



Figure 1. The Flora of Southern Africa (study) area.

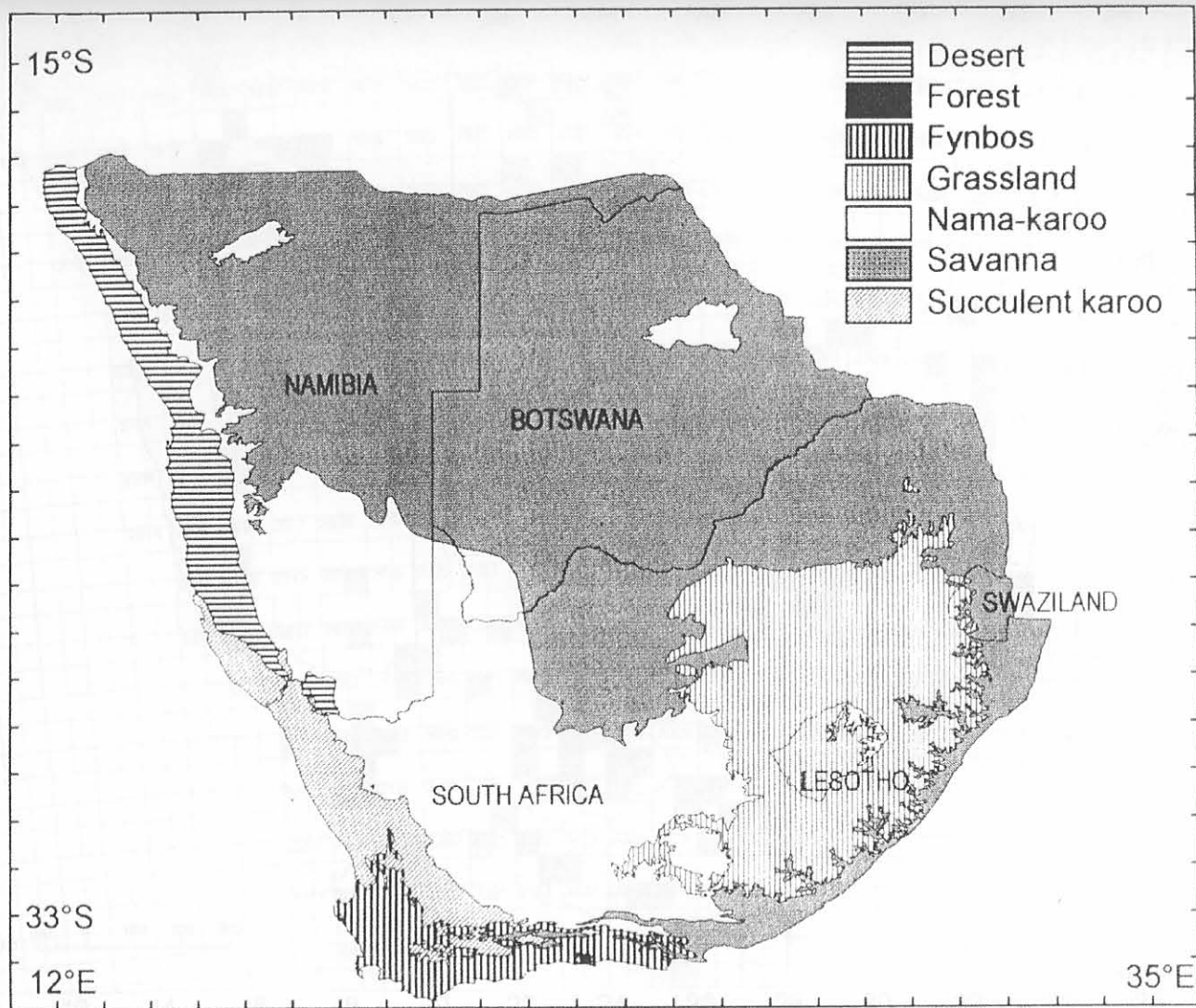


Figure 2. The Biomes of southern Africa according to Rutherford & Westfall (1986) and Rutherford (1997).

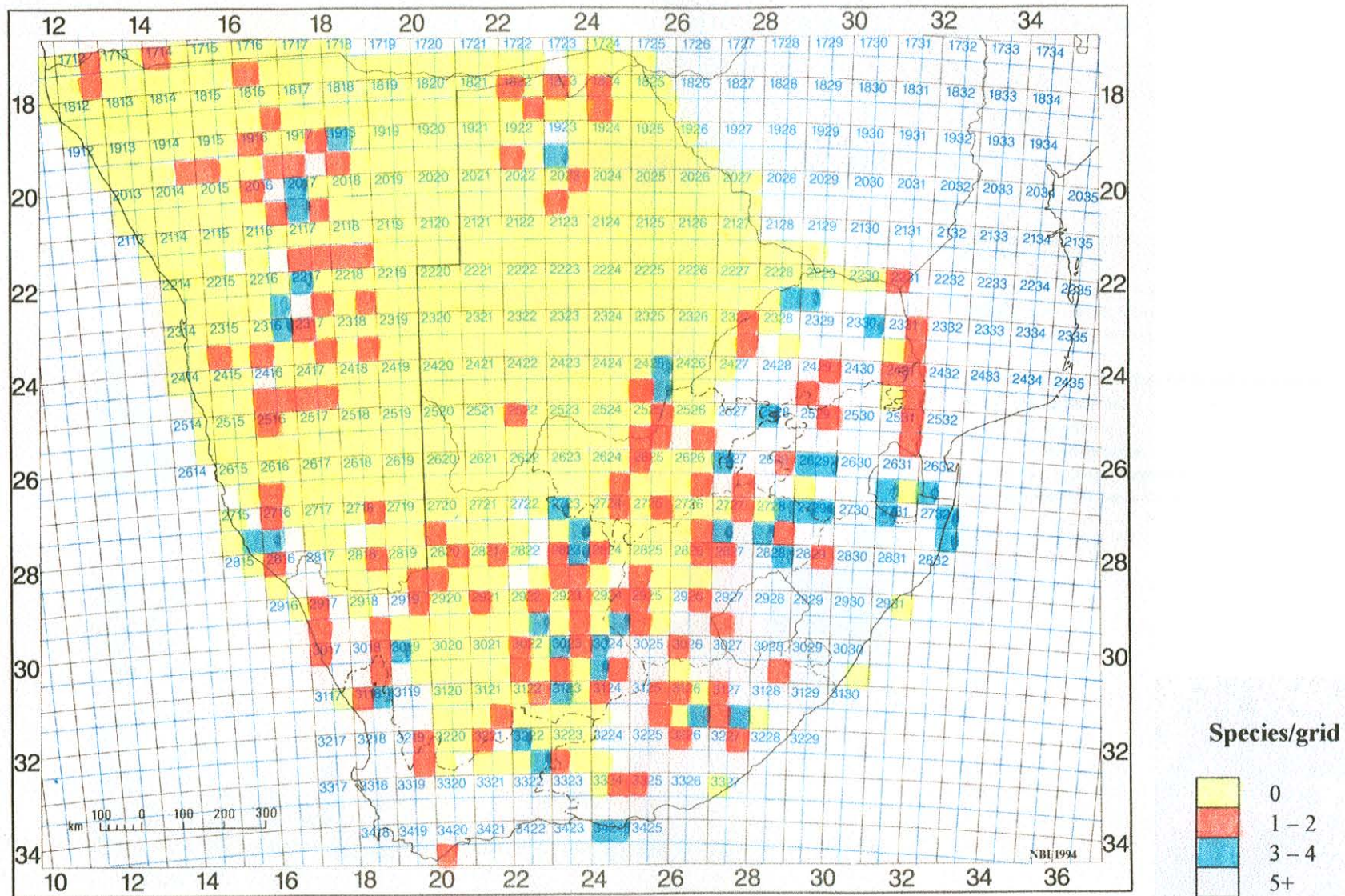


Figure 3. The geographic area in southern Africa from which less than five species/intraspecific taxa has been recorded. This figure also shows the grid squares omitted for the TWINSpan 3+ (1 - 2) and TWINSpan 5+ (1 - 2 plus 3 - 4) data sets.

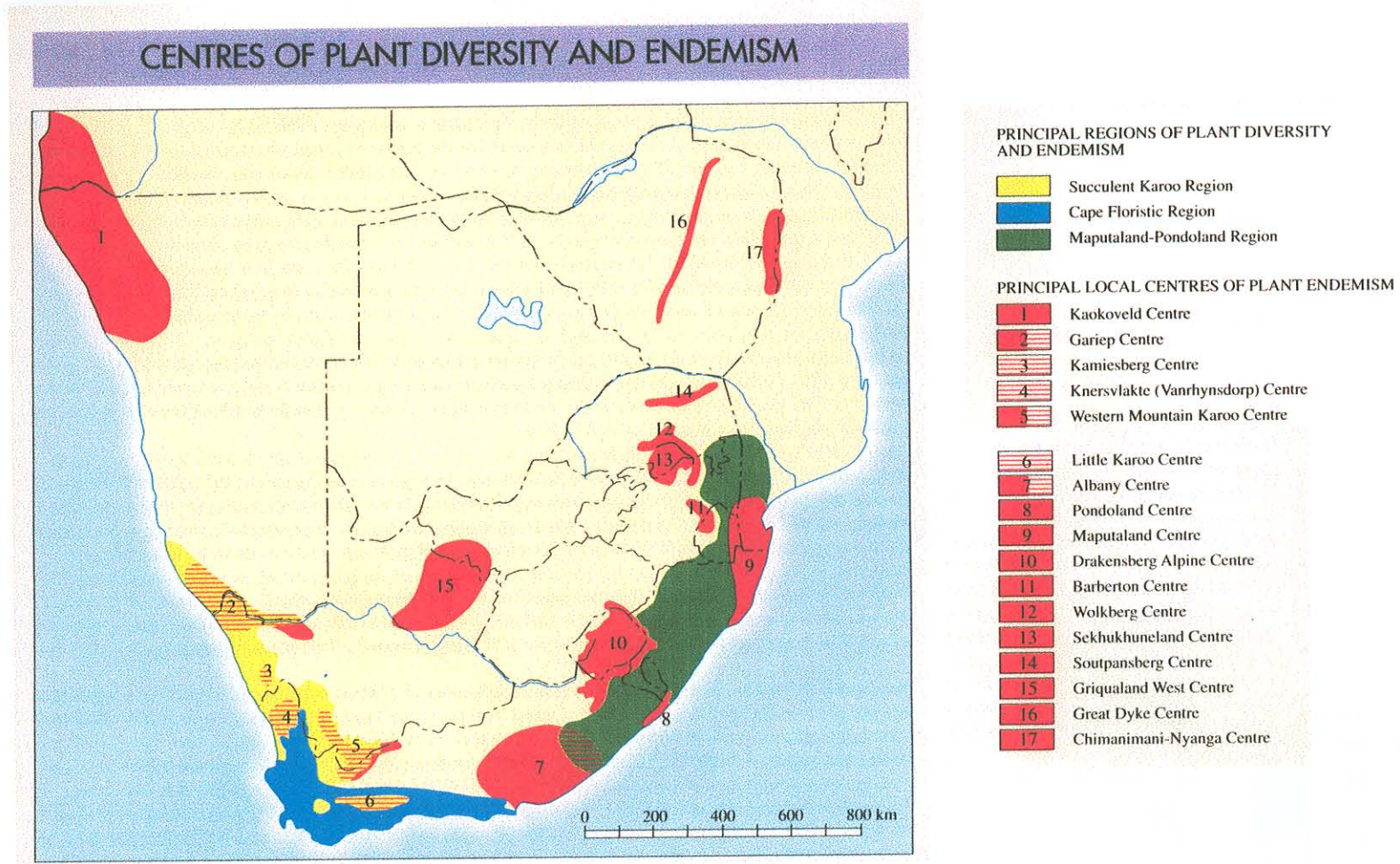


Figure 4. Centres of vascular plant diversity and endemism in southern Africa, from Van Wyk & Van Wyk (1997).

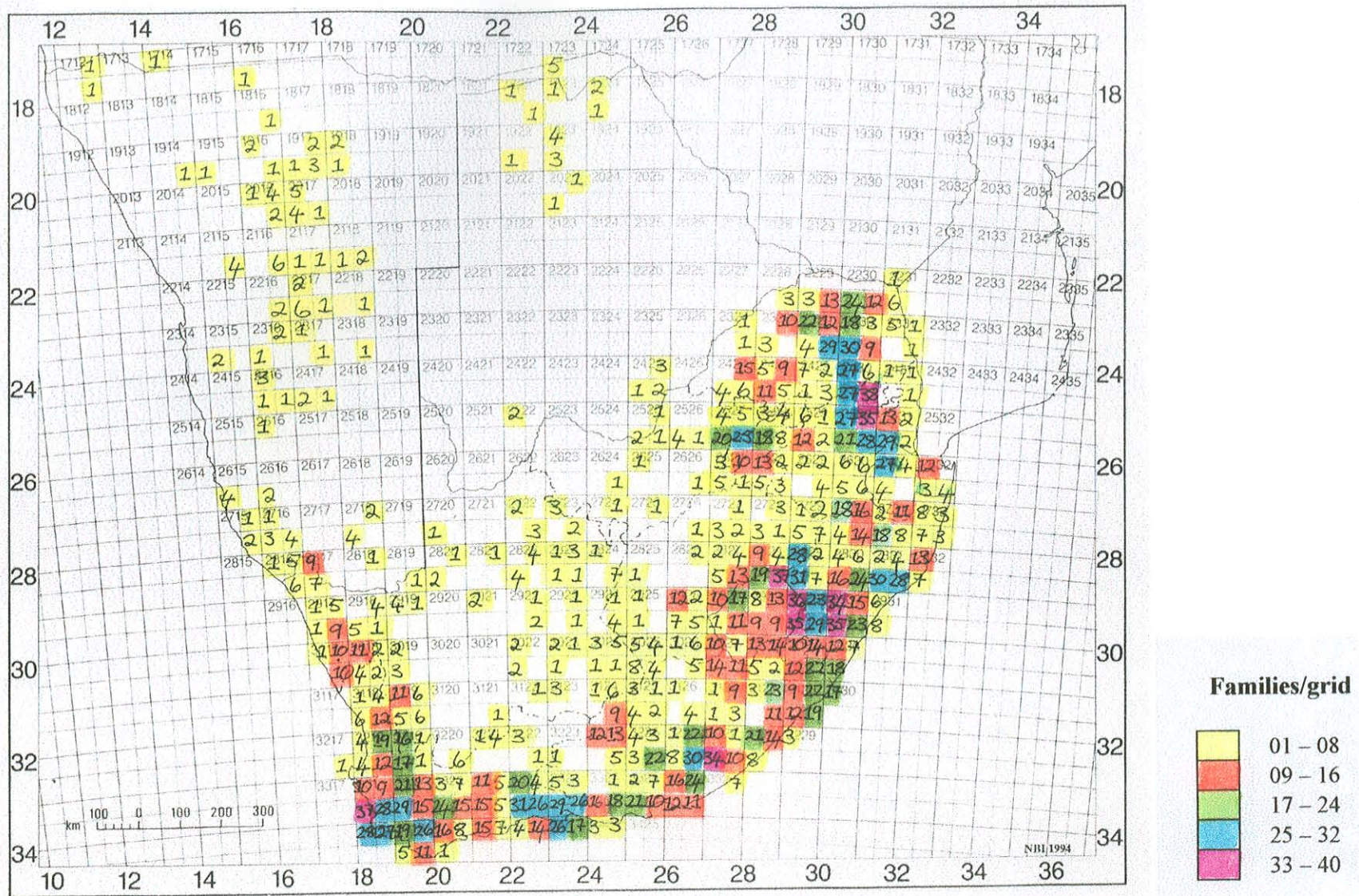


Figure 5. The geographic distribution of southern African moss families showing the number of families per 1/2° grid square.

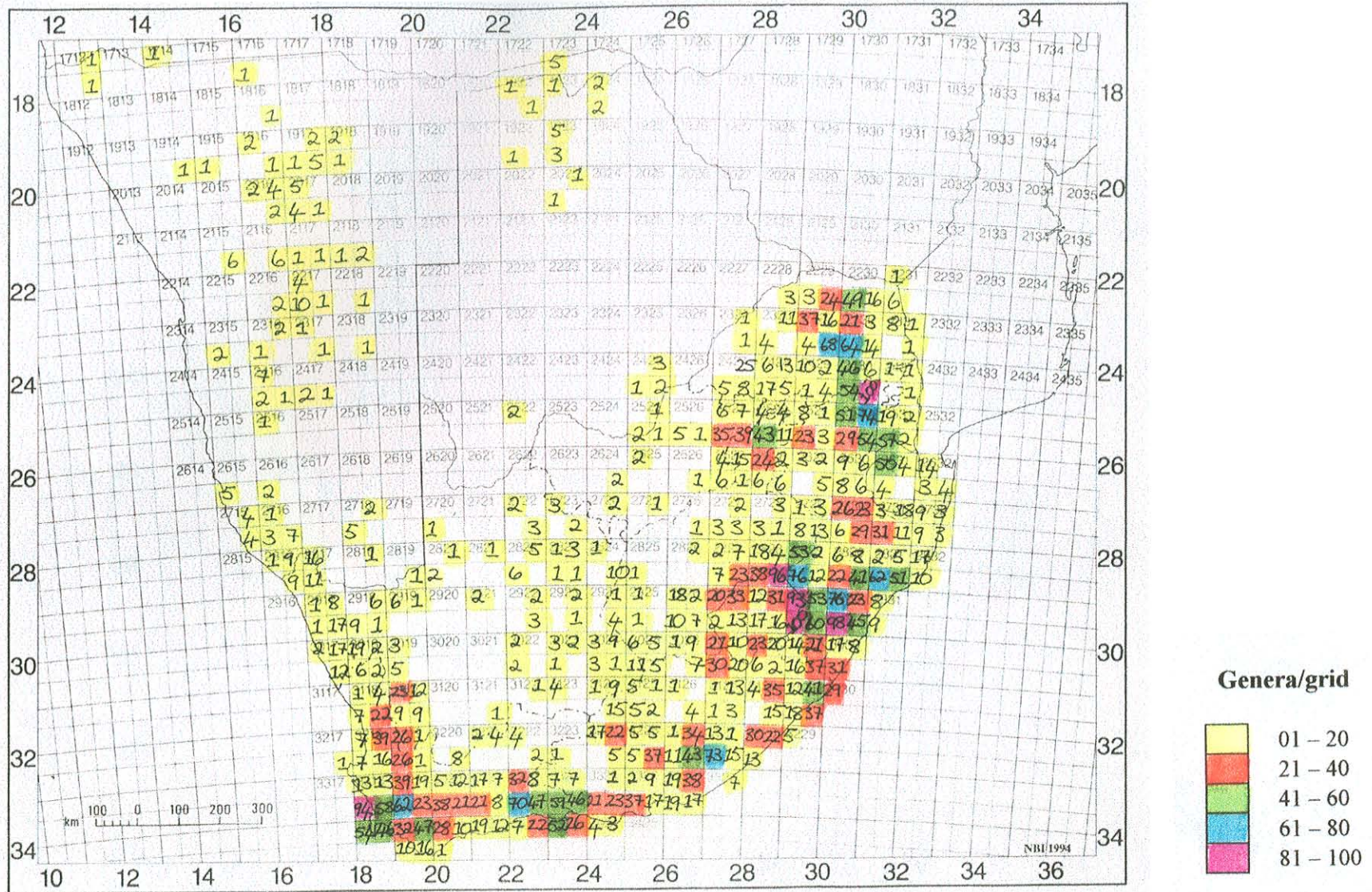


Figure 6. The geographic distribution of southern African moss genera showing the number of genera per 1/2° grid square.

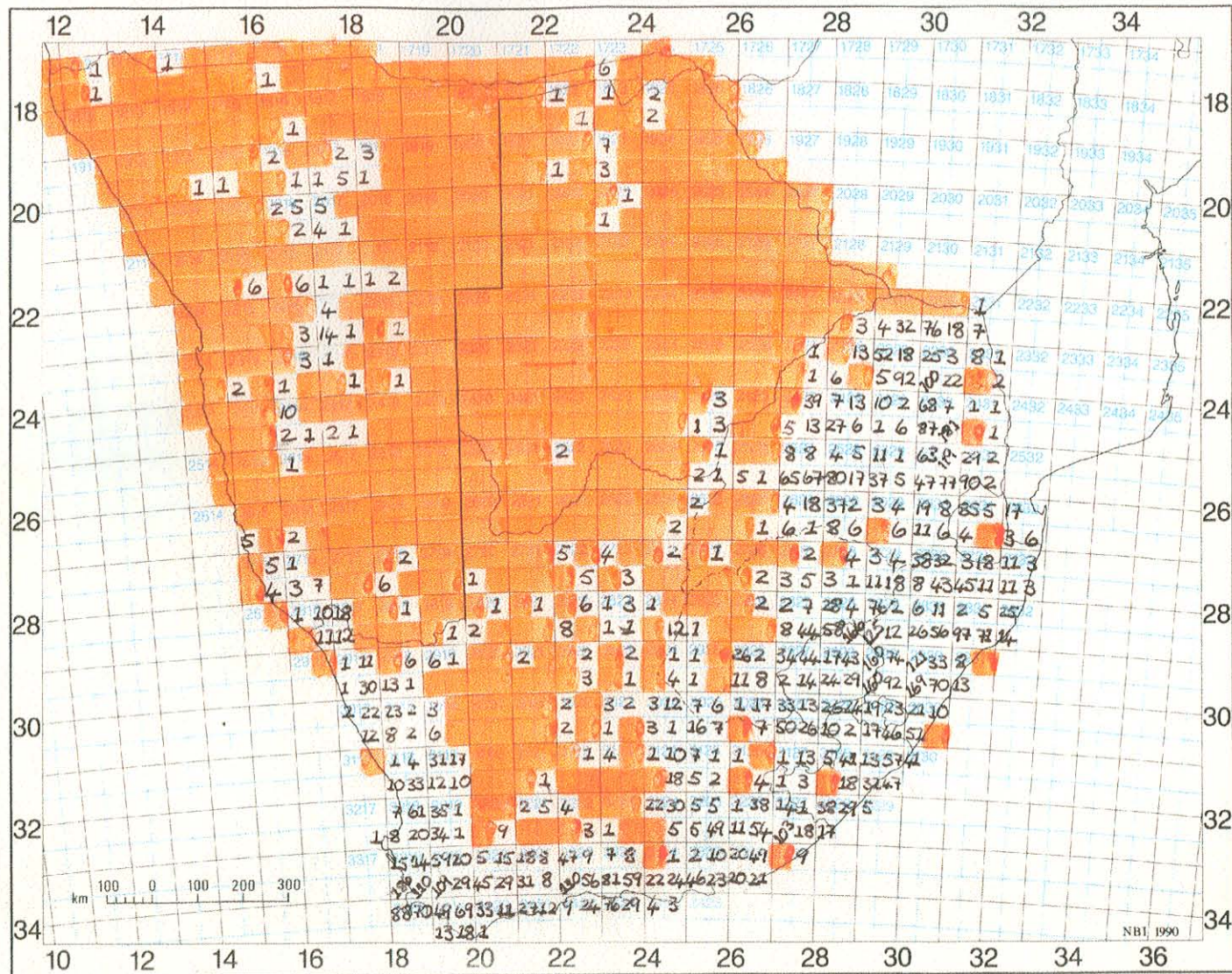


Figure 7. The joint geographic distribution of southern African mosses showing the number of moss species/intraspecific taxa per $\frac{1}{2}^{\circ}$ grid square.

