35.1	60.0	47.3	3	1	Y
Olinia ventosa	70.6	85.1	68.8	65.3	1	3	N
Diospyros whyteana	70.6	84.1	75.0	69.1	2	1	N
Cunonia capensis	64.7	78.4	70.5	89.3	1	3	N
Canthium inerme	61.8	56.9	61.9	67.3	2	2	N
Maytenus acuminata	61.8	54.8	69.0	74.1	2	0	Y
Maurocenia frangularia	57.4	56.9	38.5	34.4	1	2	N
Hartogia schinoides	57.4	48.5	79.5	87.6	1	3	N
Olea cap. sub macrocarpa	55.9	58.6	86.8	91.1	1	2	N
Maytenus heterophylla	52.9	37.6	38.9	22.9	1	2	N
Canthium mundianum	51.5	44.7	51.4	50.6	2	0	Y
Podocarpus latifolius	48.5	46.5	84.8	90.8	1	1	Y
Curtisia dentata	45.6	43.3	96.8	95.4	1	2	N ?
Cussonia thyrsiflora	45.6	15.3	38.7	23.5	4	0	N ?
Ilex mitis	44.1	36.2	93.3	95.9	1	0	Y
Podalyria calyptrata	44.1	19.7	90.0	82.2	3	0	N
Chionanthus foveolatus	42.6	33.2	79.3	77.4	2	1	N
Phylica buxifolia	42.6	25.3	27.6	17.8	3	1	?
Apodytes dimidiata	36.8	30.3	88.0	94.7	1	0	Y
Scutia myrtina	33.8	20	65.2	57.5	4	1	N ?
Secamone alpini	32.4	22.6	90.9	93.4	4	1	N ?
Grewia occidentalis	26.5	7	77.8	71.4	4	1	N ?
Virgilia oroboides	25.0	17	76.5	88.2	1	0	Y
Widdringtonia nodiflora	25.0	8.2	94.1	98.8	1	0	N
Scolopia mundii	17.6	7.9	100.0	100.0	1	3	N
Ocotea bullata	13.2	3.9	100.0	100.0	1	1	Y
Cassine eucliformis	10.3	8.2	100.0	100.0	2	0	Y ?
Euclea racemosa	10.3	3.5	0.0	0.0	3	1	N
Tarchonanthus camphoratus	8.8	3.1	0.0	0.0	1	1	N
Rhoicissus tomentosa	7.4	6	100.0	100.0	4	0	N ?
Brabejum stellatifolium	7.4	4.5	100.0	100.0	1	1	N
Sideroxylon inerme	2.9	1.1	0.0	0.0	1	2	N
Celtis africana	1.5	0.1	100.0	100.0	1	0	Y

Appendix 1: Spreadsheet of species abundance ranking sorted in order of species occurrence and abundance (columns), and forest patch size (rows). ABU.VAL = abundance value by addition. OCCUR = the number of forests out of 67 in which each species occurs.

		PATCH NO	47	44	46	48	50	10	45	59	51	26	17	64	18	42	68	66	65	62	35	49	16	67	56	58	52	39	7	60	25	57	63	38	40	3	54	11	43	20	33	1	41	22	13	21	2	14	24	23	12	28	53	19	27	32	55	37	15	36	34	9	31	6	29	5	30	4	8
		LOG AREA	2.8	2.9	2.9	2.9	3.0	3.1	3.1	3.2	3.2	3.2	3.2	3.2	3.3	3.3	3.5	3.6	3.6	3.6	3.7	3.7	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.9	3.9	3.9	3.9	3.9	3.9	4.0	4.0	4.0	4.0	4.1	4.1	4.1	4.1	4.2	4.2	4.2	4.2	4.3	4.3	4.3	4.5	4.5	4.7	4.7	4.7	4.7	4.7	4.7	4.8	4.8	4.9	5.0	5.1	5.1	5.3	5.5	5.6	5.8	5.9
SPECIES	ABU.VAL	OCCUR																																																																		
Cel afr	0.1	1																																																																	0.1
Sid ine	1.1	2			0.1																														1																																			
Bra ste	4.5	5																																																											1		2		0.5		0.5	0.5
Rho tom	6	5																				1																																			3					0.5		1			0.5
Tar cam	3.1	6																								0.1			0.5				1			0.5		0.5				0.5																											
Euc rac	3.5	7	0.5		0.5	0.5	0.5																				0.5												0.5														0.5																