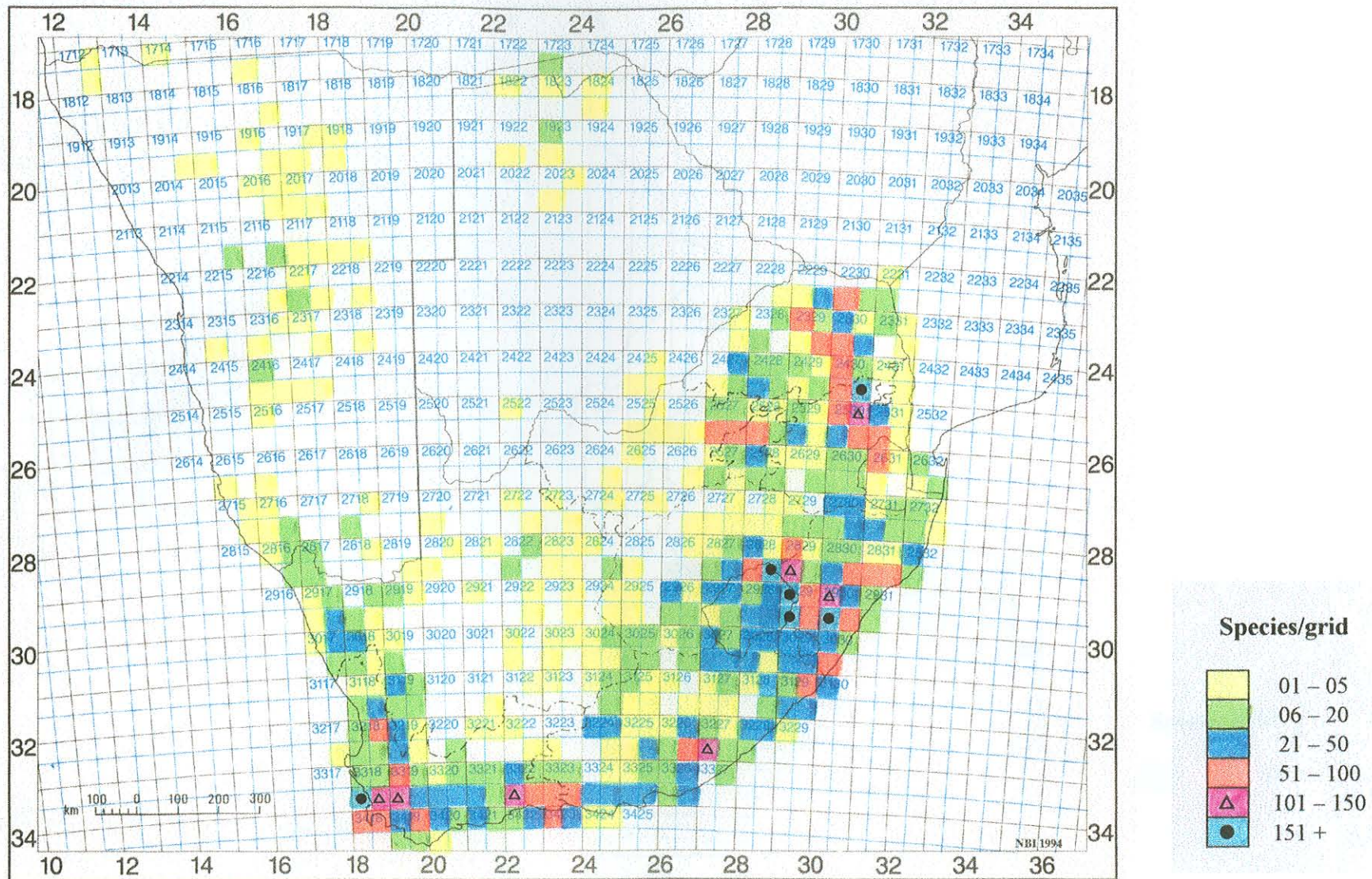
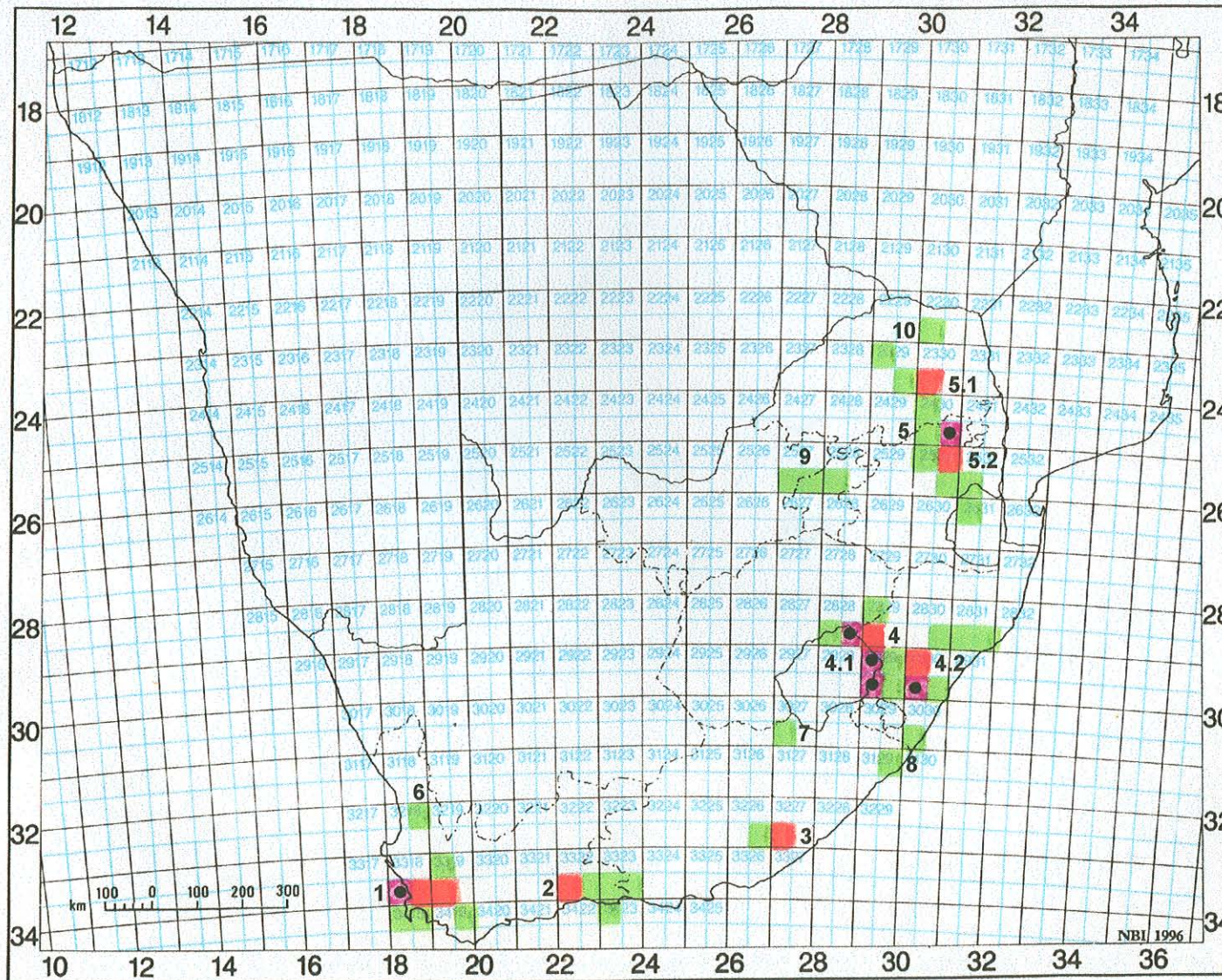


Figure 8. The joint geographic distribution of southern African mosses. The number of moss species/infraspecific taxa per $\frac{1}{2}^\circ$ grid square is shown in six intervals.



Legend

Main centres

1. South-western Cape Centre of Diversity
2. Outeniqua Centre of Diversity
3. Amathole Centre of Diversity
4. KwaZulu-Natal Centre of Diversity
 - 4.1 Drakensberg Subcentre of Diversity
 - 4.2 Midlands Subcentre of Diversity
5. Mpumalanga Centre of Diversity
 - 5.1 Wolkberg Subcentre of Diversity
 - 5.2 Blyde Subcentre of Diversity

Secondary centres

6. Cederberg Centre of Diversity
7. Witteberge Centre of Diversity
8. Pondoland Centre of Diversity
9. Magaliesberg Centre of Diversity
10. Soutpansberg Centre of Diversity

Species/grid

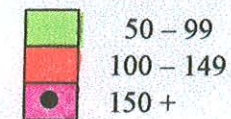


Figure 9. Centres of moss species/intraspecific diversity in southern Africa. The top three classes of a four class, number of species/intraspecific per $\frac{1}{2}^\circ$ grid square interval is shown.

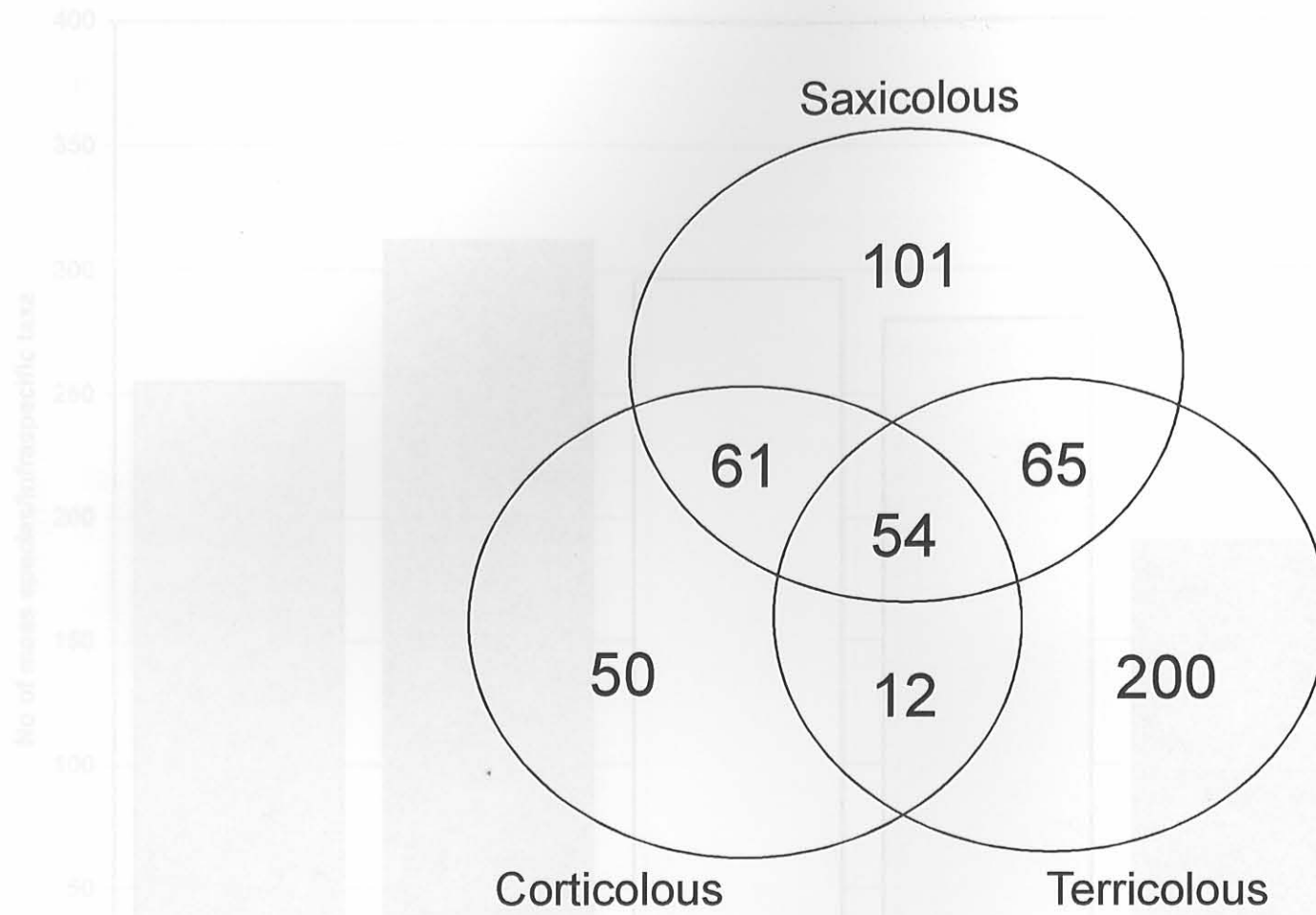


Figure 10. Venn diagram showing the distribution of southern African moss species/intraspecific taxa in the three basic types of substrate (saxicolous, terricolous and corticolous).

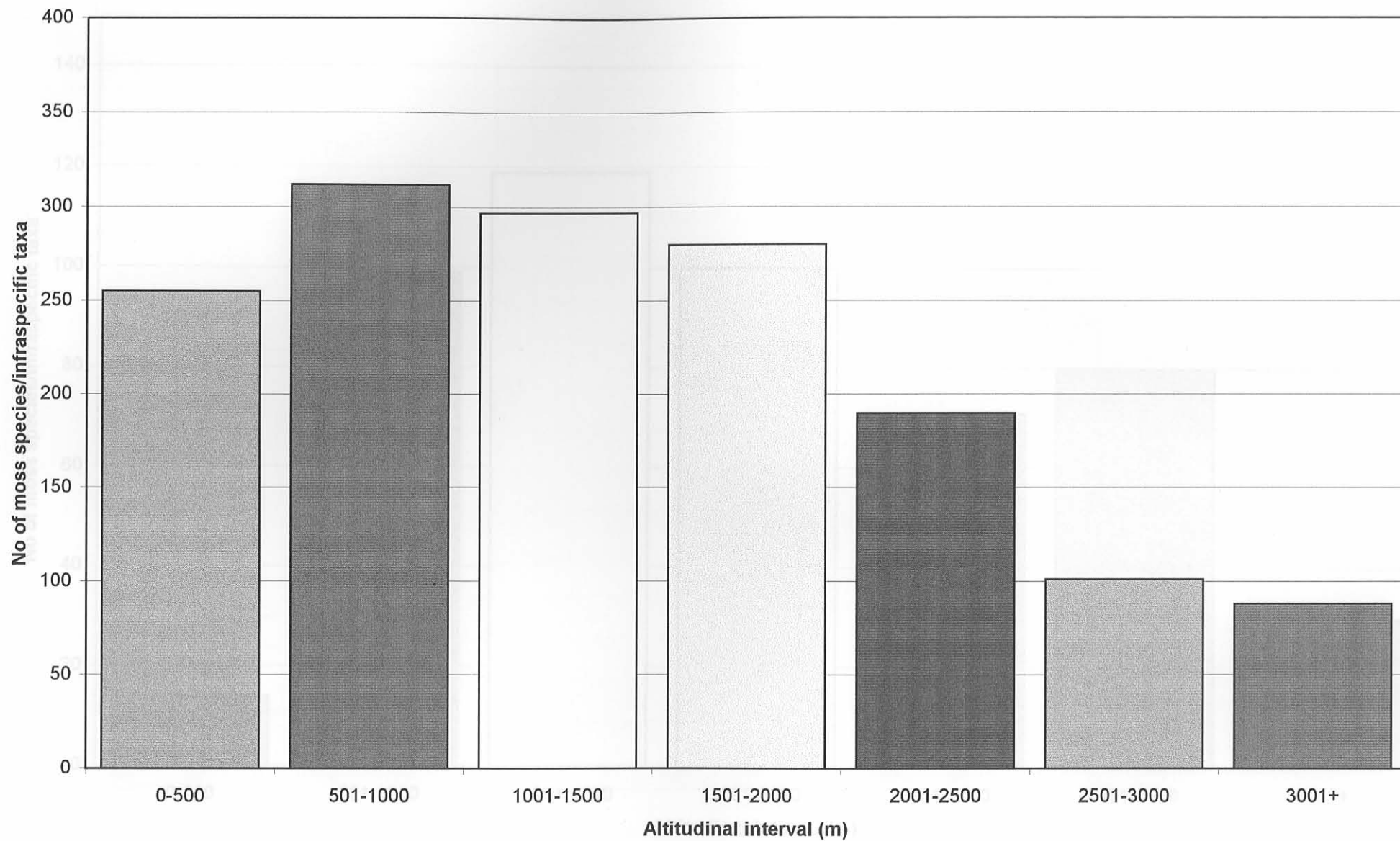


Figure 11. Altitudinal distribution of southern African mosses as represented by specimen data in PRECIS.

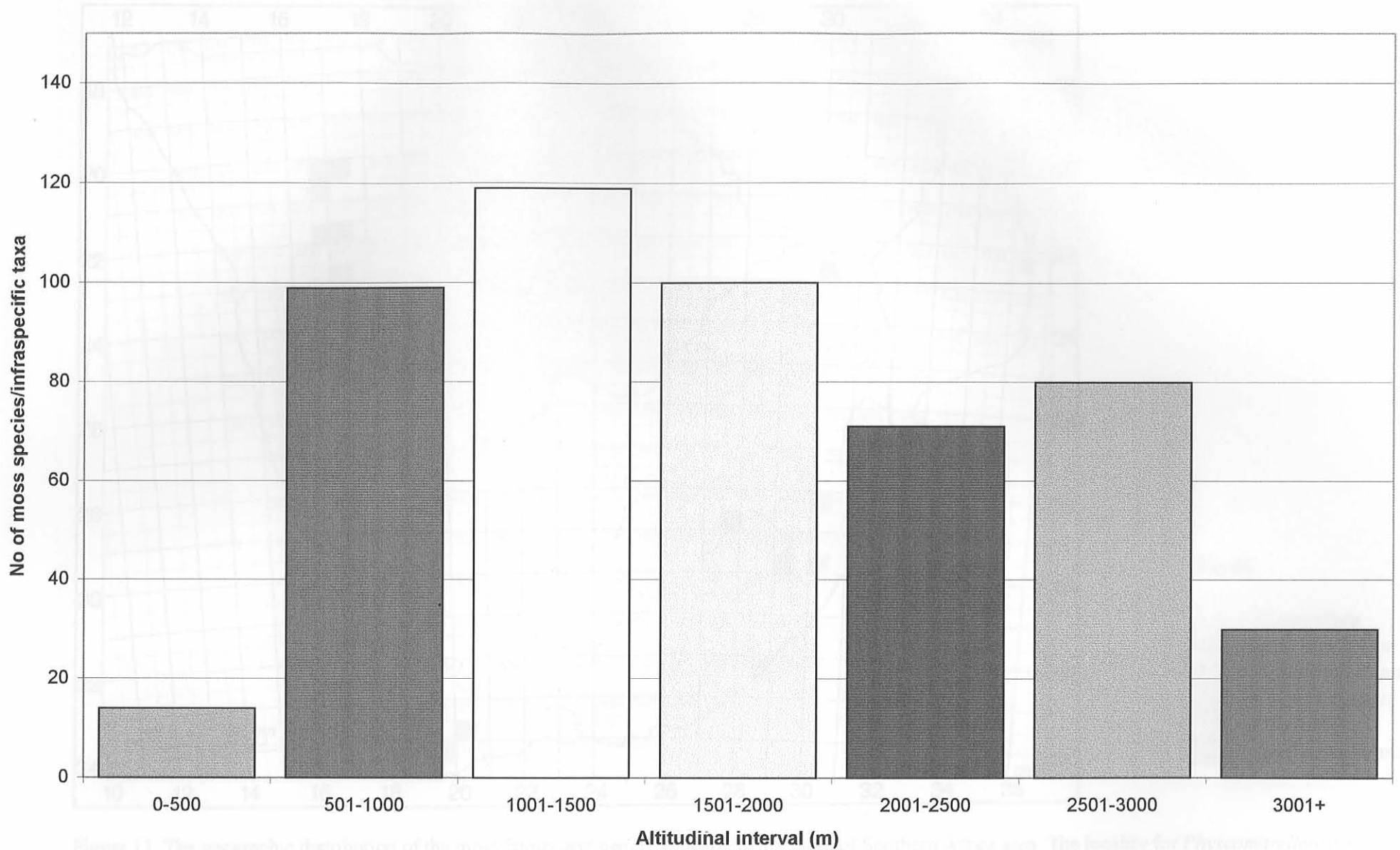


Figure 12. Altitudinal distribution of southern African mosses, as represented by specimen data in PRECIS, along a geographic transect, running from Durban on the KwaZulu-Natal coast (0 m) to the Sani Pass – Sehlabathebe area on top of the Drakensberg Mountains in Lesotho (3394 m), and between latitudes 29° 30' and 30° 00' (grid squares 2929 C & D, 2930 C & D, and 2931 C).

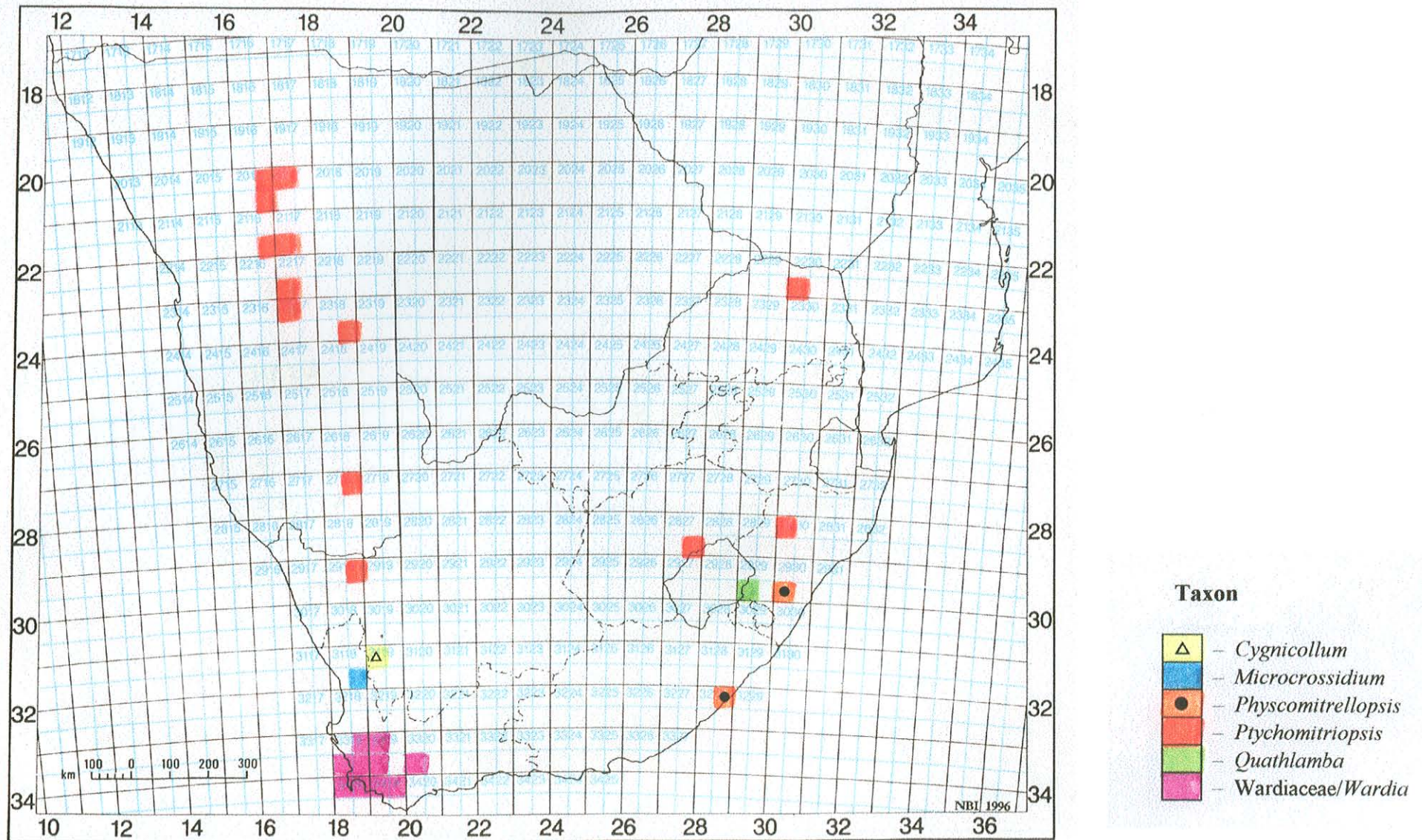


Figure 13. The geographic distribution of the moss family and genera endemic to the Flora of Southern Africa area. The locality for *Physcomitrellopsis* in KwaZulu-Natal is not precise.

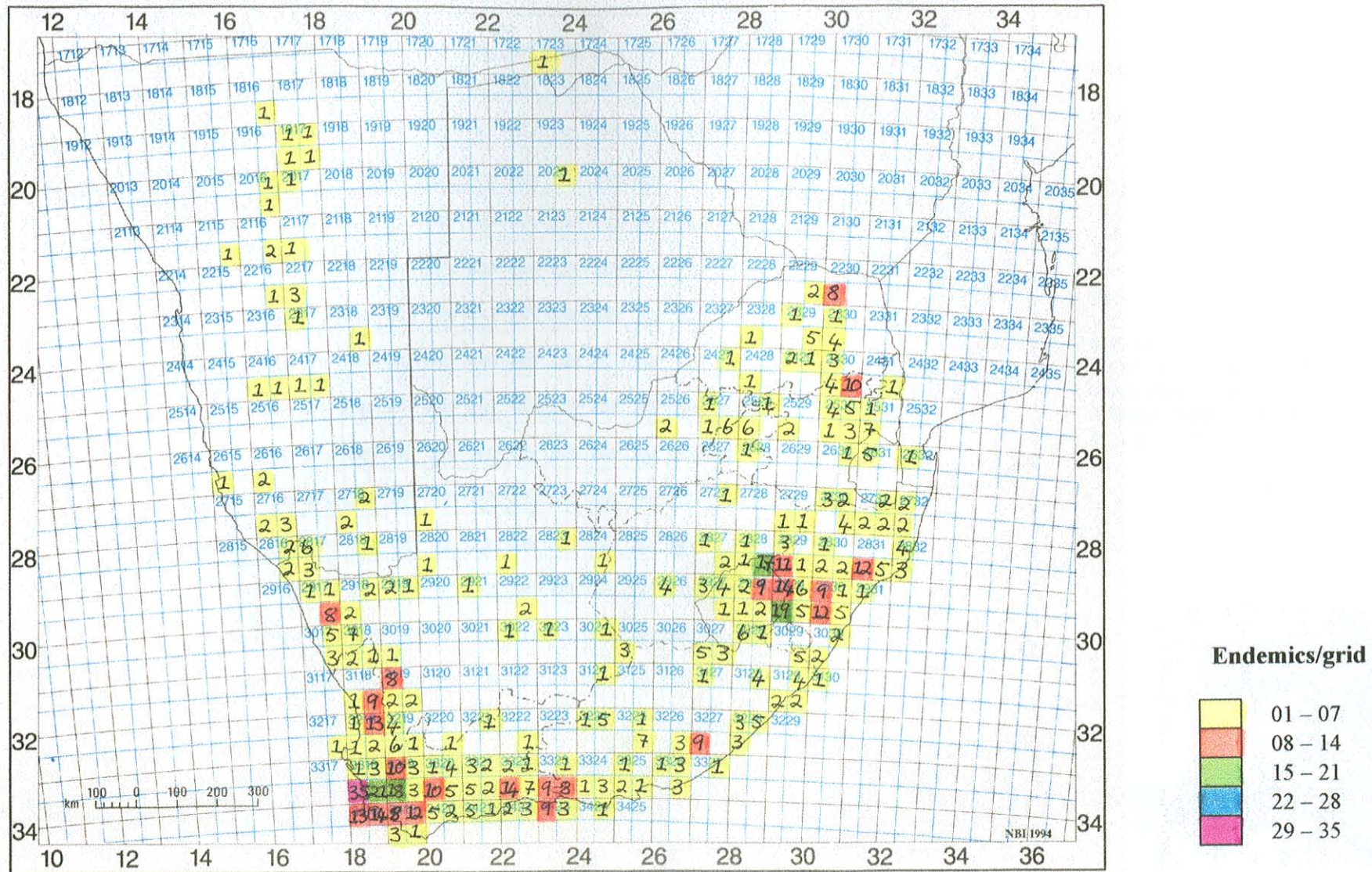
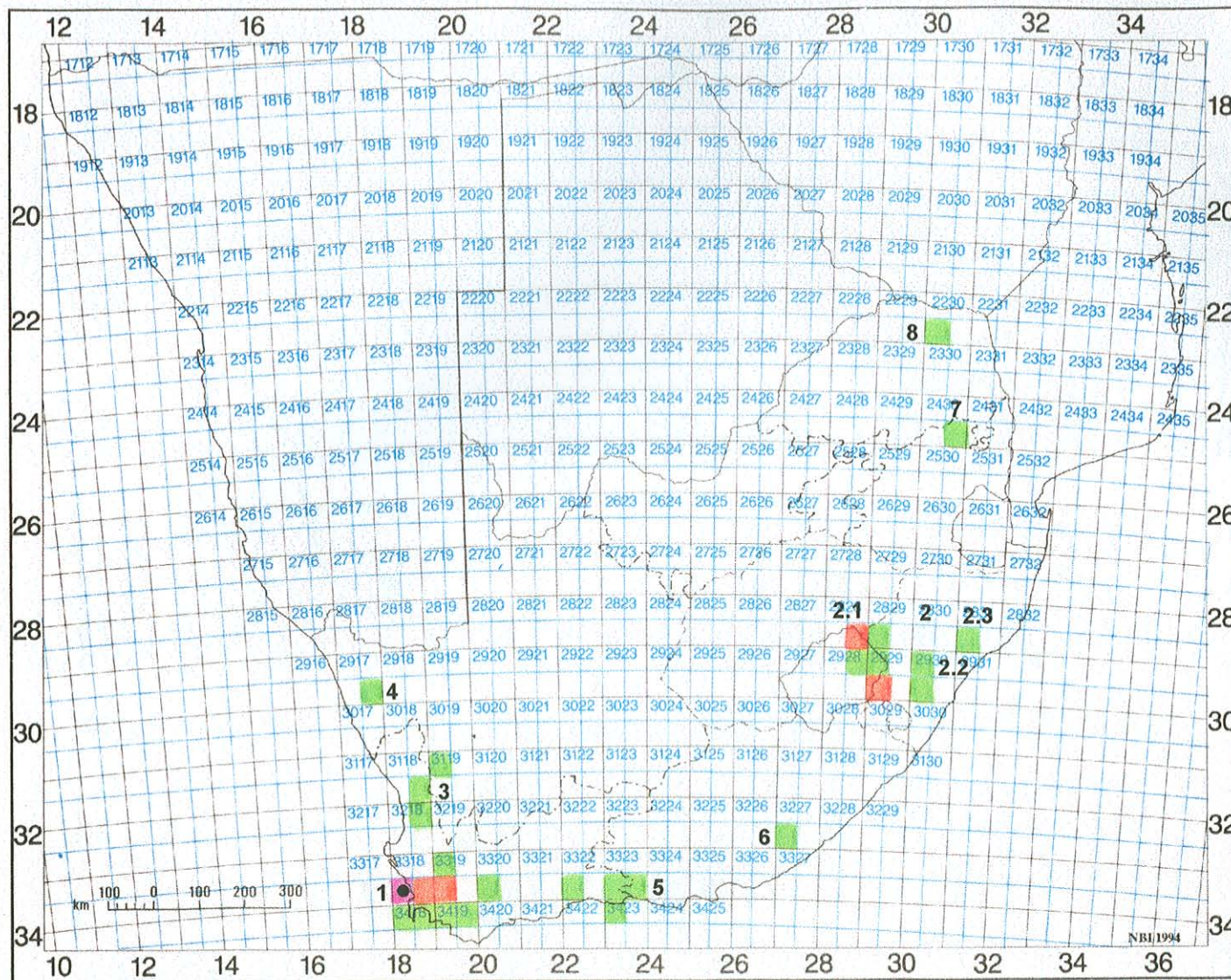


Figure 14. The geographic distribution of southern African endemics (moss species/intraspecific taxa endemic to the FSA area) showing the number of endemics per 1/2° grid square.



Legend

Main centres

1. South-western Cape Centre of Endemism
2. KwaZulu-Natal Centre of Endemism
 - 2.1 Drakensberg Subcentre of Endemism
 - 2.2 Midlands Subcentre of Endemism
 - 2.3 Zululand Subcentre of Endemism

Secondary centres

3. Cederberg Centre of Endemism
4. Kamiesberg Centre of Endemism
5. Outeniqua Centre of Endemism
6. Amathole Centre of Endemism
7. Mpumalanga Centre of Endemism
8. Soutpansberg Centre of Endemism

Endemics/grid

	08 – 14
	15 – 21
	22 – 28
	29 – 35

Figure 15. Centres of moss endemism in southern Africa. Only $\frac{1}{2}^\circ$ grid squares with eight or more endemics recorded are shown.

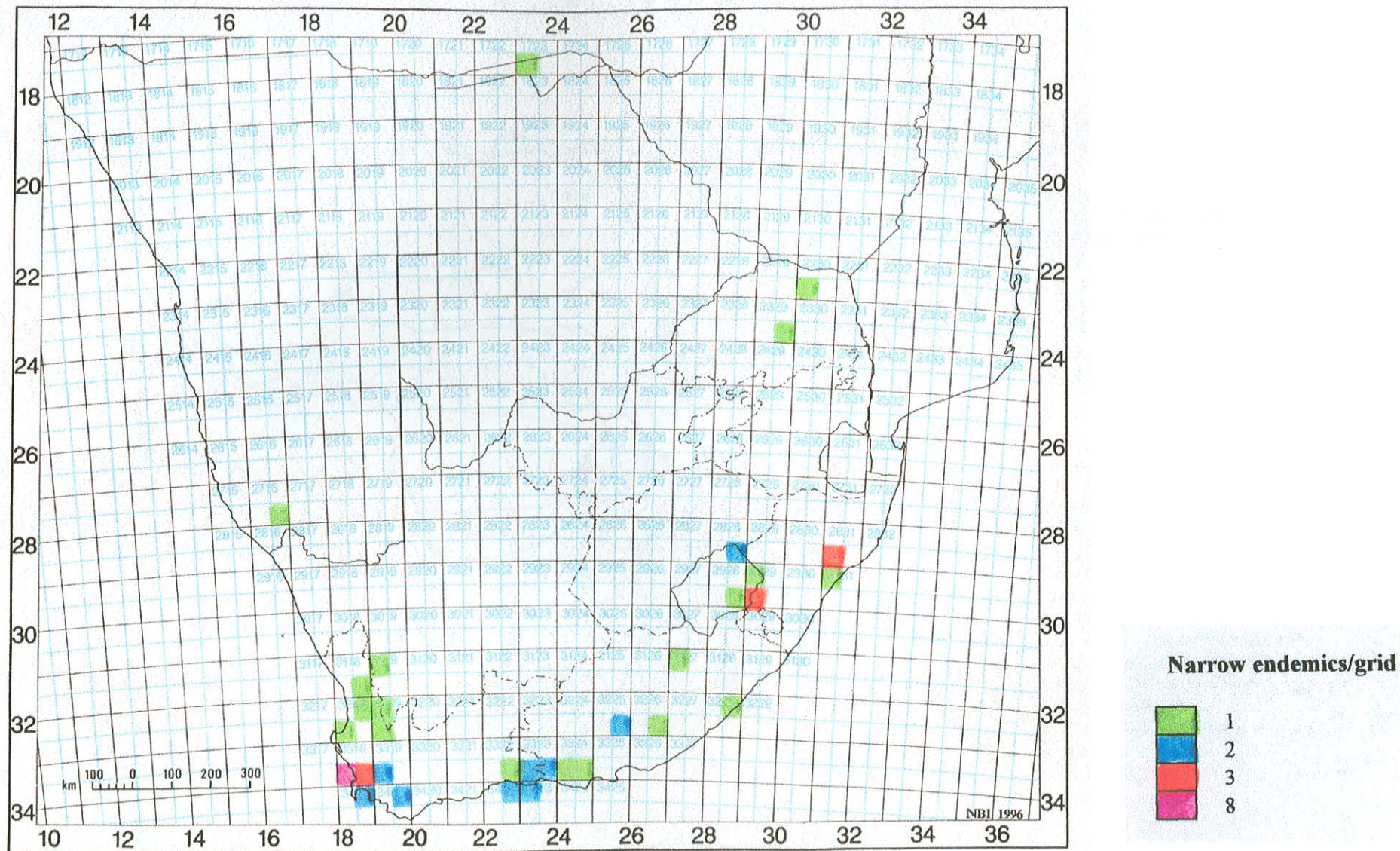
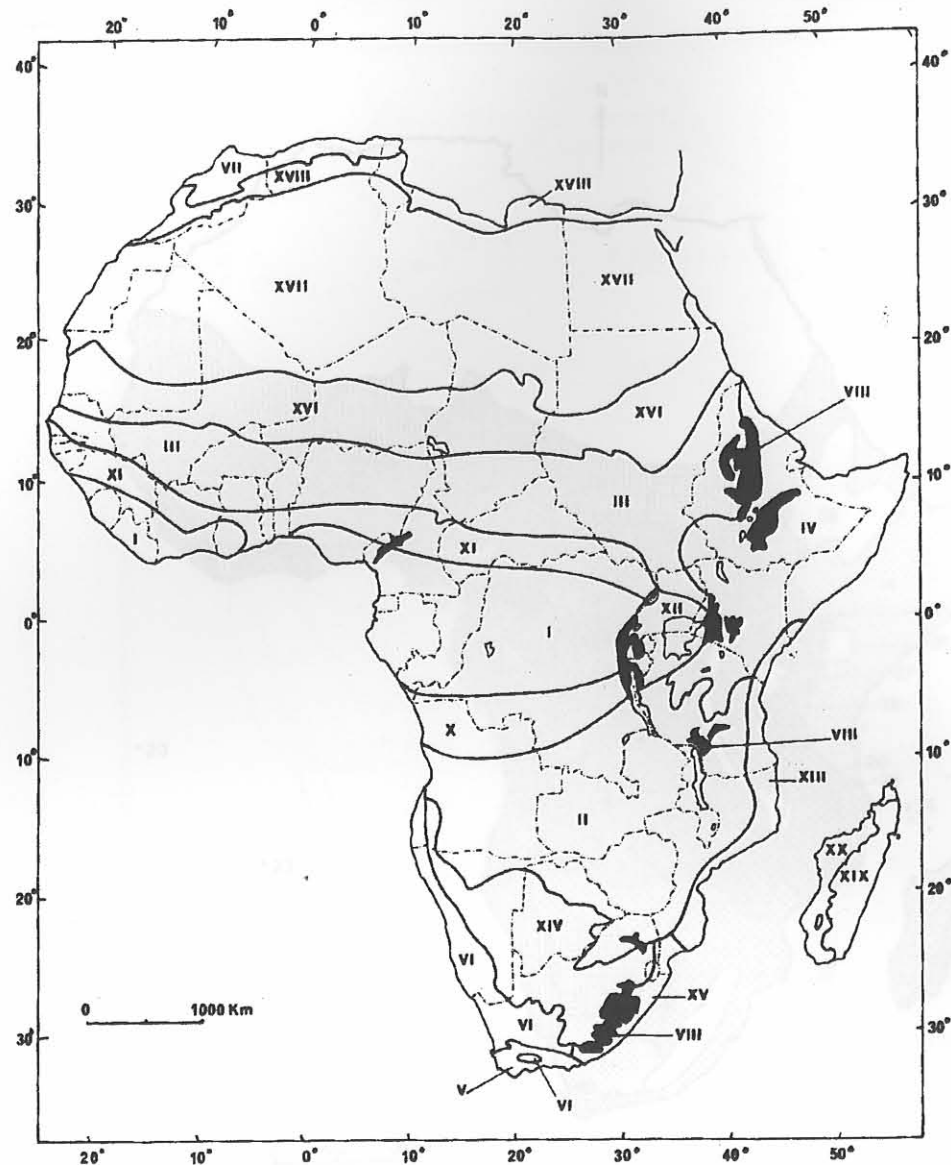


Figure 16. The distribution of narrow moss endemics (species/intraspecific taxa more or less restricted to an area the size of 1° grid square) per $\frac{1}{2}^\circ$ grid square, showing the centres of narrow moss endemism in southern Africa.



- I. Guineo-Congolian regional centre of endemism.
- II. Zambeزيan regional centre of endemism.
- III. Sudanian regional centre of endemism.
- IV. Somalia – Masai regional centre of endemism.
- V. Cape regional centre of endemism.
- VI. Karoo-Namib regional centre of endemism.
- VII. Mediterranean regional centre of endemism.
- VIII. Afromontane archipelago-like regional centre of endemism, including IX, Afroalpine archipelago-like region of extreme floristic impoverishment (not shown separately).
- X. Guinea- Congolia/Zambezi regional transition zone.
- XI. Guinea-Congolia/Sudania regional transition zone.
- XII. Lake Victoria regional mosaic.
- XIII. Zanzibar-Inhambane regional mosaic.
- XIV. Kalahari-Highveld regional transition zone.
- XV. Tongaland-Pondoland regional mosaic.
- XVI. Sahel regional transition zone.
- XVII. Sahara regional transition zone.
- XVIII. Mediterranean/Sahara regional transition zone.
- XIX. East Malagasy regional centre of endemism.
- XX. West Malagasy regional centre of endemism.

Figure 17. The main phytochoria of Africa and Madagascar according to White (1983).

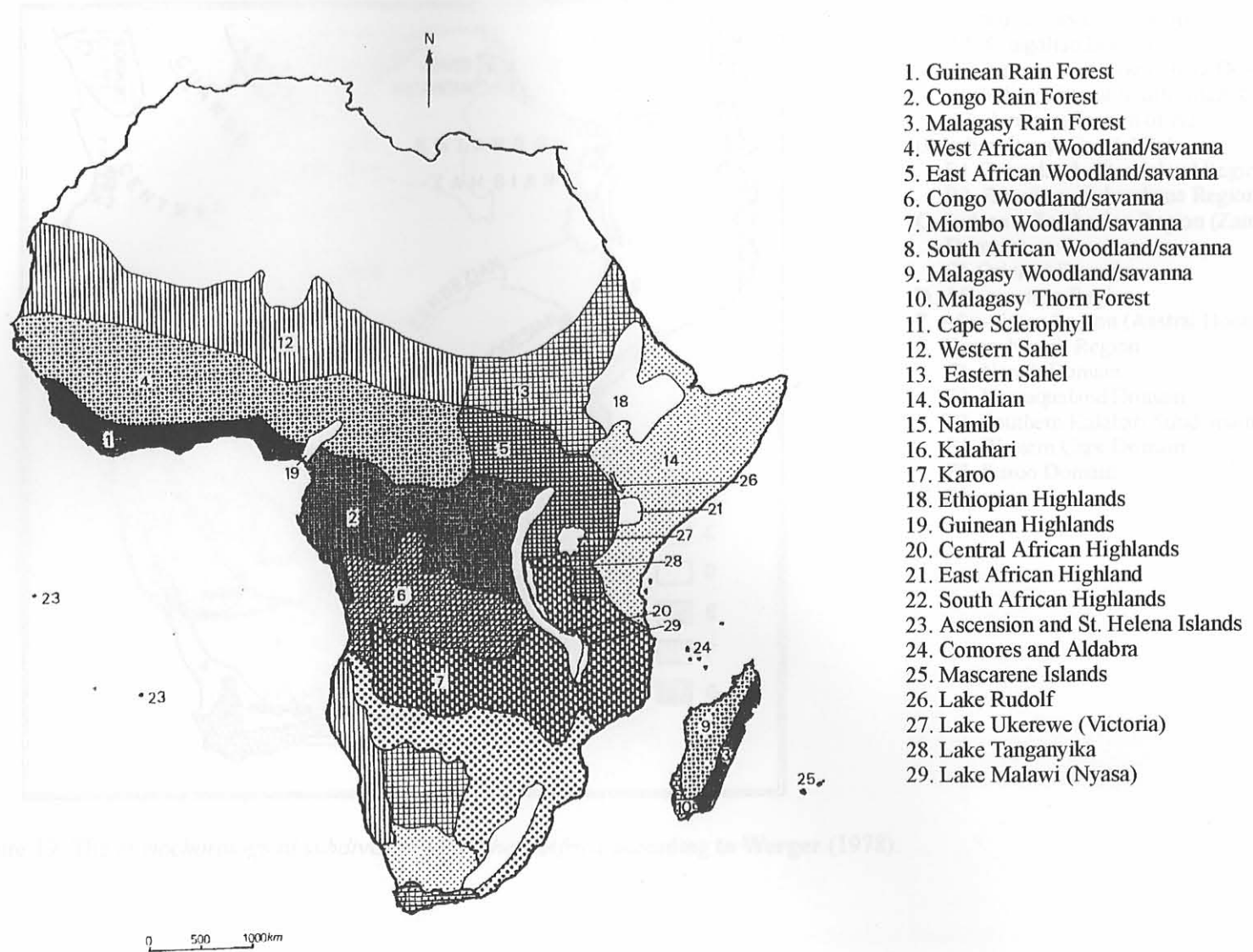


Figure 18. The *Biogeographical Provinces of the Afrotropical Realm* according to **Udvardy (1975)**.

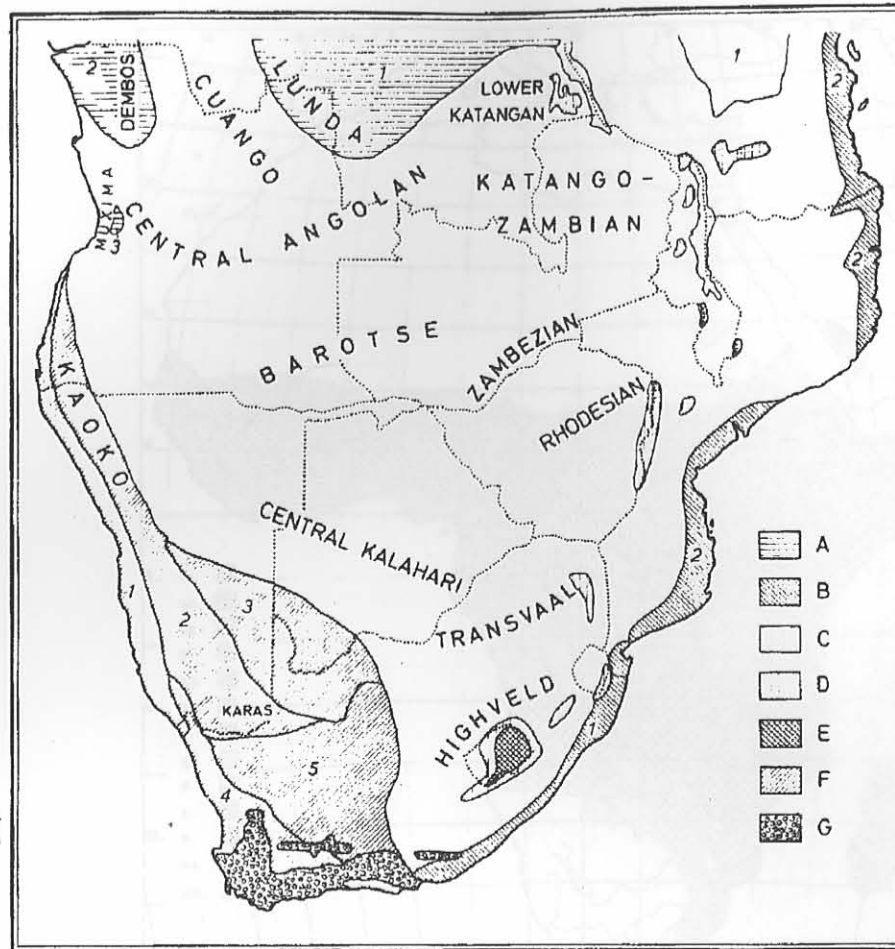


Figure 19. The *phytochorological subdivision of southern Africa* according to Werger (1978).

Figure 20. The *subdivisions of southern Africa* according to Werger (1978).
 1. Upper Guinea Domain
 2. Nigerian-Cameroonian Domain
 3. Amboim Section of A2
 4. Southern Kalahari Subdomain
 5. Karoo Domain
 6. Namaqualand Domain
 7. Western Cape Domain
 8. Namib Domain
 9. Transvaal Domain
 10. Rhodesian Domain
 11. Central Kalahari Domain
 12. Karoo-Namib Region
 13. Afro-alpine Region (Austral Domain)
 14. Afromontane Region
 15. Indian Ocean Coastal Belt
 16. Sudano-Zambeian Region (Zambeian Domain)
 17. Oriental Domain

18. Guineo-Congolian Region
 19. Congolian Domain
 20. Nigerian-Cameroonian Domain
 21. Amboim Section of A2
 22. Tongaland-Pondoland Regional Mosaic
 23. Zanzibar-Inhambane Regional Mosaic
 24. Zambeian Domain
 25. Oriental Domain
 26. Afro-alpine Region (Austral Domain)
 27. Karoo-Namib Region
 28. Namib Domain
 29. Namaqualand Domain
 30. Southern Kalahari Subdomain
 31. Western Cape Domain
 32. Karoo Domain
 33. Capensis

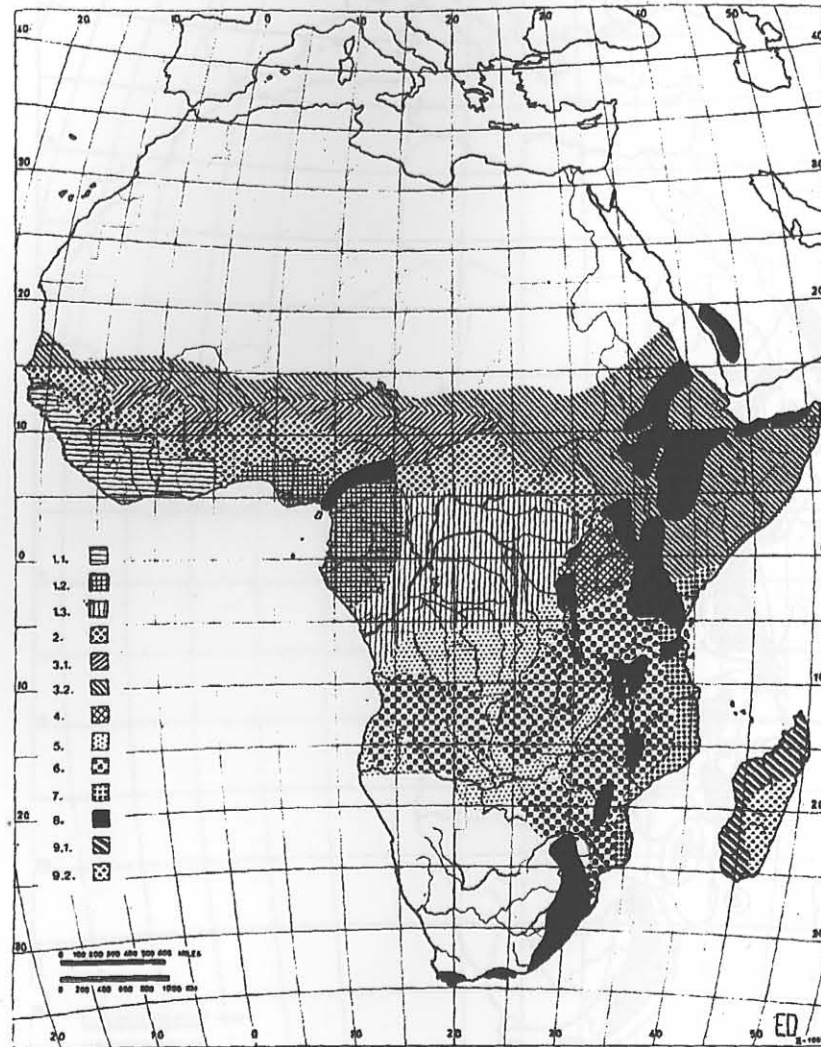


Figure 20. The *phytogeographical division of Africa* by Denys (1979, 1980). 1, Guineo-Congolian Region (1.1 Upper Guinea Domain, 1.2 Lower Guinea Domain, 1.3 Congo Basin Domain); 2, Guinea-Congolia/Sudanian Region; 3, Sudanian Region (3.1 Southern Subregion, 3.2 Northern Subregion); 4, Region of the Central African Lakes; 5, Guinea-Congolia/Zambezia Transition Region; 6, Zambezan Region; 7, Region of the Indian Ocean Coastal Belt; 8, Afromontane Region; 9, Madagascan Region (9.1 Occidental Domain, 9.2 Oriental Domain).