Cas euc	8.2	7																																														2						0.1					2			2		1		1		0.1
Oco bul	3.9	9																																												0.1		0.1		1											1		0.5	0.1	0.5		0.1	0.5
Sco mun	7.9	12											1																0.5																			1			0.5								2			0.1	0.1	0.1	1	0.1	1	0.5	
Wid nod	8.2	17										0.5	0.1																		0.5							0.5	0.1	0.5				0.5		0.5				0.5	1			0.5	0.5					0.5		0.5			0.5		0.5		0.5
Vir oro	17	17															0.5												0.5								0.5		0.5						2						1		0.5			3			1			0.5	0.5	1	0.5	0.5	0.5	1	3
Gra occ	7	18							0.5				0.1										0.5				0.5		0.1	0.5												0.1						0.5			0.1		0.5			0.1		0.5	0.5				0.5		0.5		0.5	0.5	0.5
Sec alp	22.6	22						0.5					0.5																0.5					1				0.5					0.5	1				1			2				0.5	0.1		1		2	2	0.5	2	0.5	1	0.5	2	1	2
Sou myr	20	23															0.5						1	1				0.5						1	2						0.5	0.5	0.5					1			2		2				1	0.5	0.5	0.5	0.5			0.5	1	0.5	1	0.5	1
Apo dim	30.3	25										3	0.1															2			3				0.1					2	0.1		0.5	3		2	1		1	2				1	2			0.5	1	1	S		2		1	0.5	1	0.5	S
Phy bux	25.3	29	0.5		1	0.5	1		0.5	0.1	0.5		0.5	2	0.5			4	2						0.5	0.1	1					0.1	2	0.5			1		1			0.5	1								1		1	0.5	0.5		0.5								0.5		0.5		
Chi fov	33.2	29										0.5	0.5			0.5													0.5					2	0.5			0.1	0.5	1			2	1		1				0.5	1		2	0.5	0.5	0.1		3		3	2	1	2	0.5	2	0.5	2	0.5	2
Pod cal	19.7	30											0.5		0.5								0.5								0.5					0.5	1	0.5			0.5			0.5	2				0.5	0.1	1		2	0.5	0.5	0.1	0.5	0.5	0.5	1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	1
Ile mit	36.2	30																			0.5				0.5						2					2		3		2	2	0.1			0.5	1	2	1	2		2	2	1	1	1	0.5		0.1		1	1	2	0.5	1	0.5	1	1	1	1
Cus thy	15.3	31	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	0.1							0.1	2		2			0.5	0.5		0.5						0.5	0.5				0.5	0.5			0.5	0.5		0.5			0.1	0.5				0.1	0.1		0.1			0.1			0.1		0.5				0.5
Cur den	43.3	31						2					0.5								0.1		0.1						1									2		2	2	1	2	0.5		2	1	1		1	3	1		2	2	0.5		0.1		2	1	3	1	0.5	1	2	1	2	3
Pod lat	46.5	33		2				2				3				2					0.5				0.1			0.1			3				0.1					1	0.5	0.1		3	0.1	2			3	3	1	1		0.5	2	2		0.5		3	1	2	2	0.5	1	1	1	0.5	2
Can mun	44.7	35	0.5	0.5	2	0.5					1		0.5							2		3	1		2		2	1				0.5		0.5	1		0.5		0.1		2	0.5			2		0.5	3			2		2			0.1	3	0.5	3		1		3		1	0.5	1	0.5	0.5
May het	37.6	36	0.5		0.5	0.5	3		0.5	3	1											2	0.5	0.5	3	3	2	0.5		1		0.5		1	2	0.5			1		0.5	0.5	0.5				0.5						2			0.1	1	2	0.5		0.5		1		0.5		0.5	0.5	0.5
Ole cap	58.6	38						1				2	1			1		0.1			1							3	0.1		2					0.1		2		2		0.5	1	2	1	2	0.1	0.5	2	1	3	1		1	3	0.1	0.1	3		3	1	2	1	2	2	3	2	3	3
Har sch	48.5	39						2		1		1	2	0.5	1			1			3		0.5			1		0.5			1		0.5	1				3		1		0.5	0.5	2		1	1	2	2	2	2	1		0.5	2				0.5	2	0.5	3	0.5	0.5	1	1	1	1	1
Mau fra	56.9	39	0.5	0.5	0.5	1	2			1	1	2		0.1		1		0.1	0.5	3		3			2	1	2	3			2	2	0.1	3	3				3	0.5			2	3		2			2	3		0.5		0.5			2	2		0.5	0.5		0.1		0.5				0.5