Figure 21
1 = Indian
Domain

2 = Ethiopian Domain
Drakensberg

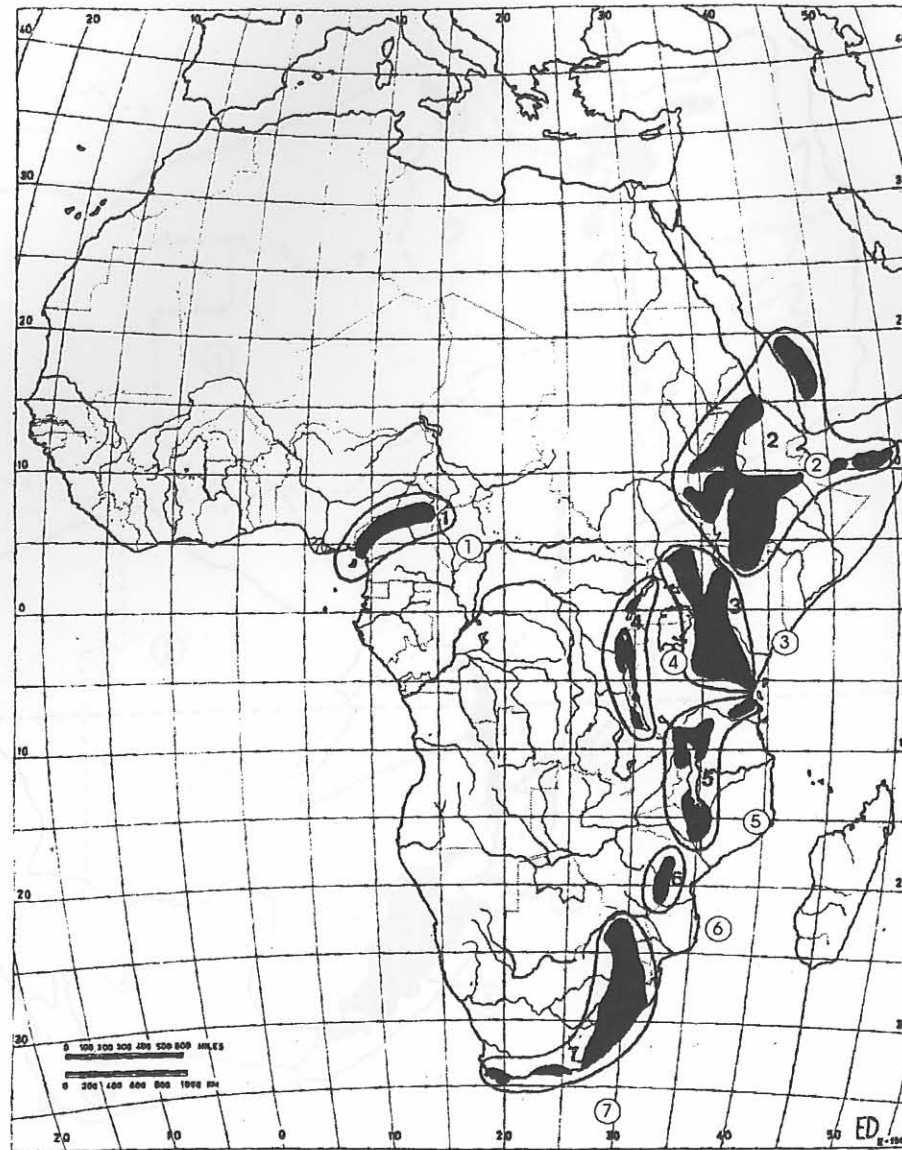


Figure 21. The seven *Mountain Domains* of the *Afromontane Region* according to **Denys** (1979). 1 = West African Domain, 2 = Ethiopian Domain, 3 = Imatongs-Usambara Domain, 4 = Kivu-Ruwenzori Domain, 5 = Uluguru-Mlanje Domain, 6 = Chimanimani Domain, 7 = Drakensberg Domain.

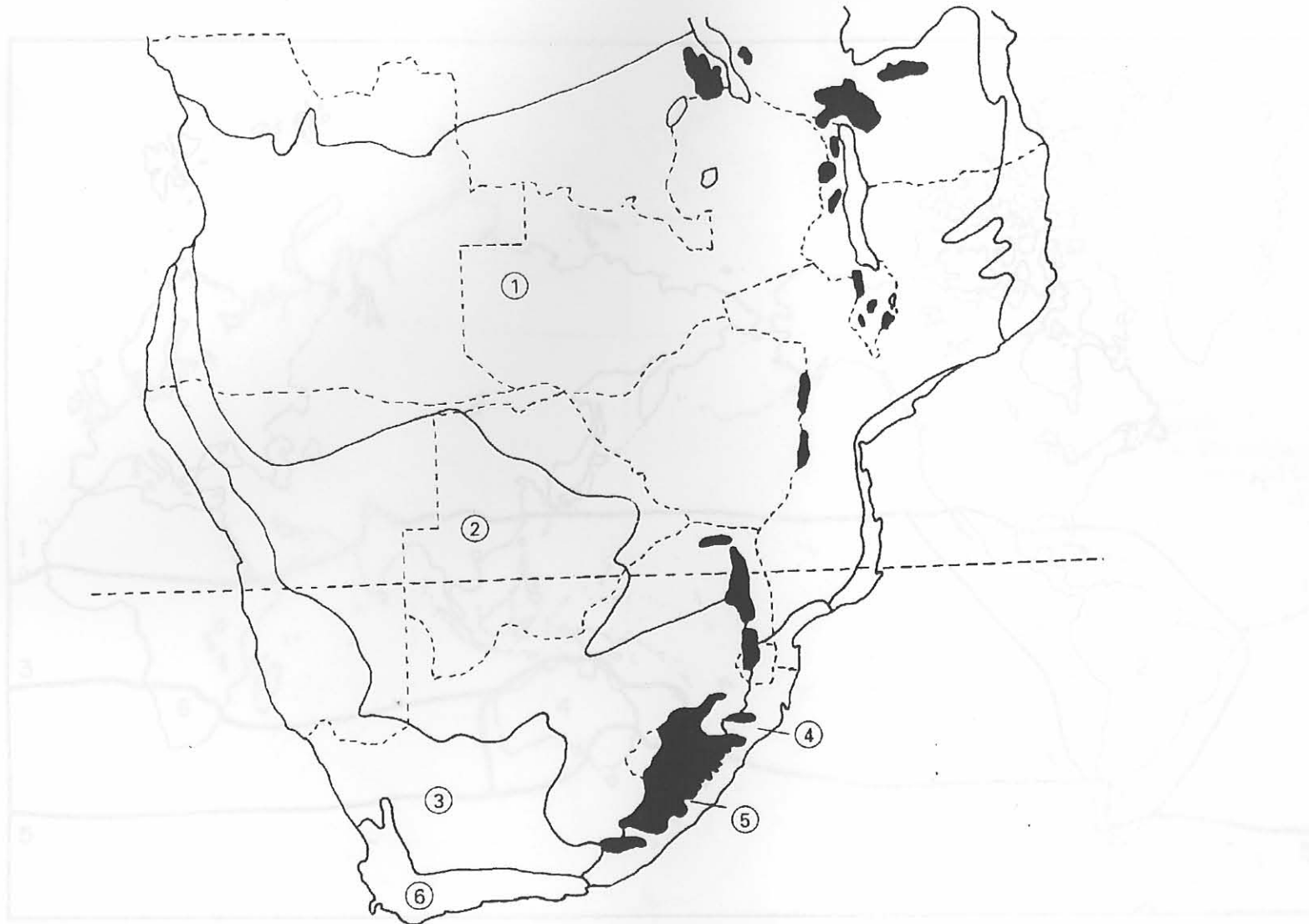


Figure 22. The *phytogeographical regions* of southern Africa according to **Goldblatt (1978)** and **Cowling & Hilton-Taylor (1997)**. 1 = Zambebian Region, 2 = Kalahari-Highveld Transition Zone, 3 = Karoo-Namib Region, 4 = Tongaland-Pondoland Region, 5 = Afromontane Region, 6 = Cape Region.

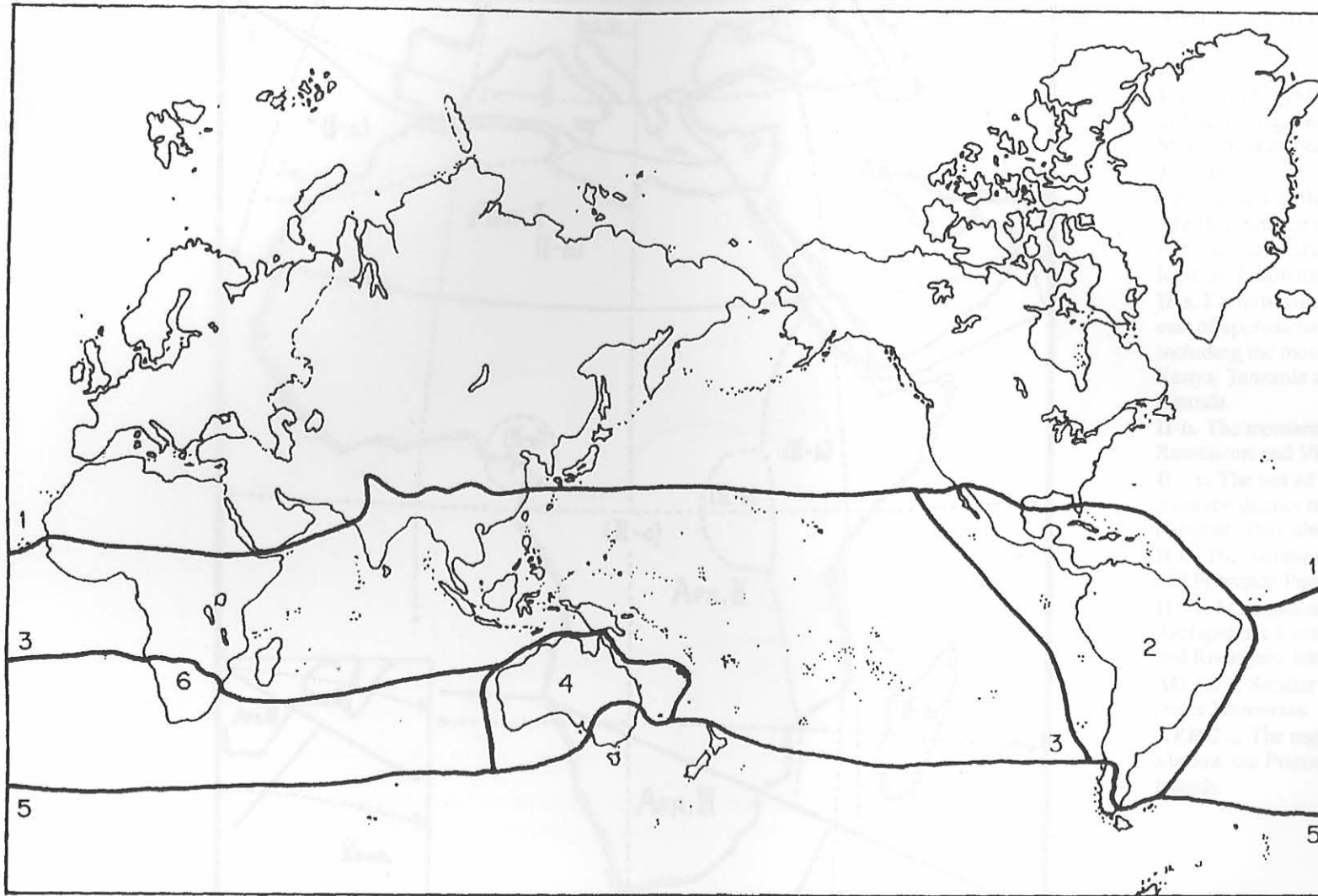
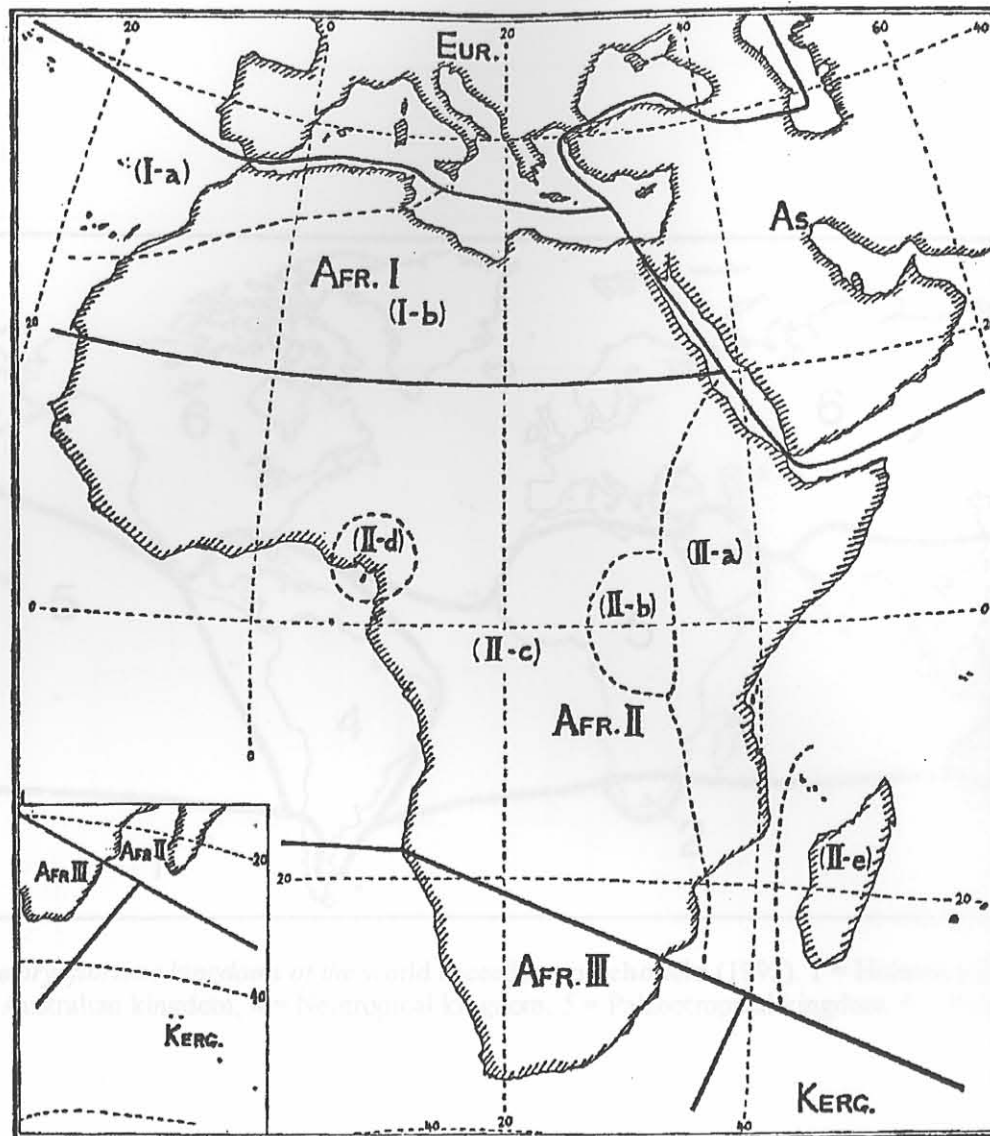


Figure 23. The *Florenreiche* of Herzog (1926) as presented by Miller (1982). 1 = Holarktisches Florenreich, 2 = Neotropisches Florenreich, 3 = Paläotropische Florenreich, 4 = Australisches Florenreich, 5 = Austral-antarktisches Florenreich, 6 = Südafrikanisches Florenreich.



Afr 1 ... Similar to Afr 1 in *Index Muscorum*, but further subdivided into the following:

I-a. Azores, Madeira, Canaries and the districts along the coast of the Mediterranean Sea in Morocco, Algeria and Tunisia.

I-b. The rest of the continental Afr 1.

Afr II ... Similar to the sum of Afr 2 and Afr 3 in *Index Muscorum*, and including at least the following subdivisions:

II-a. Eastern parts of the continental Afr 2: east of approximately 32° E Long., including the montane districts in Ethiopia, Kenya, Tanzania and eastern part of Uganda.

II-b. The montane districts including the Ruwenzori and Virunga Mts.

II-c. The rest of Afr 2, excepting the montane district of Mt. Cameroun and Fernando Poo, also including S. Tomé

II-d. The montane district of Mt. Cameroun and Fernando Poo.

II-e. Madagascar, possibly including Archipel des Comores, Reunion, Mauritius and Rodriguez Island also.

Afr III ... Similar to the continental Afr 4 in *Index Muscorum*.

KERG ... The region including Kerguelen, Marion, the Prince Edward and the Crozet Islands.

Figure 24. The *phytogeographical division of Africa, Madagascar and neighbouring islands* by Ochi (1973).

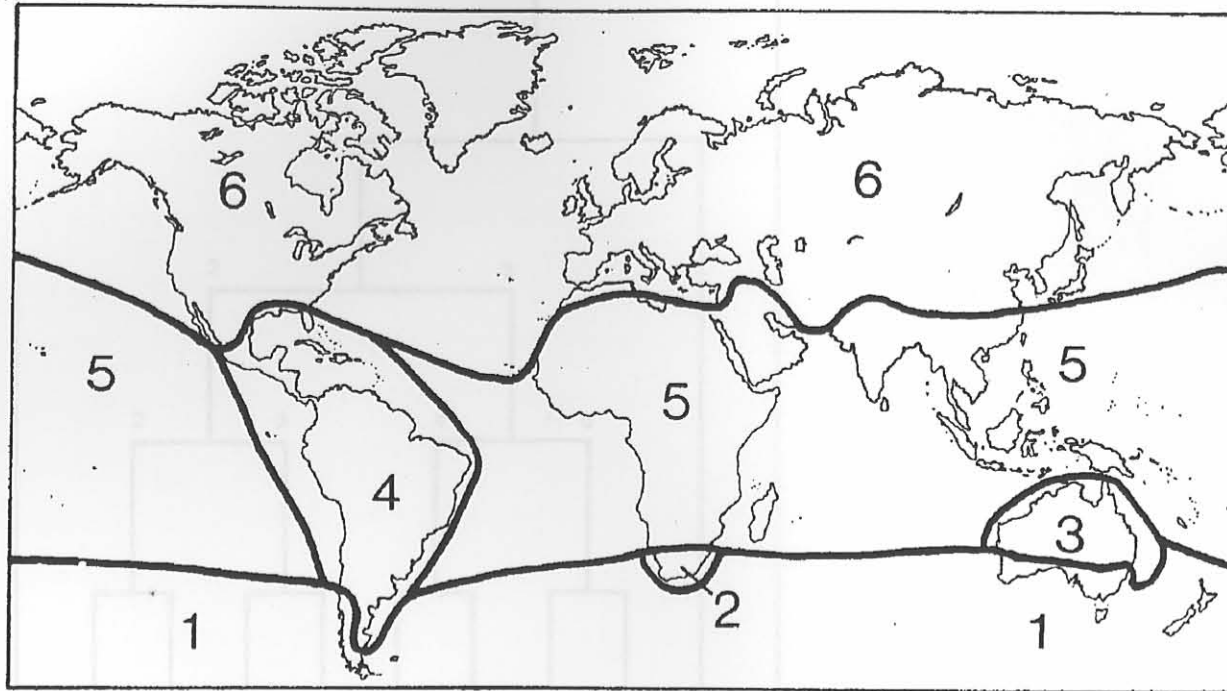


Figure 25. The *bryofloristic kingdoms of the world* according to Schofield (1992). 1 = Holantarctic kingdom, 2 = South African kingdom, 3 = Australian kingdom, 4 = Neotropical kingdom, 5 = Palaeotropical kingdom, 6 = Holarctic kingdom.

Figure 26. Dendrogram of the TWINSPAN Computers classification of grid squares into bryofloristic kingdoms.

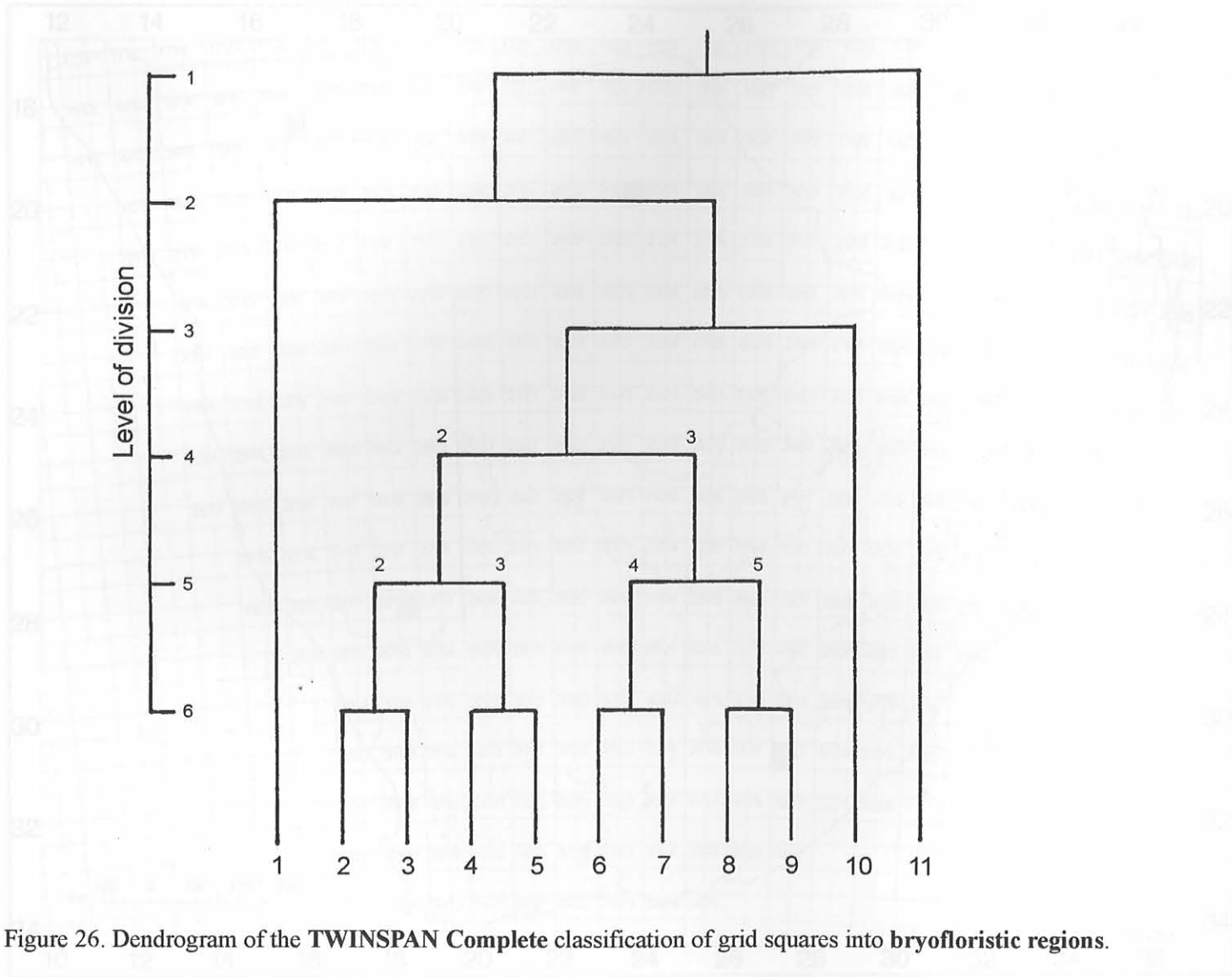


Figure 26. Dendrogram of the TWINSpan Complete classification of grid squares into bryofloristic regions.

Figure 27. The bryofloristic regions created out of the five three divisions of the TWINSpan Complete grid classification (regions 1/2, 2/1 and 3/2, mid groups 1, 10 and 10). The numbering of the groups is the same as in the dendrogram of the TWINSpan Complete grid classification (Figure 26).

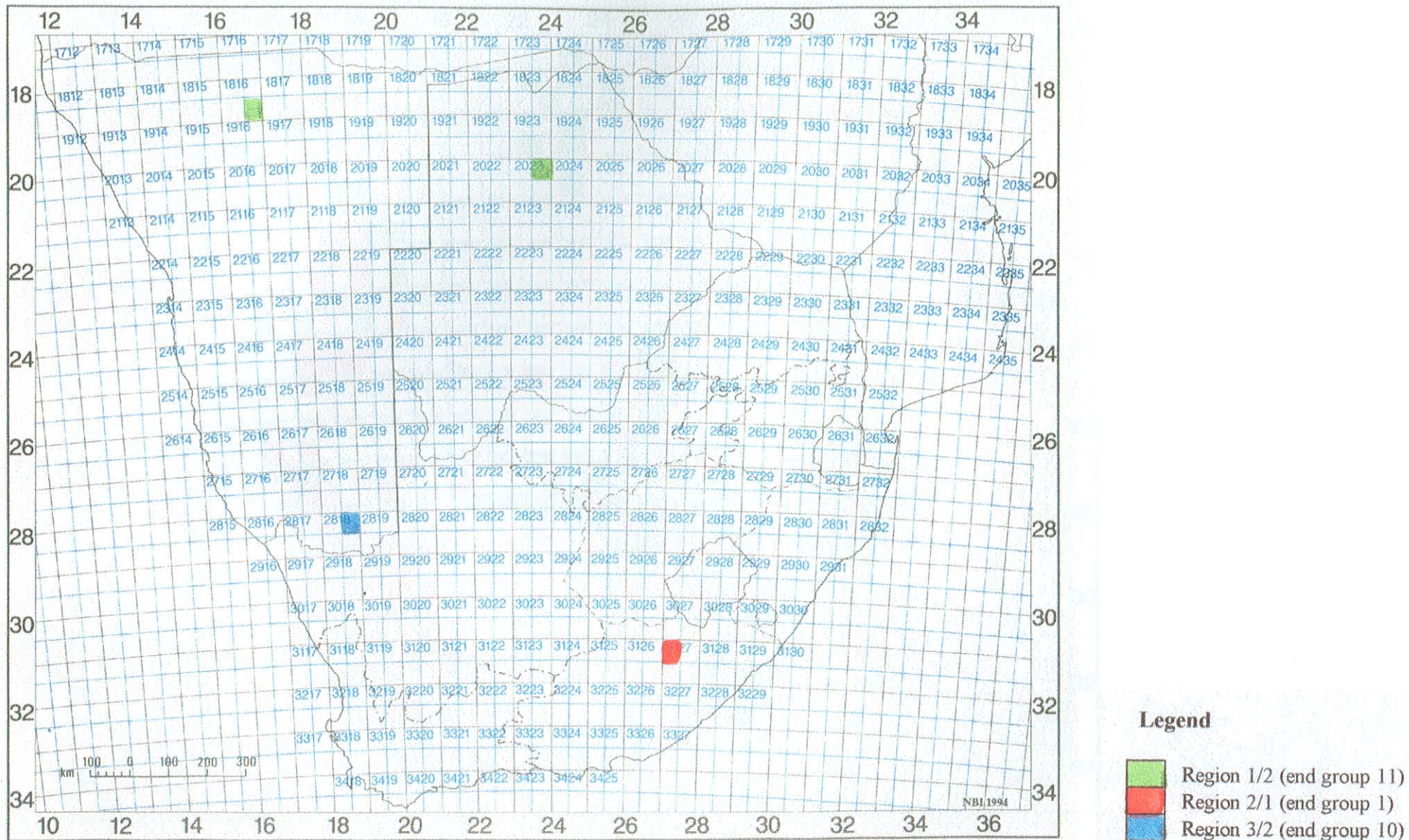


Figure 27. The bryogeographic regions delimited at the first three divisions of the TWINSPLAN Complete grid classification (regions 1/2, 2/1 and 3/2 or end groups 1, 10 and 11). The numbering of the groups is the same as in the dendrogram of the TWINSPLAN Complete grid classification (Figure 26).

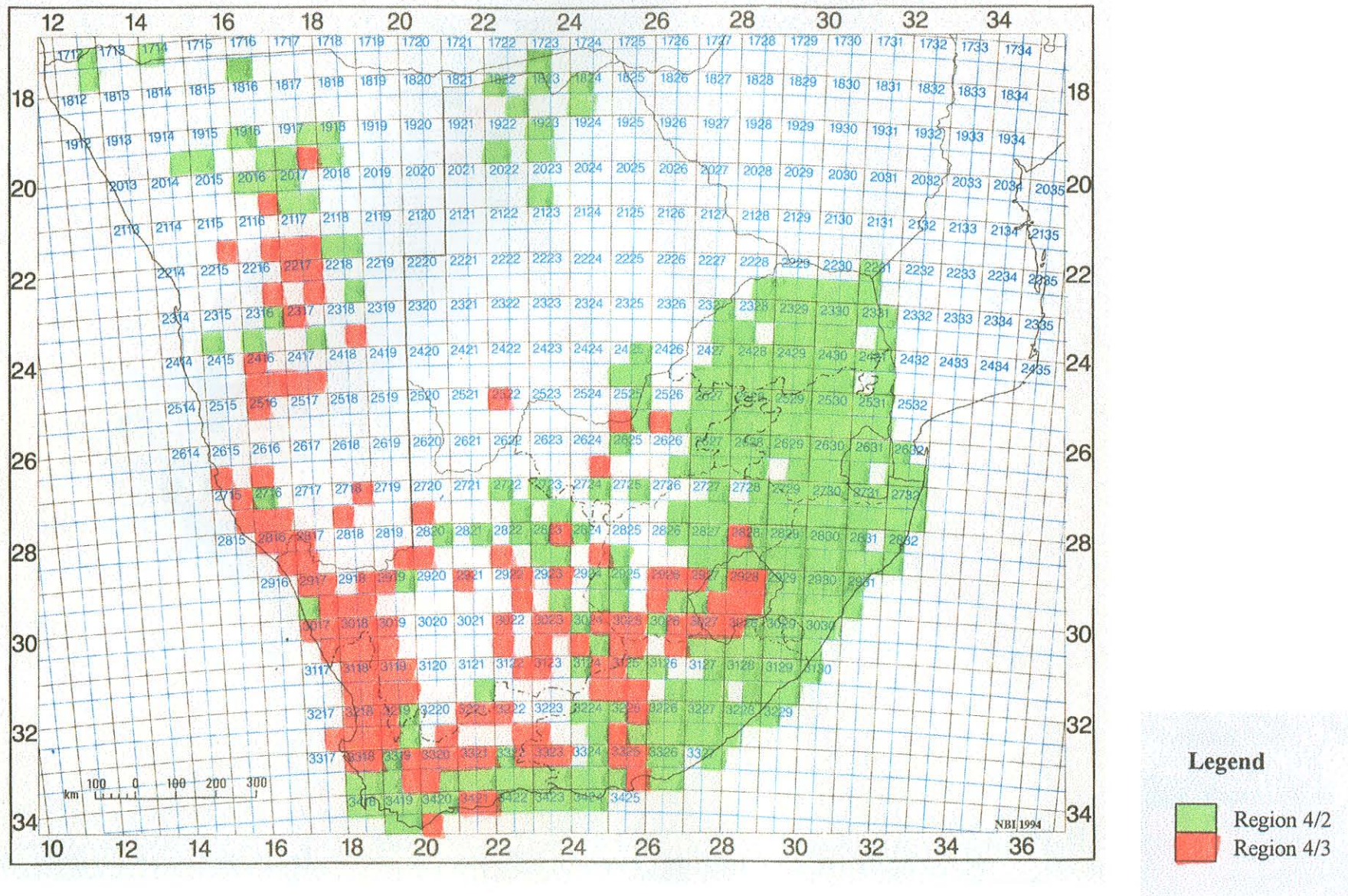


Figure 28. The two main bryogeographic regions in southern Africa (regions 4/2 and 4/3) as delimited by the TWINSpan Complete grid classification (4th level of division, regions 2 & 3). The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan Complete grid classification (Figure 26).

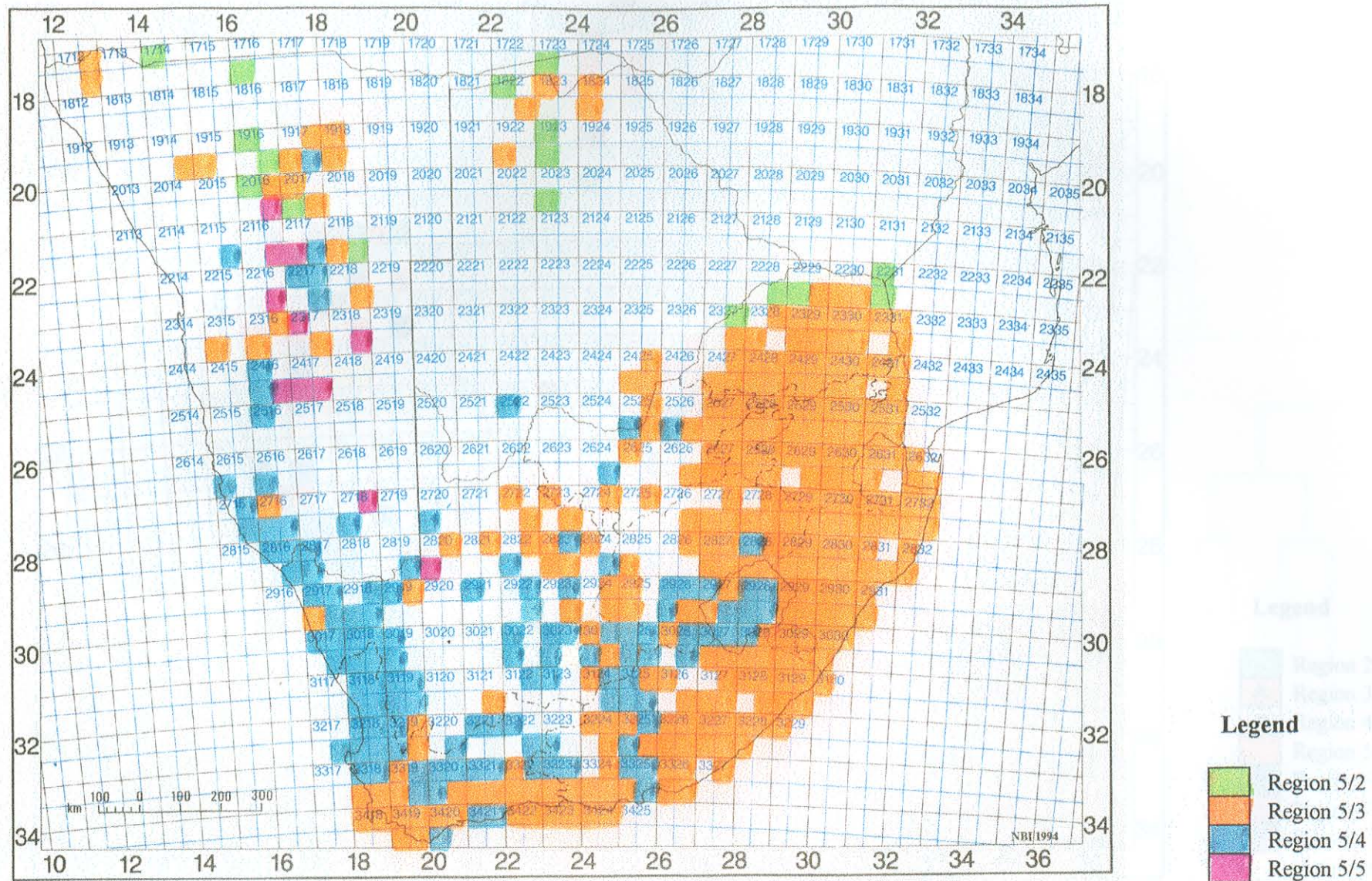


Figure 29. The four main bryogeographic regions in southern Africa (regions 5/2, 5/3, 5/4 and 5/5) as delimited by the TWINSpan Complete grid classification (5th level of division, groups 2–5). The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan Complete grid classification (Figure 26).

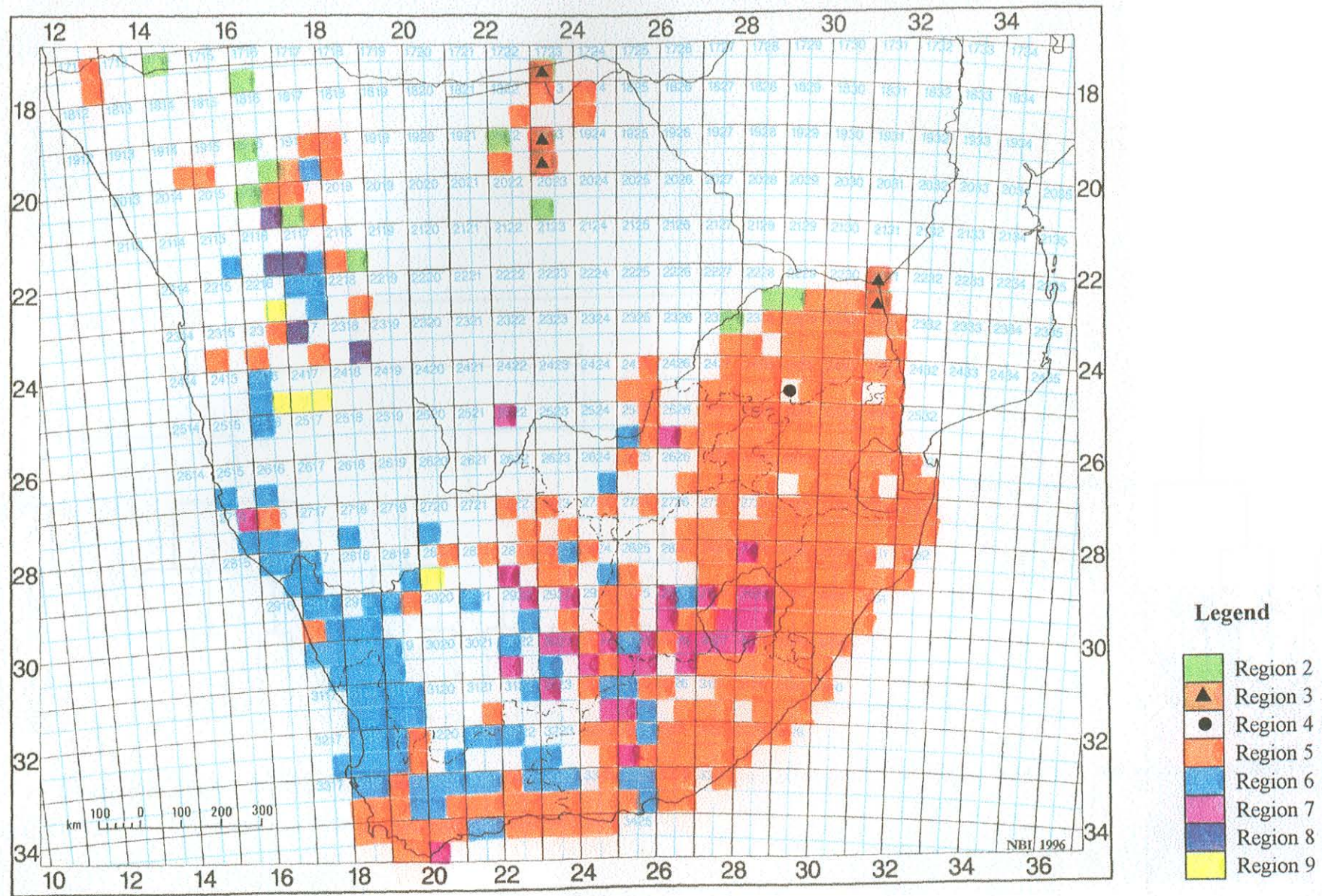


Figure 30. The eight main bryogeographic regions in southern Africa (end groups or regions 2-9) delimited by the TWINSpan Complete grid classification. The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan Complete grid classification (Figure 26).

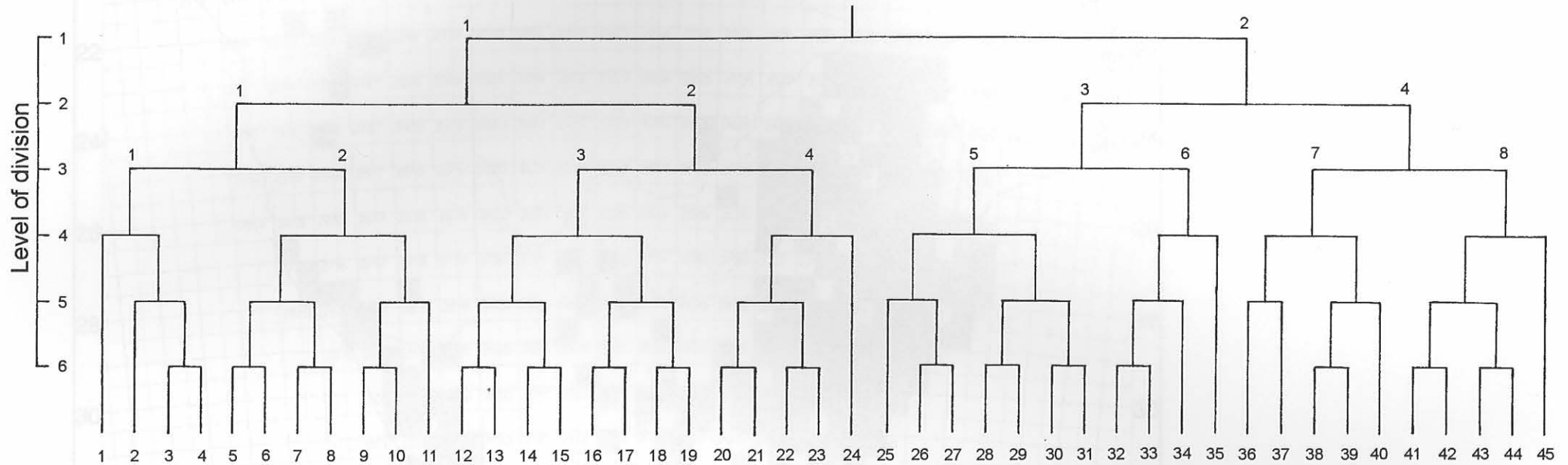


Figure 31. Dendrogram of the TWINSpan 3+ classification of grid squares into **bryofloristic regions**. The regions at the different levels of division have been numbered in the order of the two-way matrix.

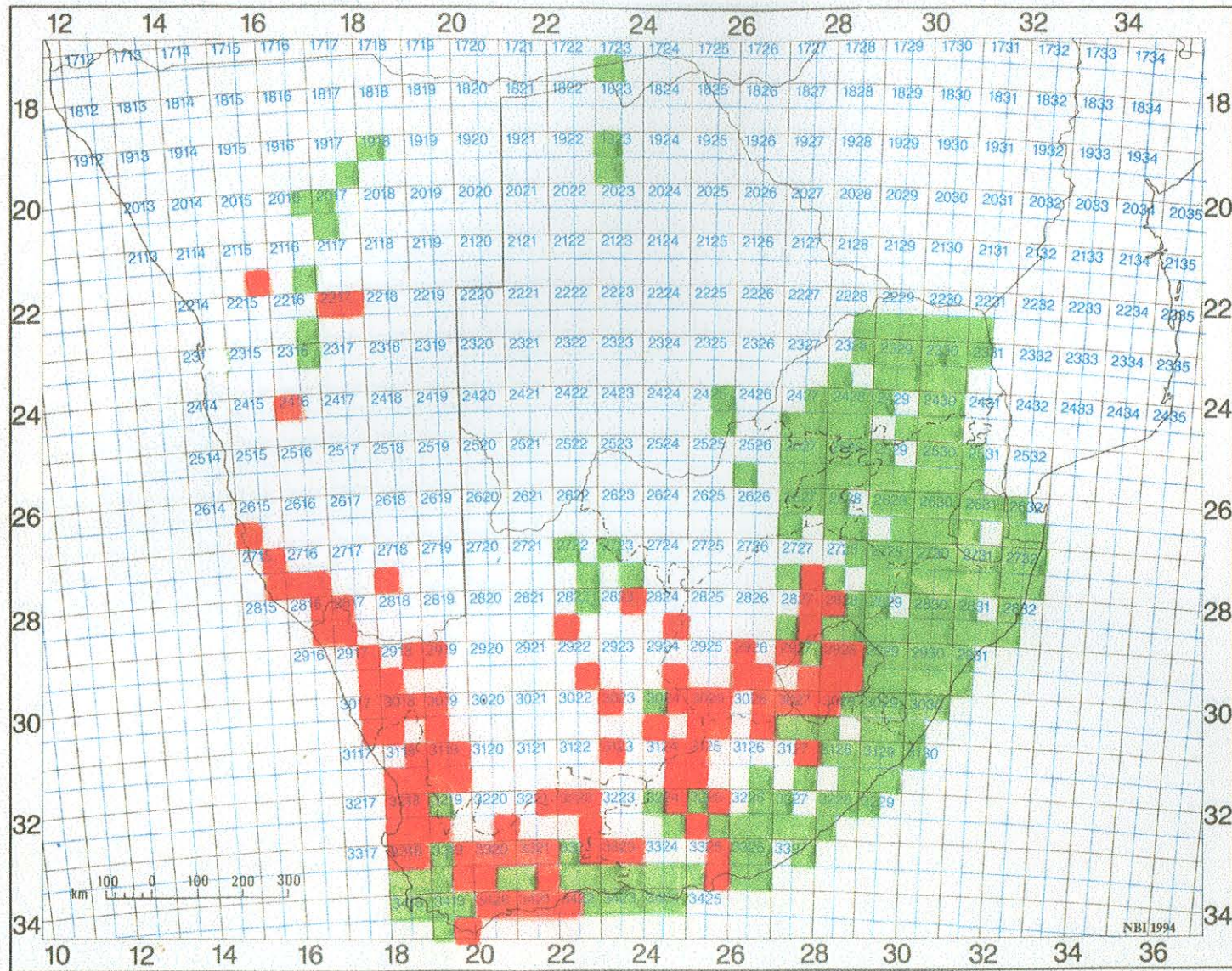


Figure 32. The two main bryogeographic regions in southern Africa (regions 1/1 and 1/2) as delimited by the TWINSpan 3+ grid classification (1st level of division, groups 1 & 2). The numbering of the groups is the same as in the dendrogram of the TWINSpan 3+ grid classification (Figure 31).

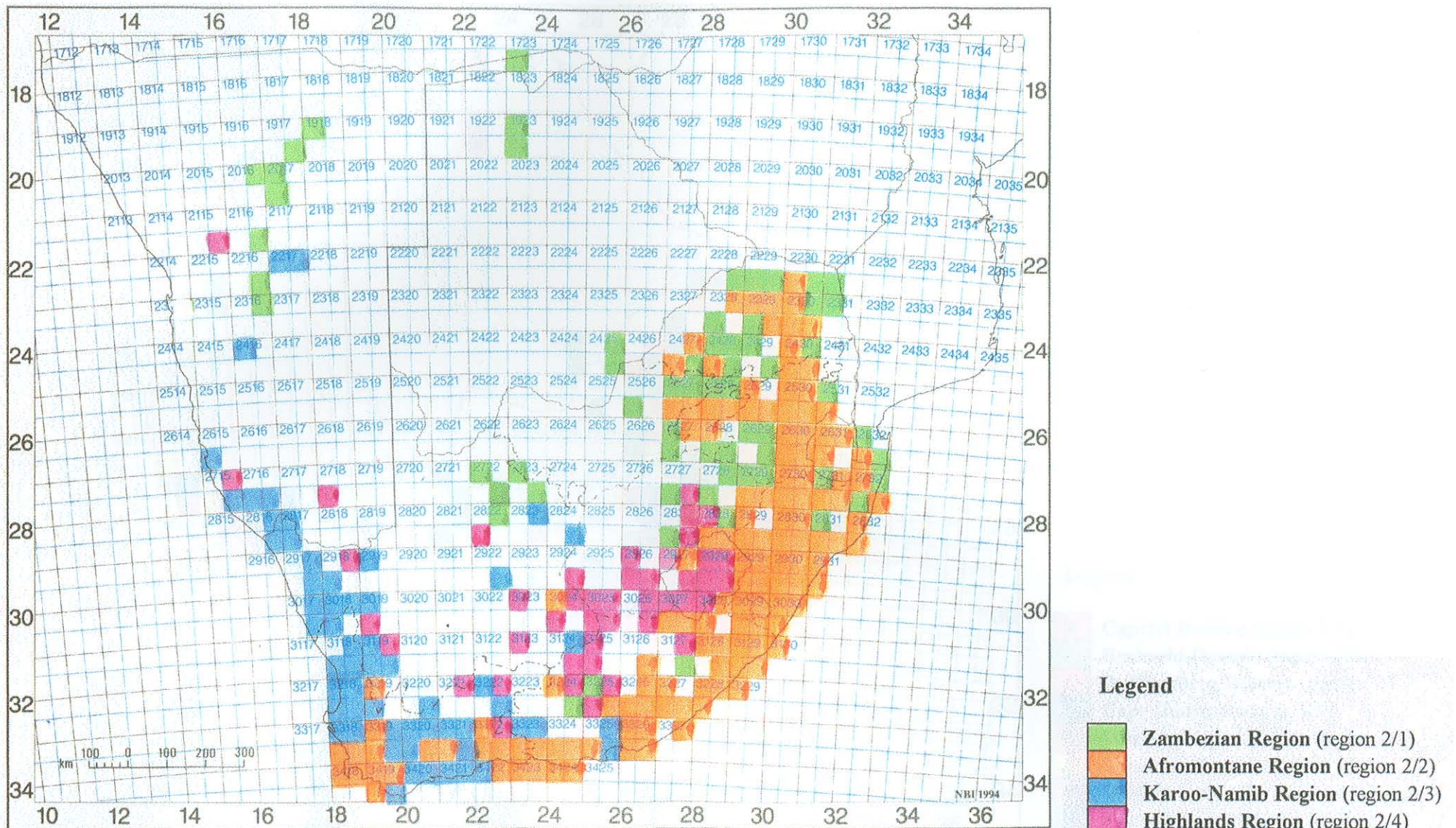


Figure 33. The **Bryogeographic Regions** of southern Africa as delimited by the **TWINSpan 3+** grid classification (2nd level of division, groups 1–4). The numbering of the groups is the same as in the dendrogram of the **TWINSpan 3+** grid classification (Figure 31).

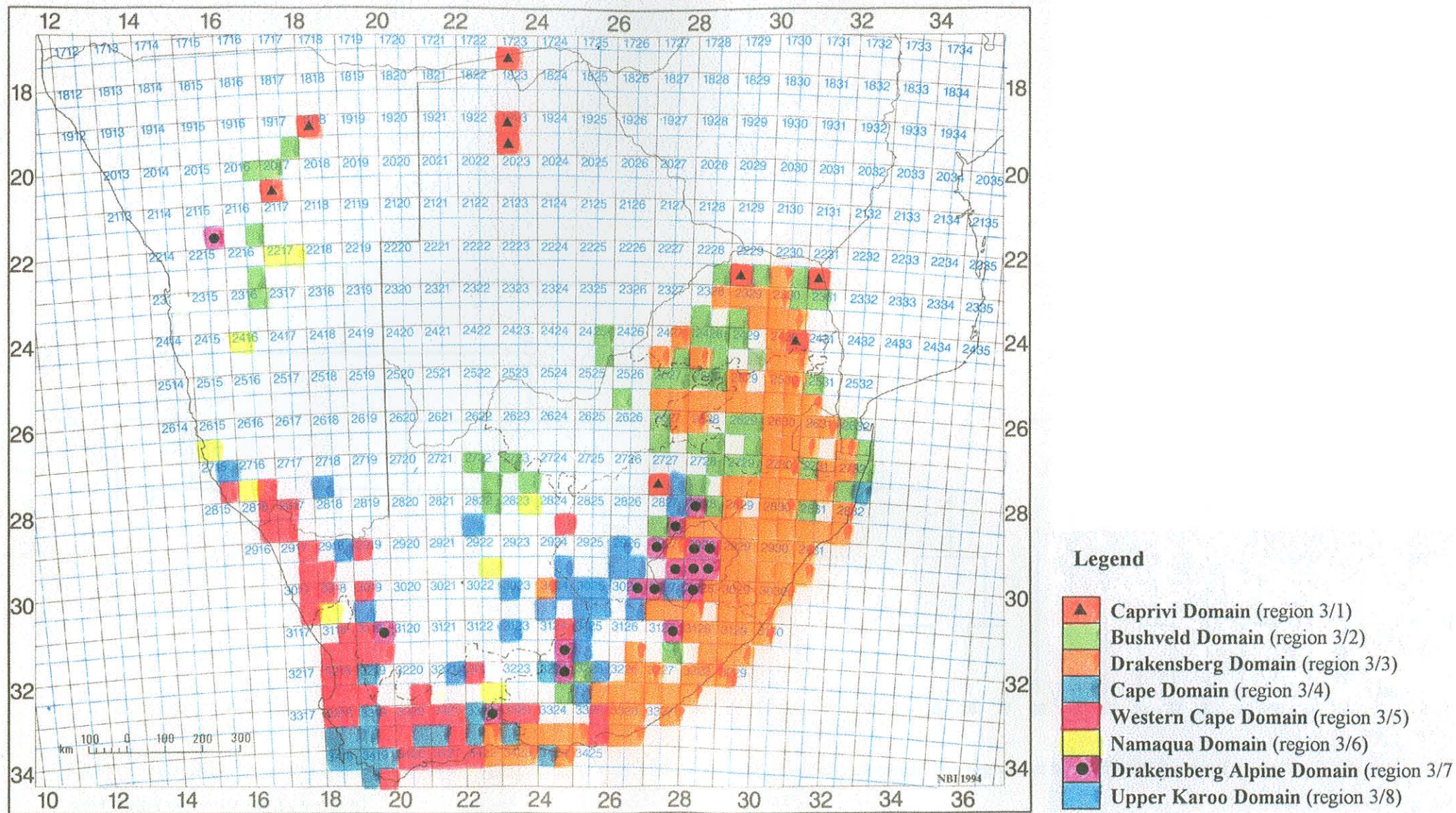


Figure 34. The **Bryogeographic Domains** of southern Africa as delimited by the **TWINSpan 3+** grid classification (3rd level of division, groups 1–8). The numbering of the groups (regions) is the same as in the dendrogram of the **TWINSpan 3+** grid classification (Figure 31).