May acu	54.8	42						0.5		0.5		2	0.5	0.5		2		0.1	1		3				2	0.5		2			2		0.5	2	1			3		1	1			1		2	0.5		2	1	1	1	0.1	1	1	0.1	2	3		3	1	3	1	0.5	2	0.5	1	1	1
Can ine	56.9	42	0.5		0.5	1		1			0.5	0.5	2					2	0.1		0.5		1		1		1	1	2	2					1		1	0.1	1		1		1		3		0.1	2			2		3	0.1		2	2	3	2	1	1	2	1	2	2	1	2	1	3
Cun cap	78.4	44						3		2			2	0.1	3			1	0.5		4				1	1		1	3		3		0.1			2	0.5	4	0.1	2	3	2	0.5	1		3	2		2	3	2	3	0.5	3	3	0.5	0.1	0.5		2	1	3	1		1	2	1	2	3
Dic why	84.1	48					0.5	3				0.5	1	4				3	3	2	1		2		2				0.5		2		4	0.5	2	0.5		1	1	0.5	2	3	2	0.1	2	0.5	1	2	0.5	0.5	3	1		0.5	0.5	0.5	2	1	2	2	1	4	1	4	3	3	3	2	3
Oli ven	85.1	48				1					1	2	0.5						1	3	0.5	3	1		2		2	3	2		0.5			1	2	0.5	0.5	1	2	2	1		2	2	3	0.5	1	3	0.5	0.5	3		2	0.5	2	0.1	4	3	3	2	2	2	2	0.5	2	3	3	3	3
Pol myr	35.1	50	0.5		0.5	0.5			0.5	2	0.5	0.5	0.5	2					0.5	1	0.5			0.5	0.5	2	0.5				0.5		2	0.5	0.5			0.5	1	0.5	0.5	1	0.5	0.5	1	0.5	0.5	0.5	0.5	0.1	1	0.5	2	0.5	0.5		0.5		0.5	0.5	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Clu pul	48.5	54		0.5			1			2	0.5	0.5	0.5	1	0.5			4	2	2	0.5	2			0.5	2	0.5	3.5	0.5		0.5	3	1	0.5	0.5	0.5	0.5	0.5	1		1	1	0.5	0.5	1		0.5	1	0.5	0.5	1	0.5	1	0.5	0.5	0.5	1	0.5		1	0.5	1	0.5	0.5	0.5	0.5	0.5	0.5	2
Hal luc	78.2	54				0.5		1		1		0.5	1	1	3	2		1			2	3	0.5		3	1	1	2	0.1		1	1	1		1	1		2	1	1	2	3	0.5	2	2	1	1	2	3	1	2	1	3	2	1	2	1	0.5	0.1	2	1	2	1	2	1	2	0.5	1	3
Rap mel	111.3	54		0.5	0.5		0.1	2		1		3	2	0.1	1	3		1			4		1		1	1		2	2		3		0.1	1	3	2		3	1	1	3	2	2	2	2	2	2	3	3	2	3	2	3	3	2	3	2	2	3	3	2	3	3	2	2	3	3	2	3
May ole	49.4	55	0.5		0.5	0.5	1	0.5	0.5	2	0.5	2	1	1	1	0.5		3	1	0.5	0.5	3	0.1		2	2	1	0.5			2	3	1	0.5	0.5	0.1		1		0.5	0.5	1	0.5	0.5	1	0.5	0.5			0.5	1		2	0.5	0.5	0.1		1		0.5	0.5	1	0.5	0.5	1	0.5	0.5	0.1	0.5
Ole afr	79.1	55	2	2	1	2	0.5	0.5	2	2	3			3	1	1	3	1	1	3	2	3	1	3	3	2	3	2		4		1	3	2	2	0.1	0.5		3	0.5	0.5		2				0.1				0.5	0.5	3	0.1	0.1	0.1	2	1	1	0.5	0.5	0.5	0.5	0.5	0.5	1	0.5	0.1	0.5
Cas per	87.8	56						2	0.1	1	0.5	1	2	2	0.5	0.5			0.5	3	2		2		0.5	1	1	1	0.1		2		2	1	0.5	0.5	0.5	1	3	2	2	2	2	1	1	2	1	3	1	1	2	0.5	1	0.5	2	0.1	1	3	3	3	3	3	3	0.5	2	3	3	2	3
Kig afr	113.2	64	0.5	2	0.5	1		3	2	1	0.5	2	1	2	2	2	3	1	0.5		3	3	2	3	3	1	2	4	2	1	2	3	2		1	2	1	3	1	0.5	2	4	1	1	1	0.5	2	3	3	2	3	1	3	0.5	0.1	2	2	0.1	1	2	0.5	2	2	2	1	2	1	2	3
SPECIES NUMBER			11	8	13	13	10	15	9	15	13	19	24	14	11	11	4	15	14	10	18	10	17	5	20	15	16	20	16	6	19	9	14	20	20	14	12	20	21	21	21	19	24	22	16	20	21	18	20	21	29	16	22	25	25	23	20	25	19	27	26	26	30	26	34	29	31	30	35

Appendix 2: List of species excluded from the analysis.

SPECIES
Cassine maritima
Colpoon compressum
Erica caffra
Myrsine pillansii
Noltia africana
Olea exasperata
Pterocelastrus rostratus
Pterocelastrus tricuspidatus
Rhus tomentosa
Rhus lucida
Rhus angustifolia

Appendix 3: Environmental data for 68 forest patches on Table Mountain used for the Canonical Correspondence Analysis.