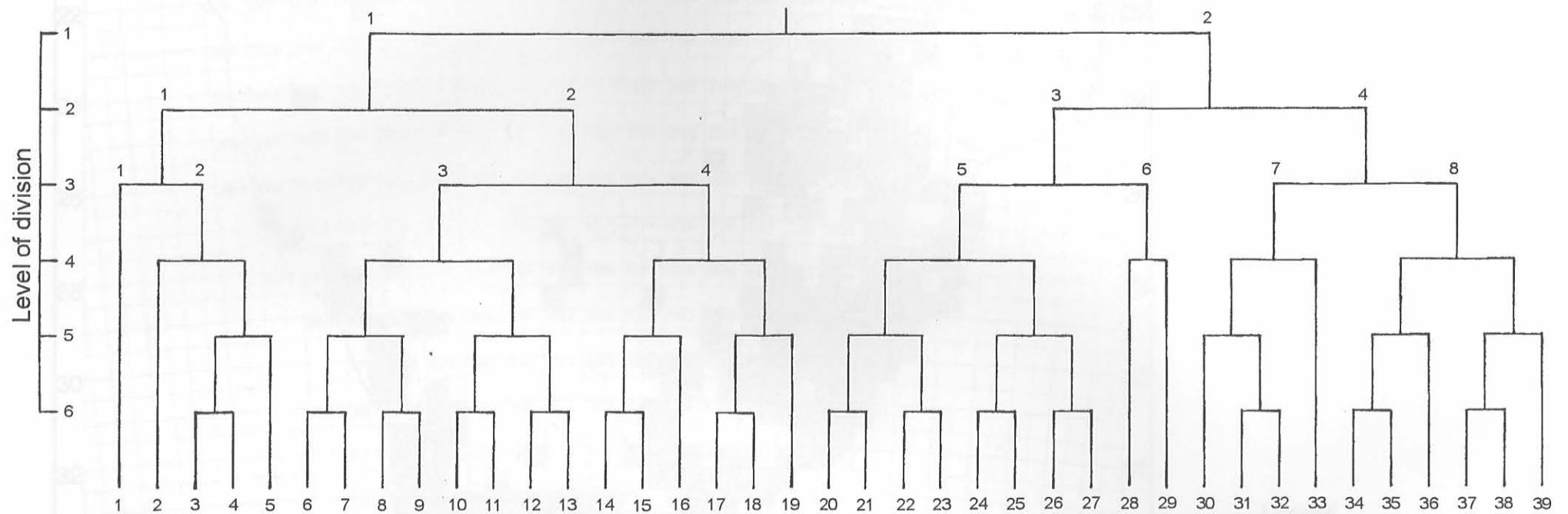


Figure 35. Dendrogram of the **TWINSpan 5+** classification of grid squares into **bryofloristic regions**. The regions at the different levels of division have been numbered in the order of the two-way matrix.

Figure 36. The two main biogeographic regions in southern Africa (regions 1 & 2) as defined by the **TWINSpan 5+** grid classification (division groups 1 & 2). The numbering of the groups (regions) is the same as in the dendrogram of the **TWINSpan 5+** grid classification.

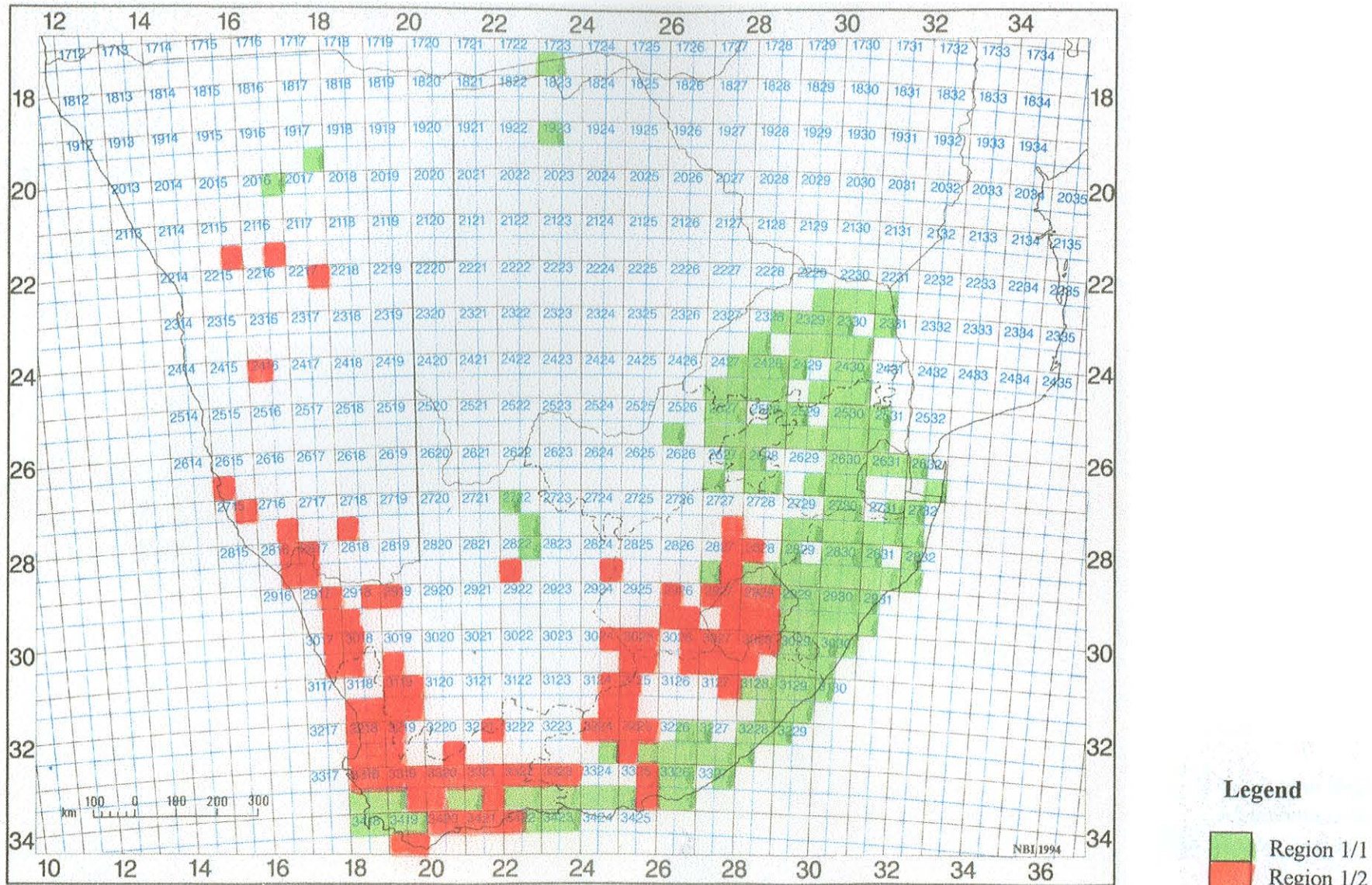


Figure 36. The two main bryogeographic regions in southern Africa (regions 1/1 and 1/2) as delimited by the TWINSpan 5+ grid classification (1st level of division, groups 1 & 2). The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan 5+ grid classification (Figure 35).

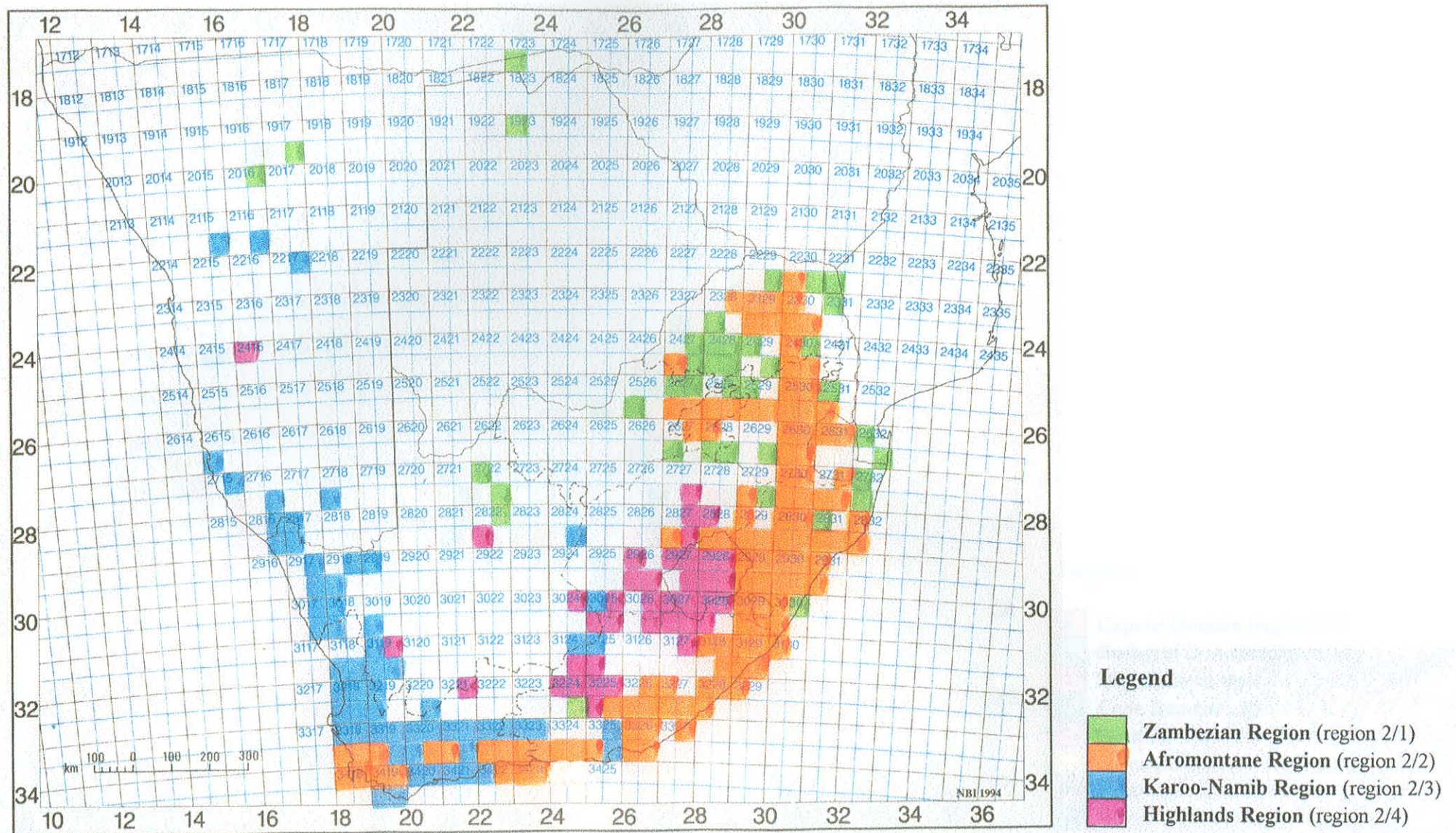
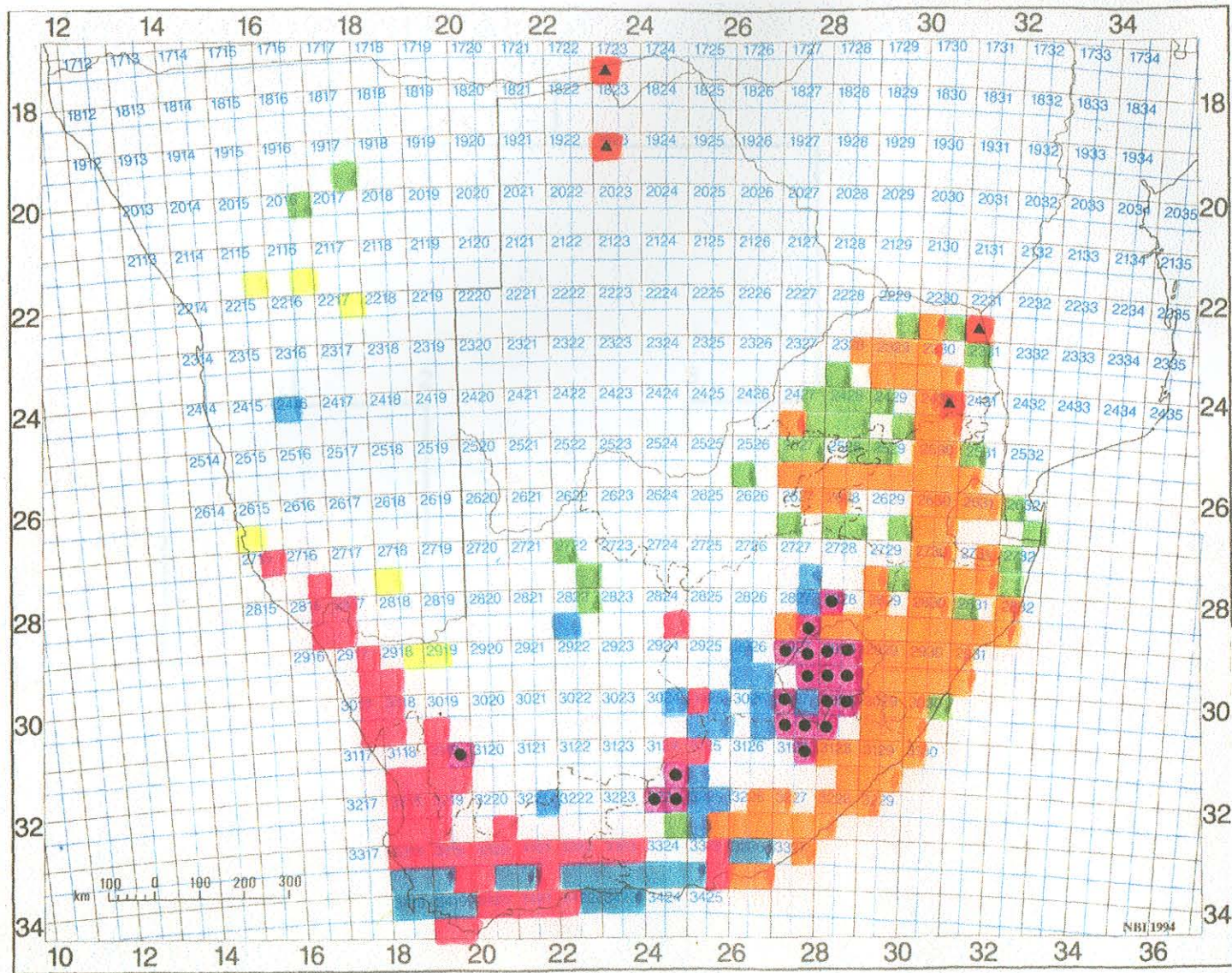


Figure 37. The **Bryogeographic Regions** of southern Africa as delimited by the **TWINSpan 5+** grid classification (2nd level of division, groups 1–4). The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan 5+ grid classification (Figure 35).



Legend

- ▲ Caprivi Domain (region 3/1)
- Bushveld Domain (region 3/2)
- Drakensberg Domain (region 3/3)
- Cape Domain (region 3/4)
- Western Cape Domain (region 3/5)
- Namaqua Domain (region 3/6)
- Drakensberg Alpine Domain (region 3/7)
- Upper Karoo Domain (region 3/8)

Figure 38. The **Bryogeographic Domains** of southern Africa as delimited by the **TWINSpan 5+** grid classification (3rd level of division, groups 1–8). The numbering of the groups (regions) is the same as in the dendrogram of the TWINSpan 5+ grid classification (Figure 35).

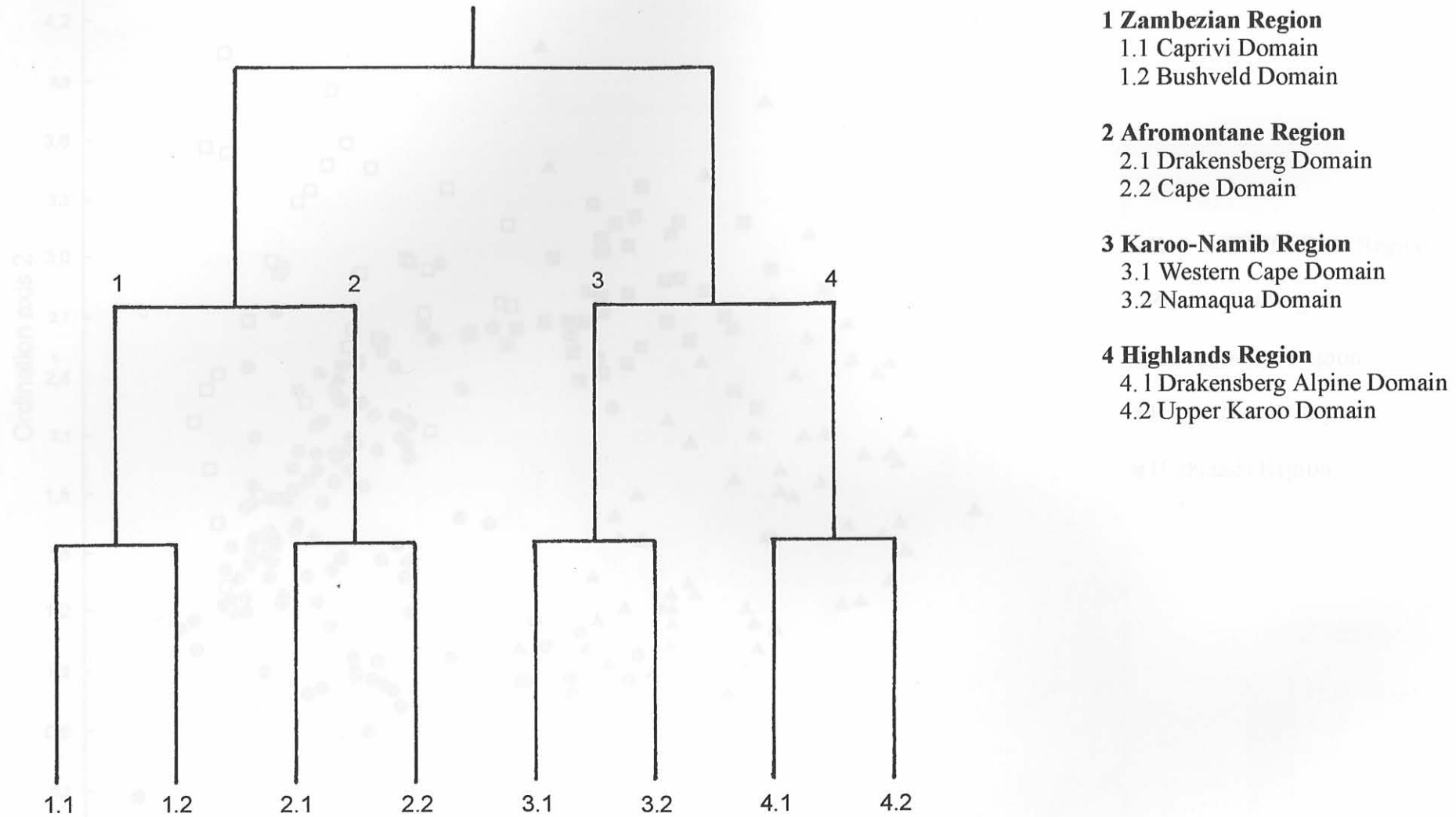


Figure 39. Hierarchical classification of the bryofloristic Regions and Domains of southern Africa.

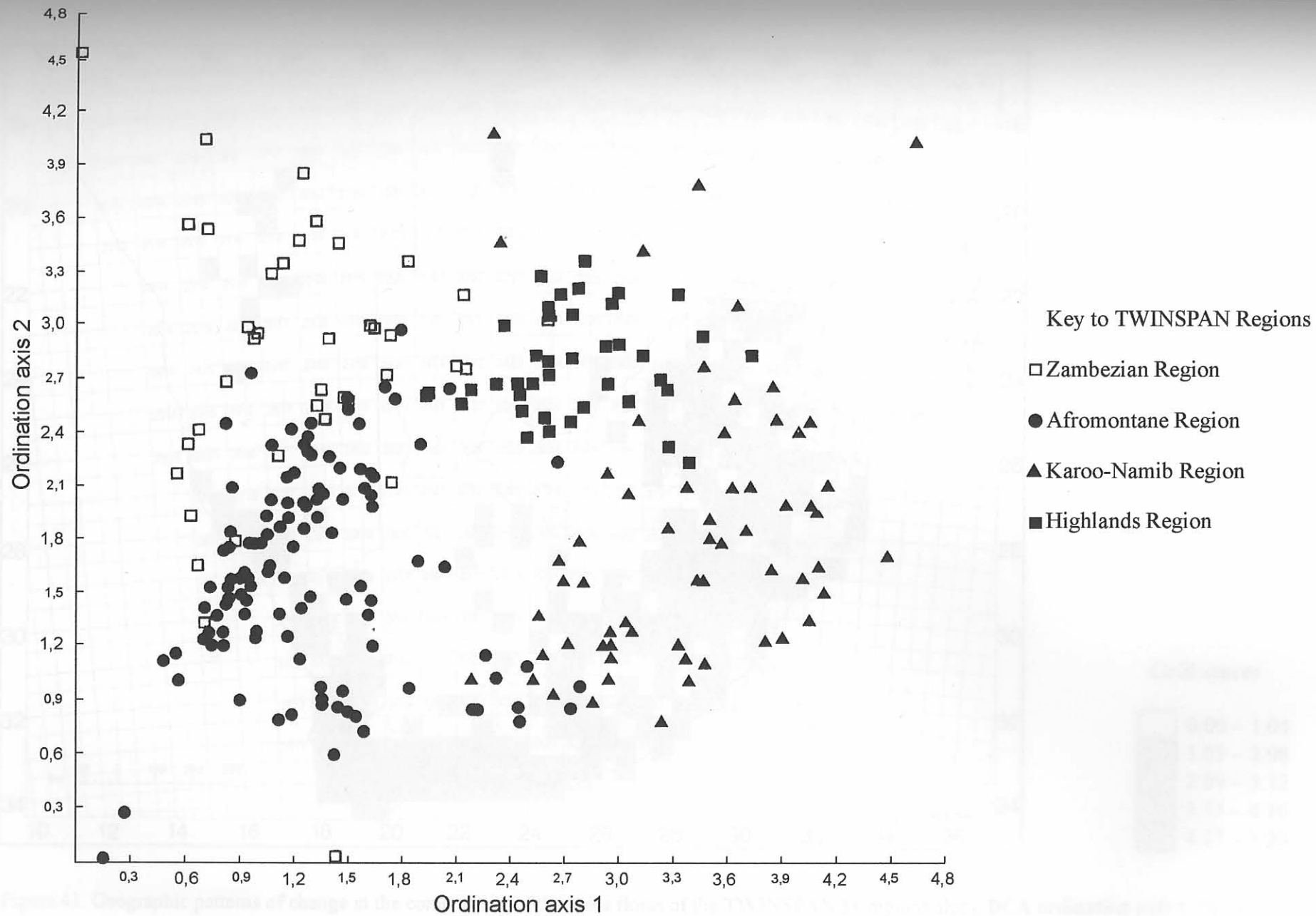


Figure 40. Distribution of TWINSPAN 5+ Regions along the first two axes of a DCA ordination of TWINSPAN 5+ grid squares. Scale marks are in standard deviation (SD) units.

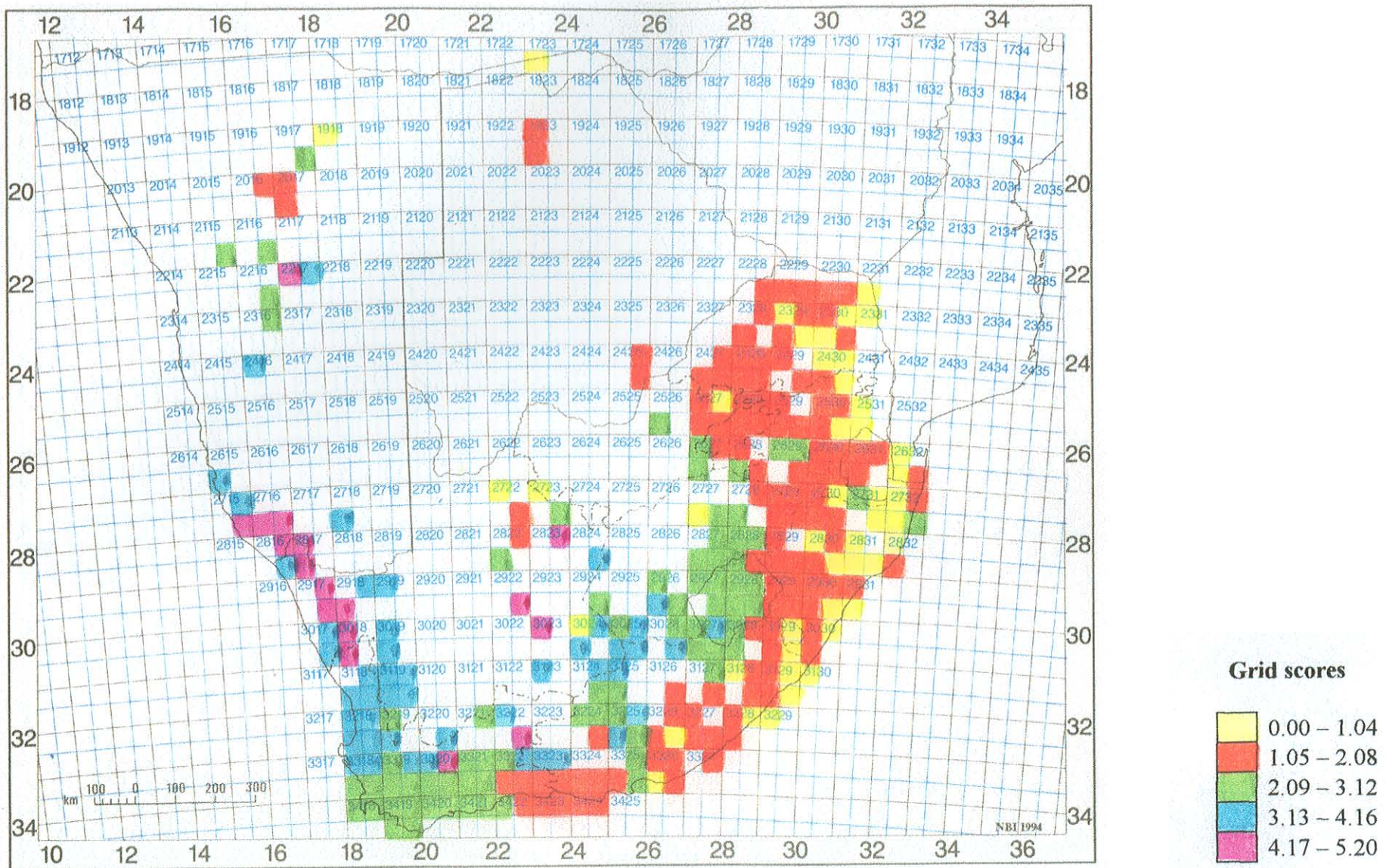


Figure 41. Geographic patterns of change in the composition of the moss floras of the TWINSpan 3+ regions along DCA ordination axis 1. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

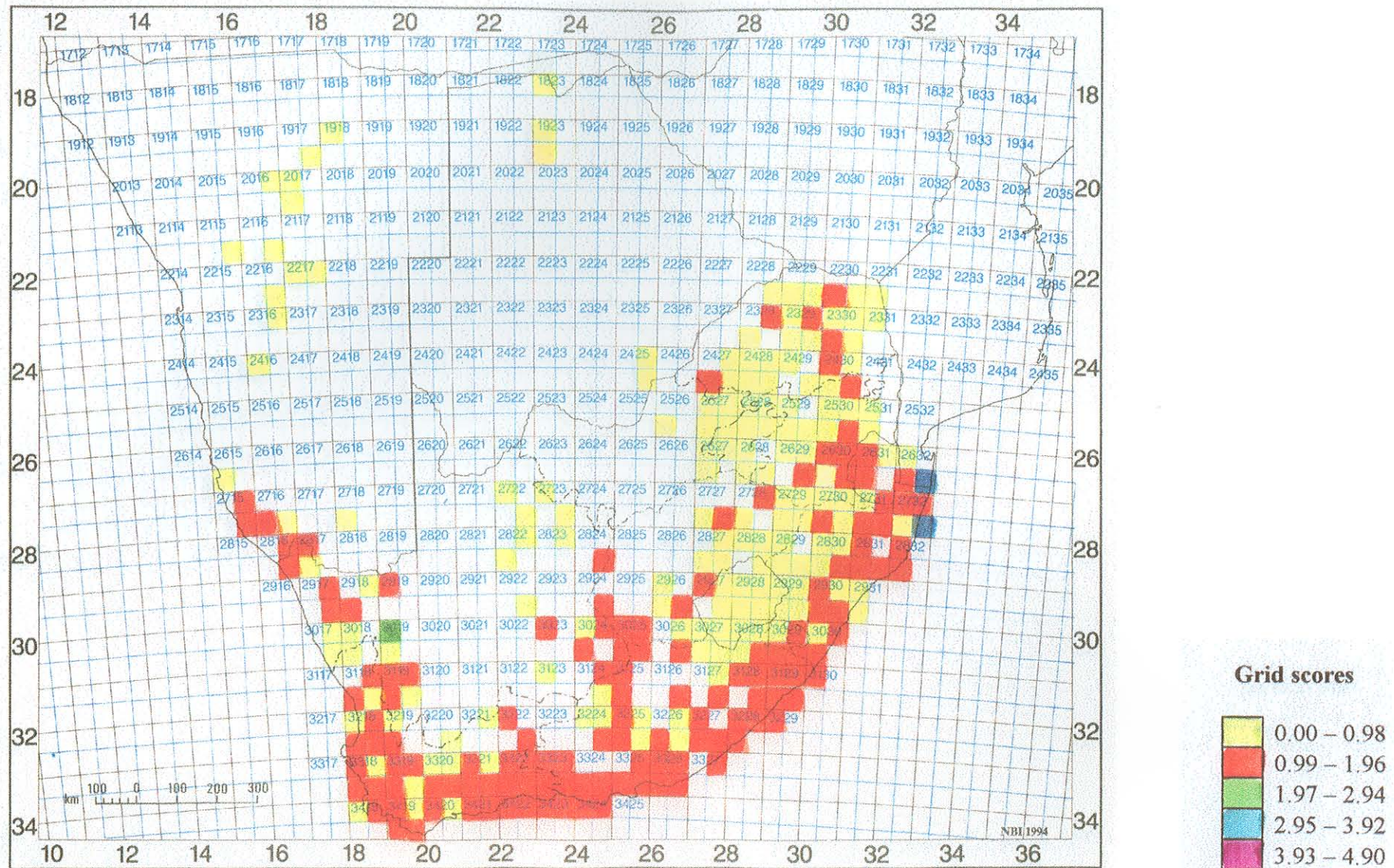


Figure 42. Geographic patterns of change in the composition of the moss floras of the TWINSpan 3+ regions along DCA ordination axis 2. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

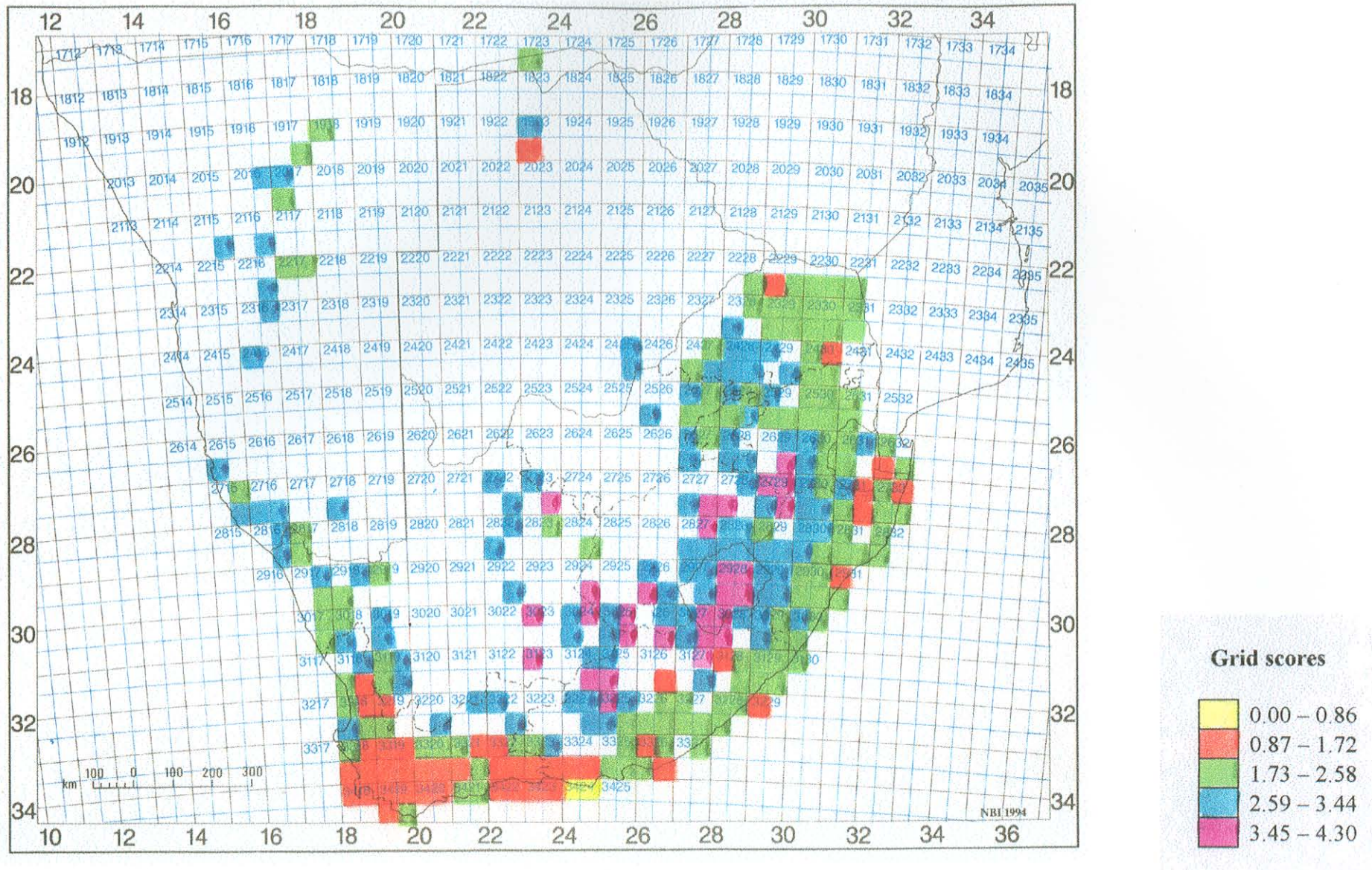


Figure 43. Geographic patterns of change in the composition of the moss floras of the TWINSpan 3+ regions along DCA ordination axis 3. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

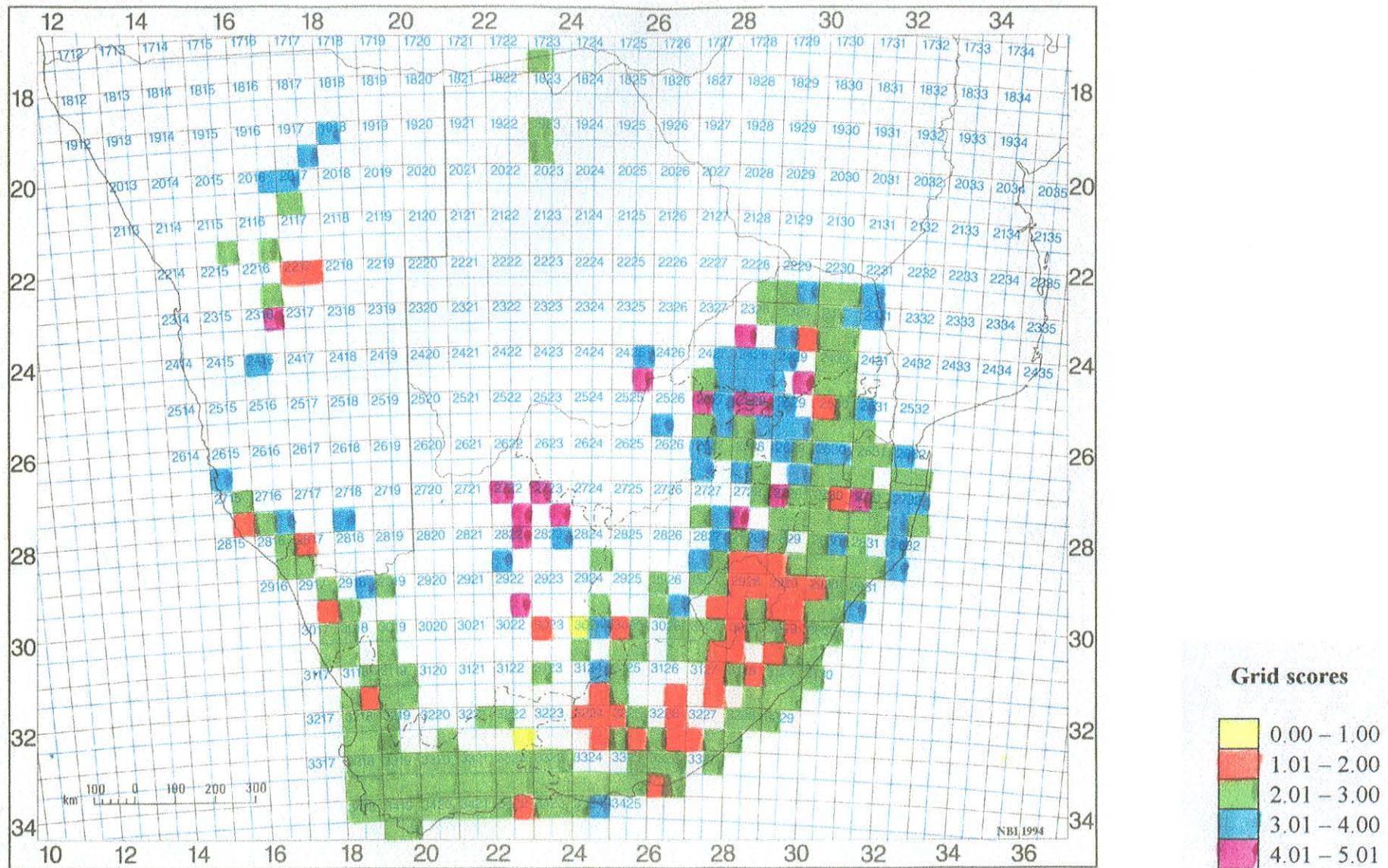


Figure 44. Geographic patterns of change in the composition of the moss floras of the TWINSPAN 3+ regions along DCA ordination axis 4. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

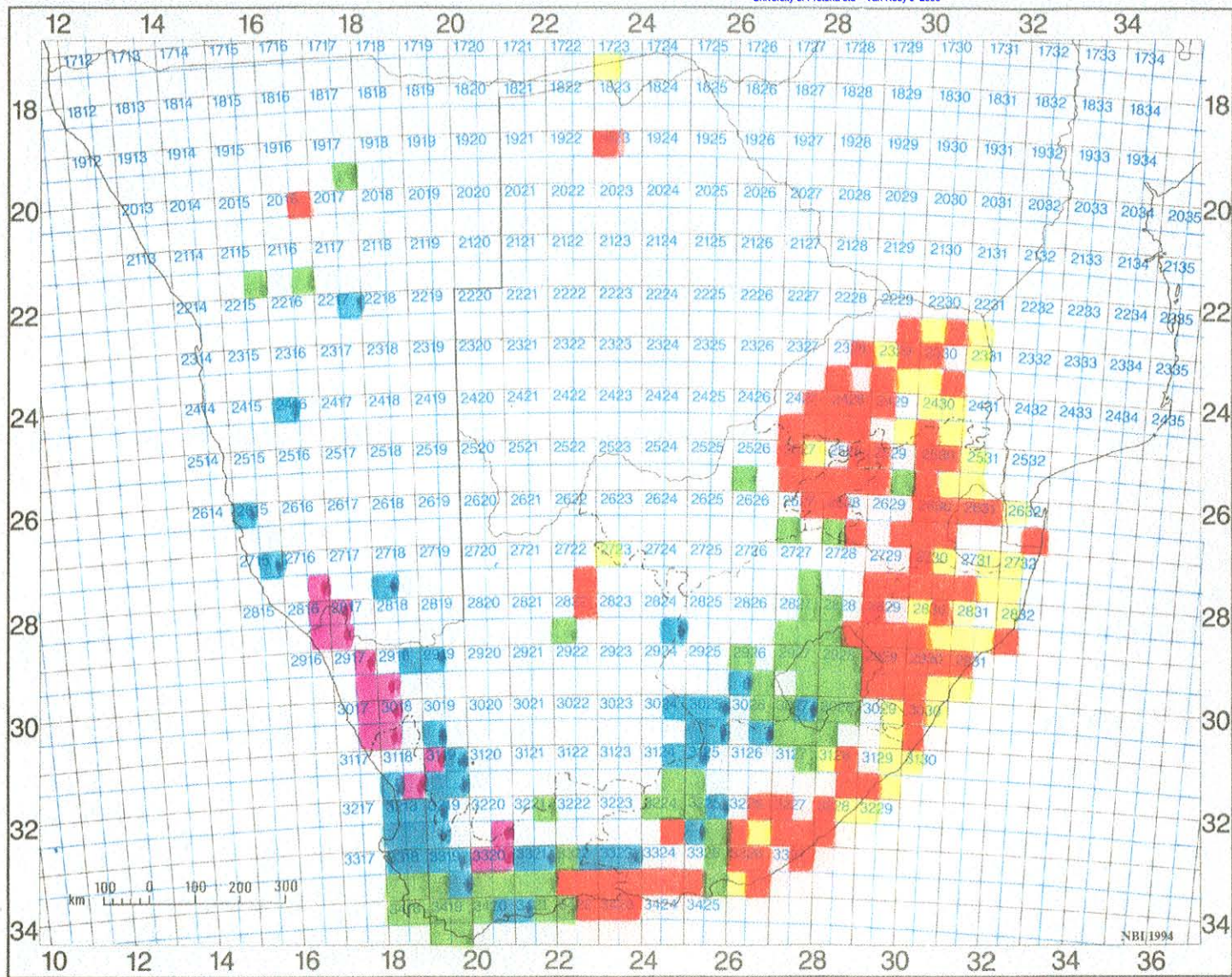


Figure 45. Geographic patterns of change in the composition of the moss floras of the TWINSPAN 5+ regions along DCA ordination axis 1. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

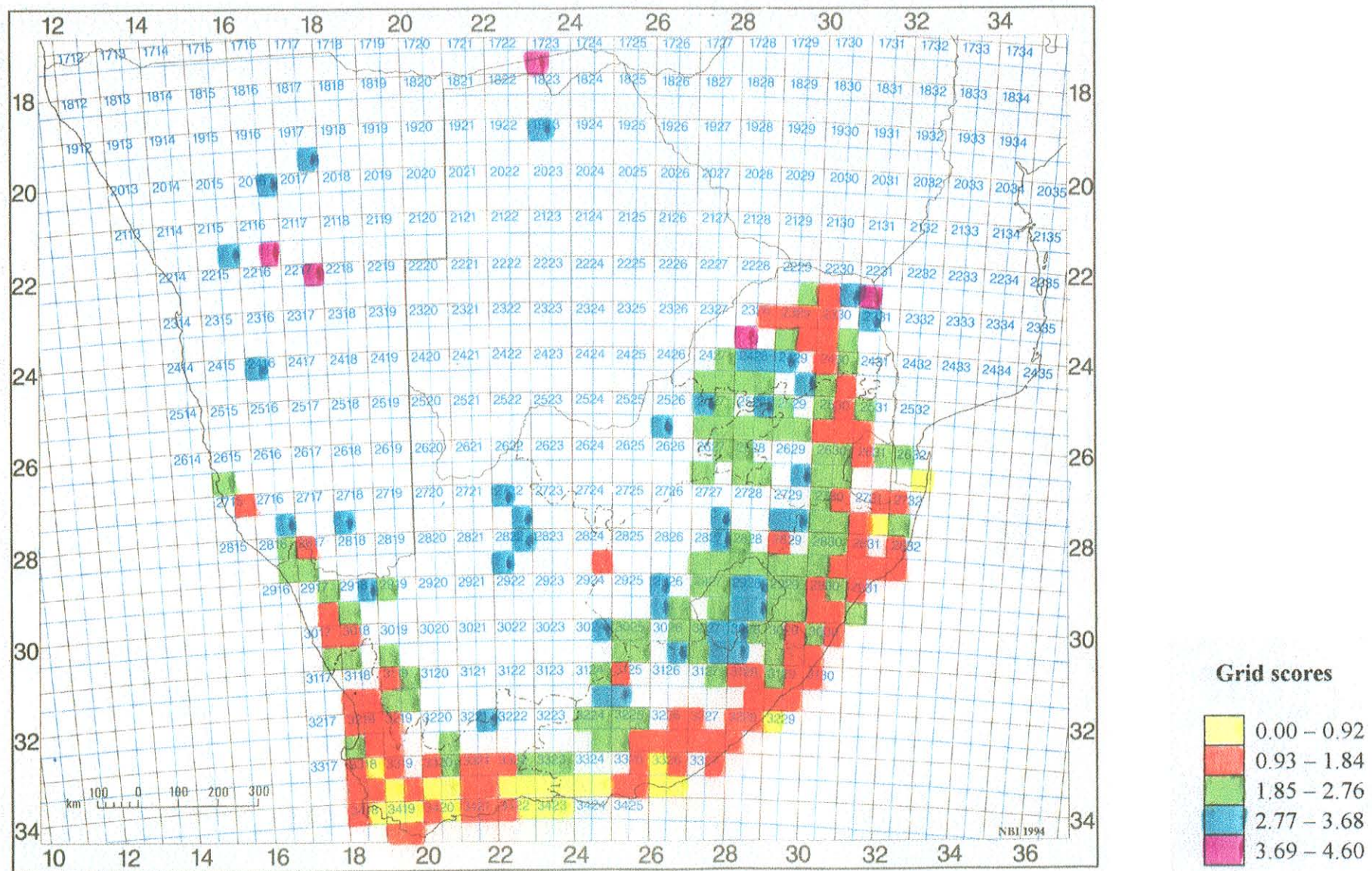


Figure 46. Geographic patterns of change in the composition of the moss flora of the TWINSpan 5+ regions along DCA ordination axis 2. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

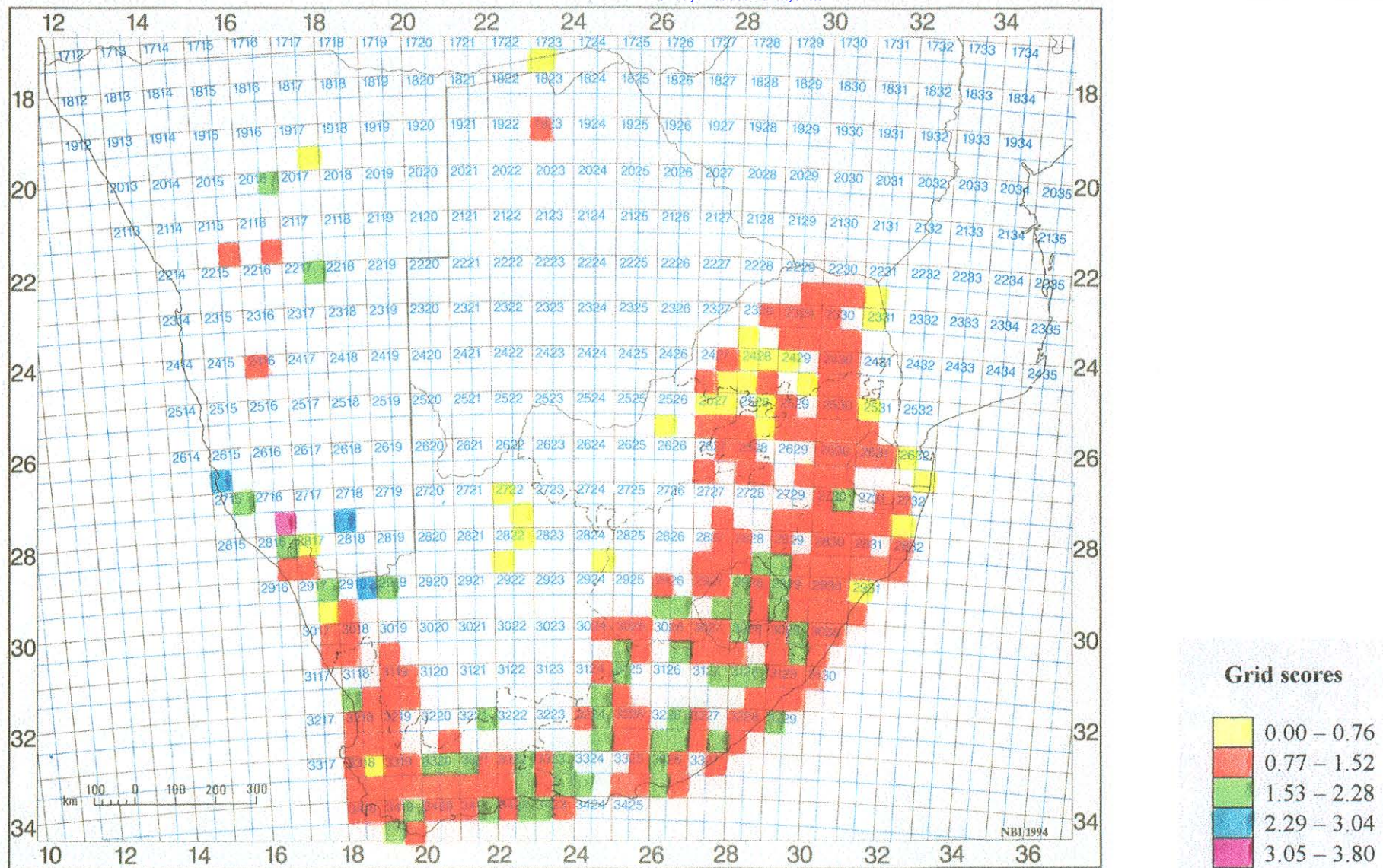


Figure 47. Geographic patterns of change in the composition of the moss floras of the TWINSpan 5+ regions along DCA ordination axis 3. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

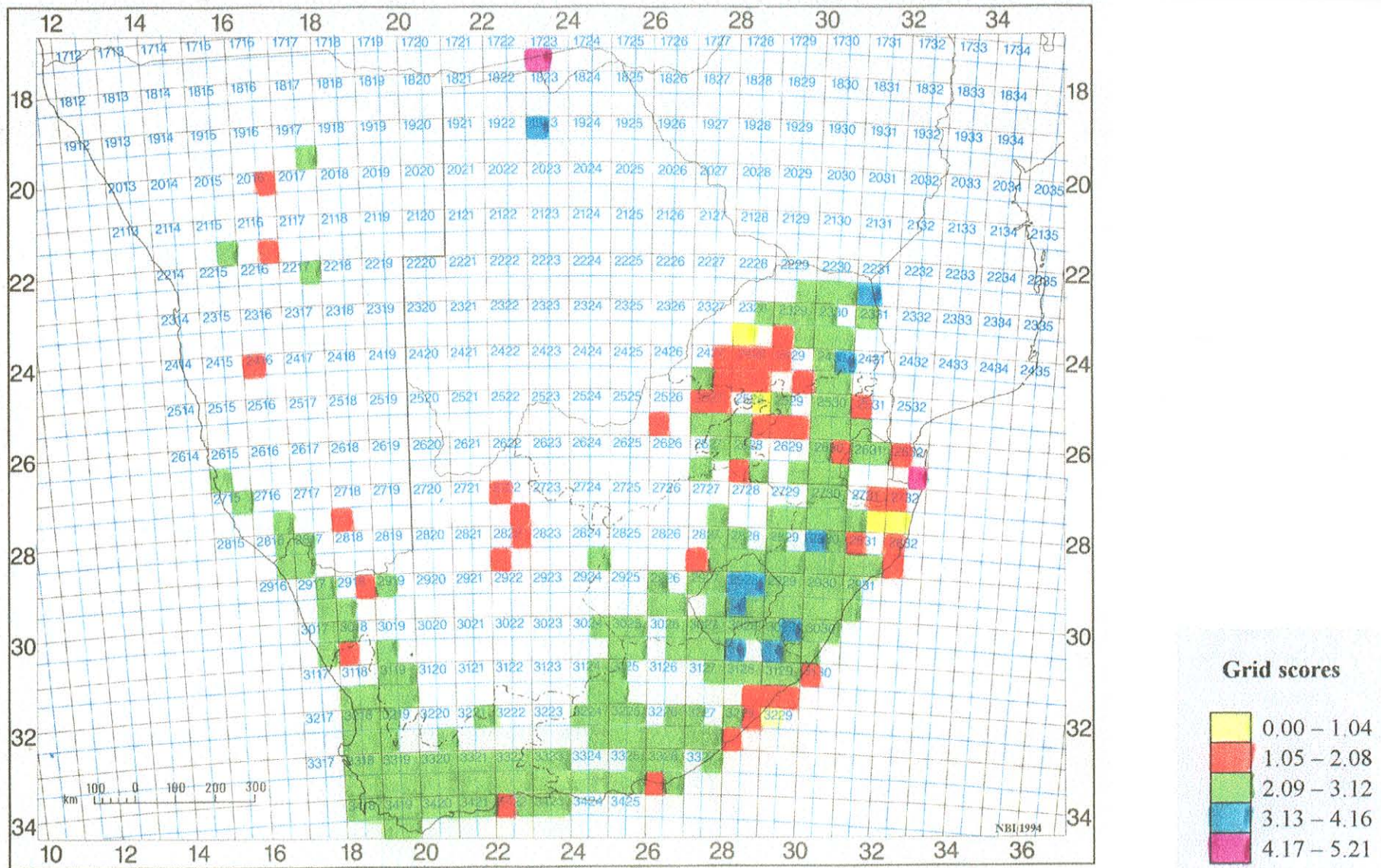


Figure 48. Geographic patterns of change in the composition of the moss floras of the TWINSpan 5+ regions along DCA ordination axis 4. The grid scores, given as standard deviation units (SD), have been divided into five intervals.