PATCH NO.	AREA	MOIST	N.ASP	S.ASP	E.ASP	W.ASP	DISTB	RIVER	SCREE	GRANIT	SHALE	TMS
1	3	2	0	1	1	0	1	1	3	0	3	1
2	3	3	0	1	1	0	1	1	2	1	1	1
3	2	3	0	1	1	0	3	1	2	1	1	1
4	5	3	0	1	1	0	2	1	3	2	1	2
5	5	3	0	1	1	0	2	1	3	1	1	2
6	5	3	0	1	1	0	3	1	2	2	1	2
7	2	3	0	1	0	0	3	1	1	2	0	1
8	5	3	0	1	1	0	1	1	2	2	1	3
9	5	3	0	1	1	0	0	1	3	1	0	1
10	1	3	0	1	0	0	0	1	3	0	0	3
11	2	3	0	1	1	0	1	1	3	1	0	2
12	4	3	0	1	1	0	2	1	2	1	0	2
13	3	3	0	0	1	0	2	1	1	1	0	1
14	3	3	0	1	1	0	2	1	1	3	0	1
15	4	3	0	1	1	0	2	1	0	3	0	0
16	2	2	0	0	1	0	2	0	0	3	0	0
17	1	3	0	1	0	1	1	1	1	2	0	1
18	1	3	0	0	0	1	2	1	1	2	0	1
19	4	3	0	1	0	1	0	1	3	1	0	2
20	3	3	0	1	0	0	0	1	3	0	0	2
21	3	3	0	1	0	0	0	0	3	0	0	3
22	3	2	0	1	0	0	0	0	3	0	0	2
23	3	3	0	1	0	0	0	0	3	0	0	3
24	3	3	1	0	0	0	0	1	3	0	0	3
25	2	3	0	1	0	0	0	0	3	0	0	3
26	1	3	0	1	0	0	0	1	3	0	0	3
27	4	3	0	1	0	0	0	1	3	1	0	2
28	4	3	0	1	0	1	1	1	2	1	0	2
29	5	3	0	1	1	0	0	1	3	2	1	2
30	5	3	0	1	1	0	2	1	3	2	1	2
31	5	3	0	1	1	0	1	1	3	1	0	2
32	4	3	0	1	0	0	3	1	3	1	2	2
33	3	3	0	0	1	0	0	1	3	1	0	2
34	4	3	0	1	1	0	1	1	3	1	1	2
35	2	3	0	1	1	0	2	1	2	1	1	2
36	4	3	0	1	1	0	0	1	3	1	1	2
37	4	2	0	1	1	0	1	1	3	1	1	2
38	2	1	1	0	0	0	0	0	3	0	1	3
39	2	2	0	0	0	1	0	1	3	0	1	2
40	2	1	1	0	0	1	0	0	2	0	2	1
41	3	2	0	1	0	1	0	0	2	0	2	2
42	1	2	1	0	0	1	0	0	3	0	0	3
43	2	1	0	1	0	1	1	0	3	0	3	2
44	1	2	1	0	0	1	0	0	3	0	0	3
45	1	1	0	0	0	1	1	0	2	2	0	1
46	1	1	0	0	0	1	0	0	3	0	0	3
47	1	1	0	0	0	1	0	0	3	0	0	3
48	1	1	0	0	0	1	0	0	3	0	1	2
49	1	1	1	0	0	1	0	0	3	0	2	1
50	1	1	1	0	0	0	0	0	2	0	3	1
51	1	1	1	0	0	1	0	0	3	0	1	2
52	2	1	1	0	0	1	0	0	3	0	0	3
53	4	1	0	0	0	1	0	1	3	1	1	2
54	2	1	0	0	0	1	1	1	2	2	0	2
55	4	2	1	0	0	1	0	1	3	0	2	2
56	2	2	0	1	0	1	0	1	3	0	2	2
57	2	1	0	1	0	1	0	1	3	0	2	2
58	2	1	0	1	0	1	0	1	3	0	1	2
59	1	2	0	0	0	1	0	1	2	0	3	2
60	2	1	0	0	0	1	3	0	1	3	0	1
61	1	1	0	0	0	1	3	1	1	3	0	1
62	2	1	1	0	0	0	0	0	3	0	0	3
63	2	1	1	0	1	0	0	0	3	0	0	3
64	1	1	1	0	0	0	0	0	3	0	2	2
65	2	2	1	0	0	1	0	1	2	0	1	2
66	2	1	1	0	0	1	1	0	3	0	1	2
67	2	1	1	0	0	0	2	0	0	0	3	1
68	2	1	1	0	0	0	3	0	0	0	3	1