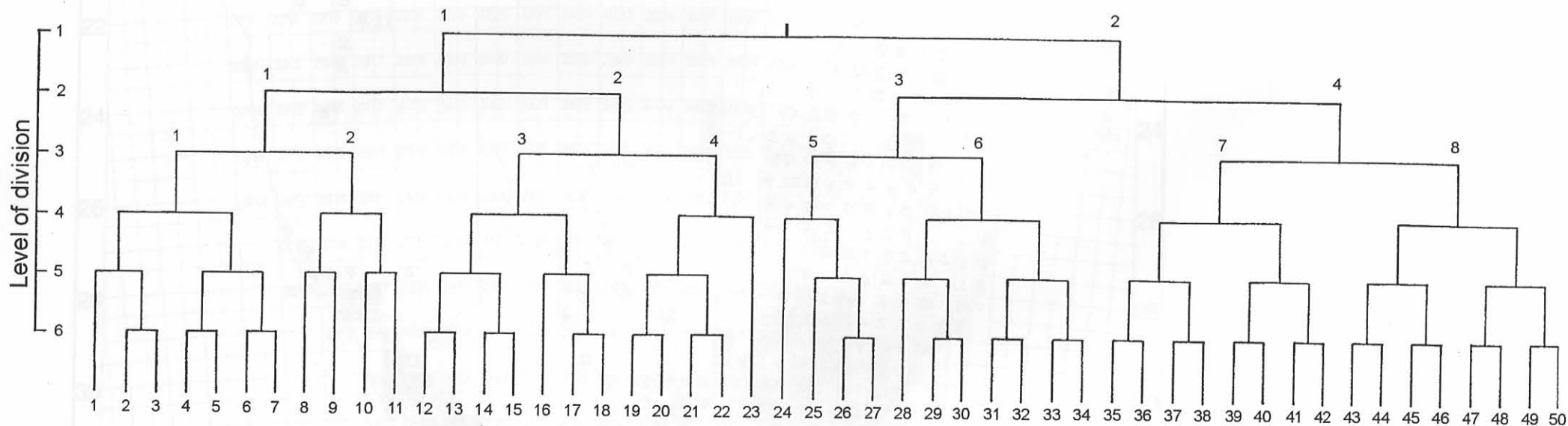


Figure 49. Dendrogram of the TWINSpan 3+ classification of species into bryofloristic elements.

Figure 50. The geographic distribution of bryofloristic element 1 (TWINSpan 3+ division 1, 1st level of division, group 1). The numbering of the groups in the tree is the same as in the dendrogram of the TWINSpan 3+ species classification (Figure 49).

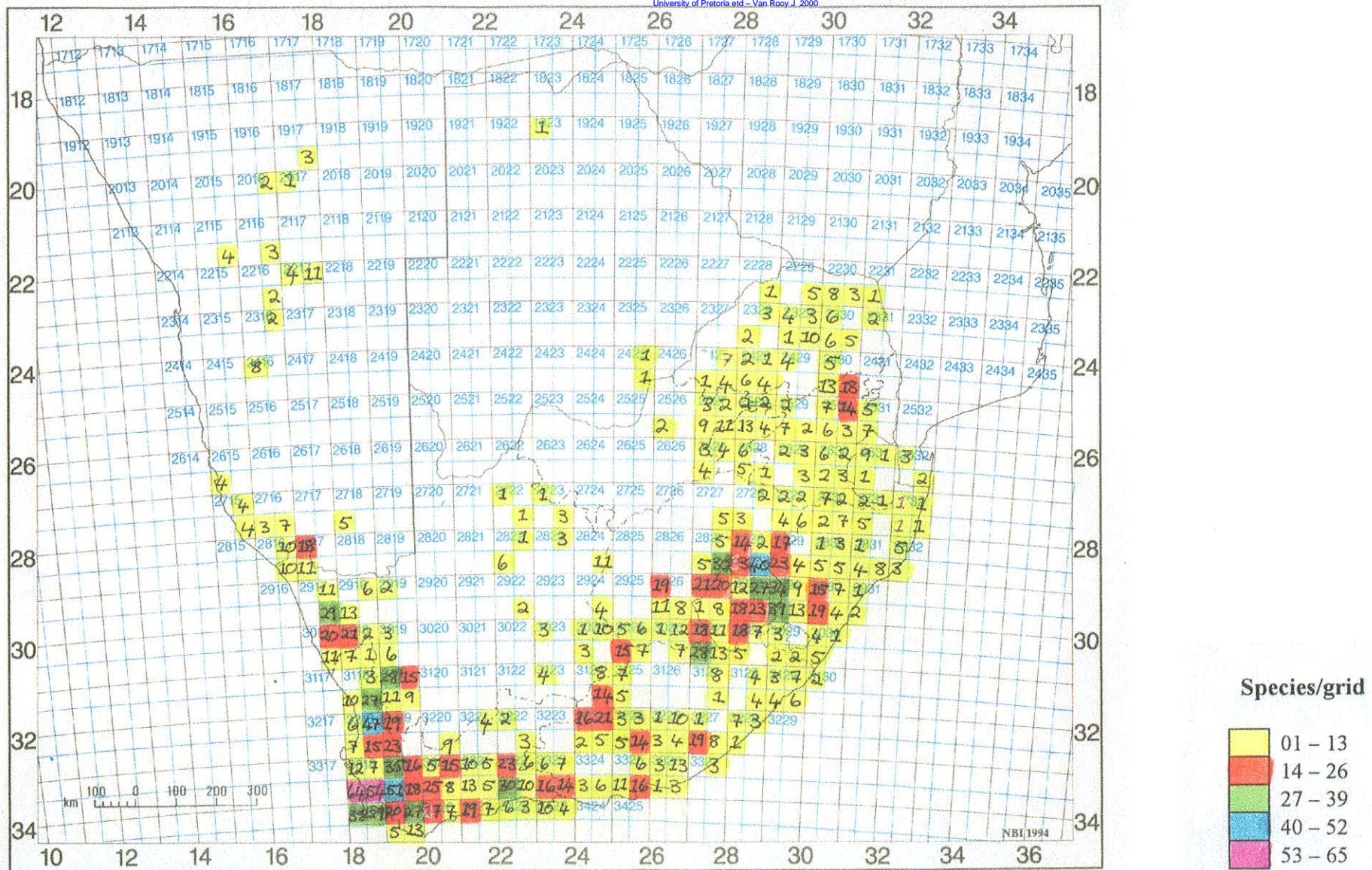


Figure 50. The geographic distribution of bryofloristic element 1/1 (TWINSPAN 3+ species classification, 1st level of division, group 1). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

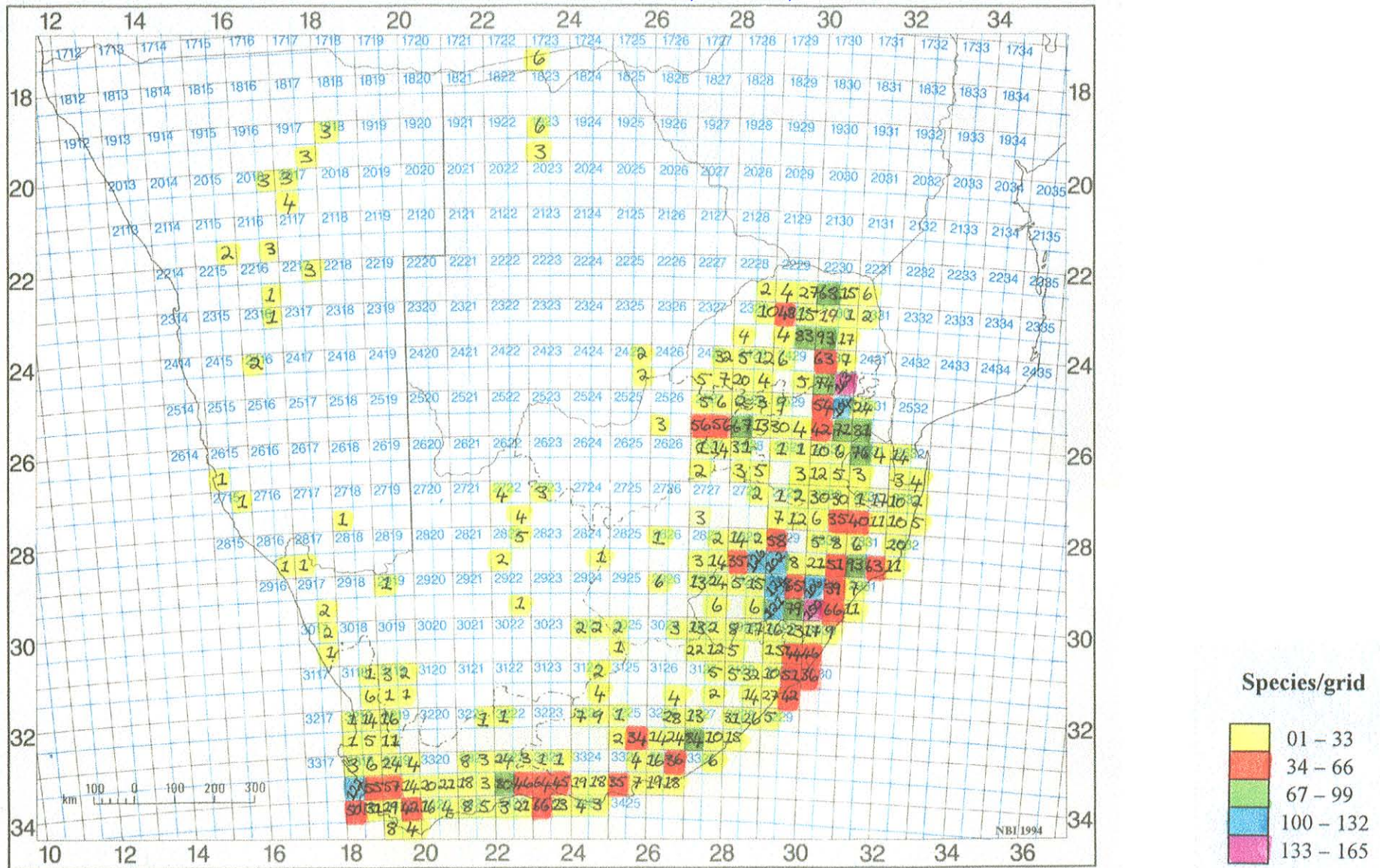


Figure 51. The geographic distribution of bryofloristic element 1/2 (TWINSPAN 3+ species classification, 1st level of division, group 2). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

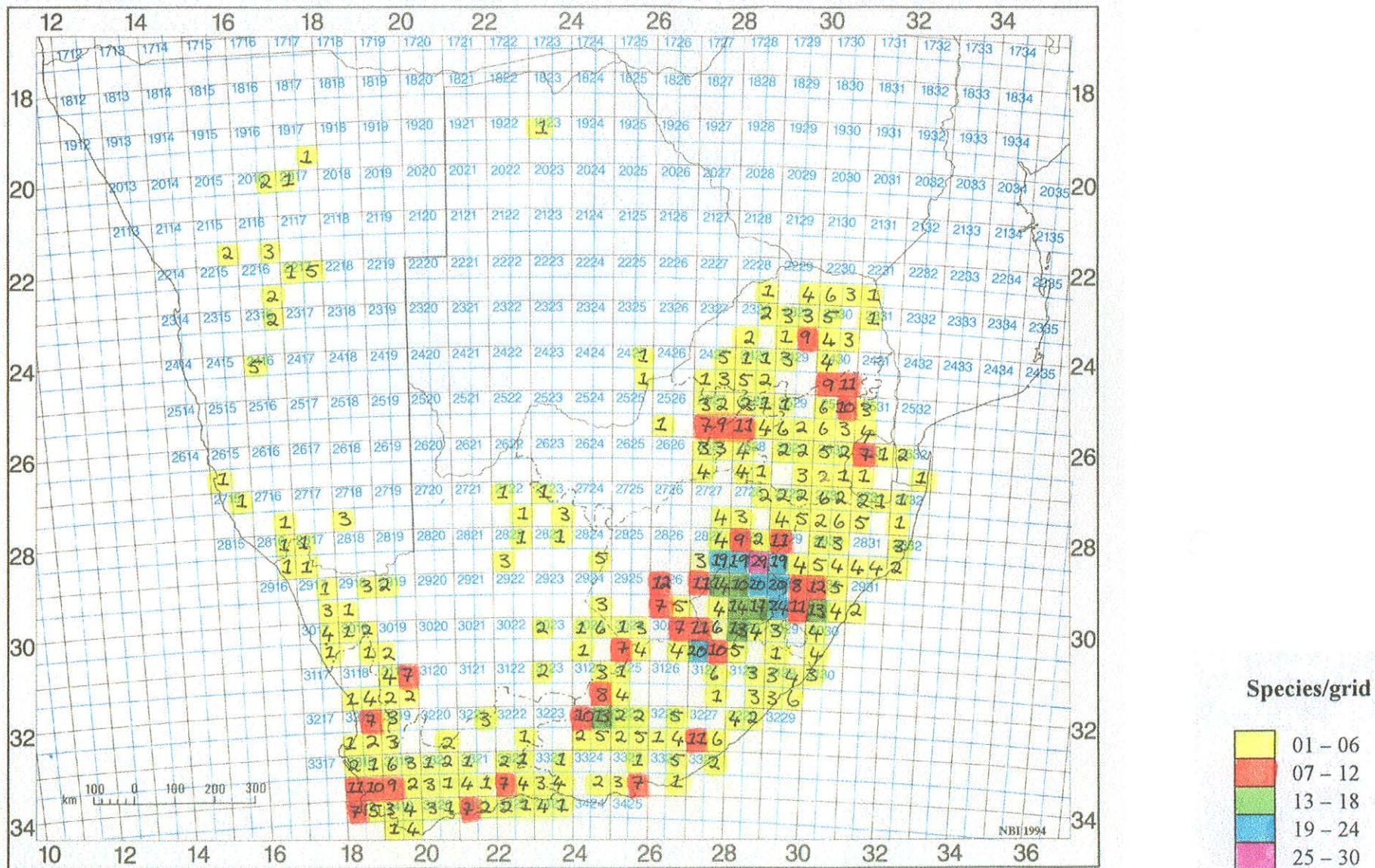


Figure 52. The geographic distribution of the **Eastern Highlands Element** or element 2/1 (TWINSPAN 3+ species classification, 2nd level of division, group 1). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

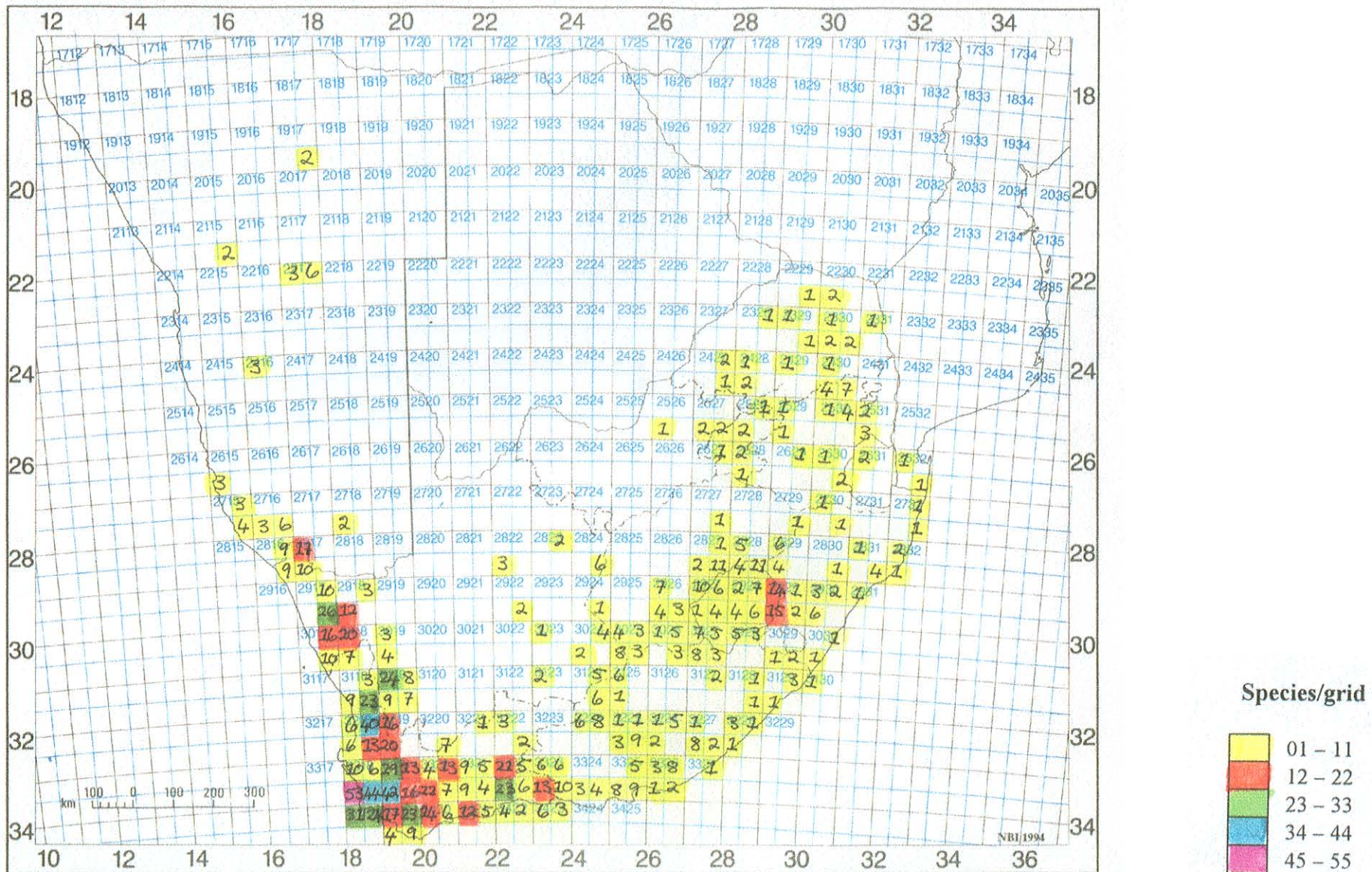


Figure 53. The geographic distribution of the **Cape Element** or element 2/2 (TWINSPLAN 3+ species classification, 2nd level of division, group 2). The numbering of the groups is the same as in the dendrogram of the TWINSPLAN 3+ species classification (Figure 49).

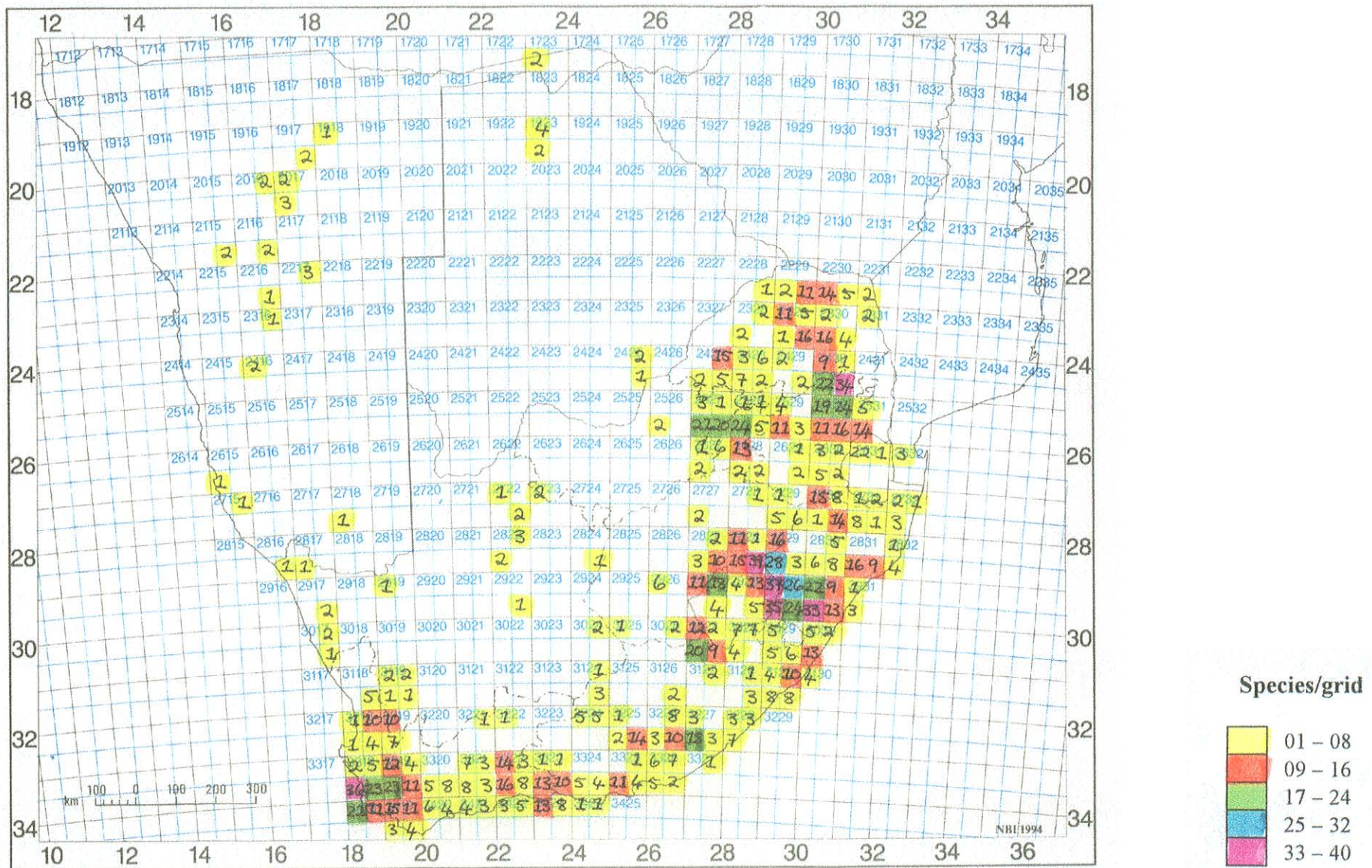


Figure 54. The geographic distribution of the **Afromontane Grassland Element** or element 2/3 (TWINSPAN 3+ species classification, 2nd level of division, group 3). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

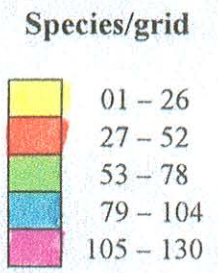
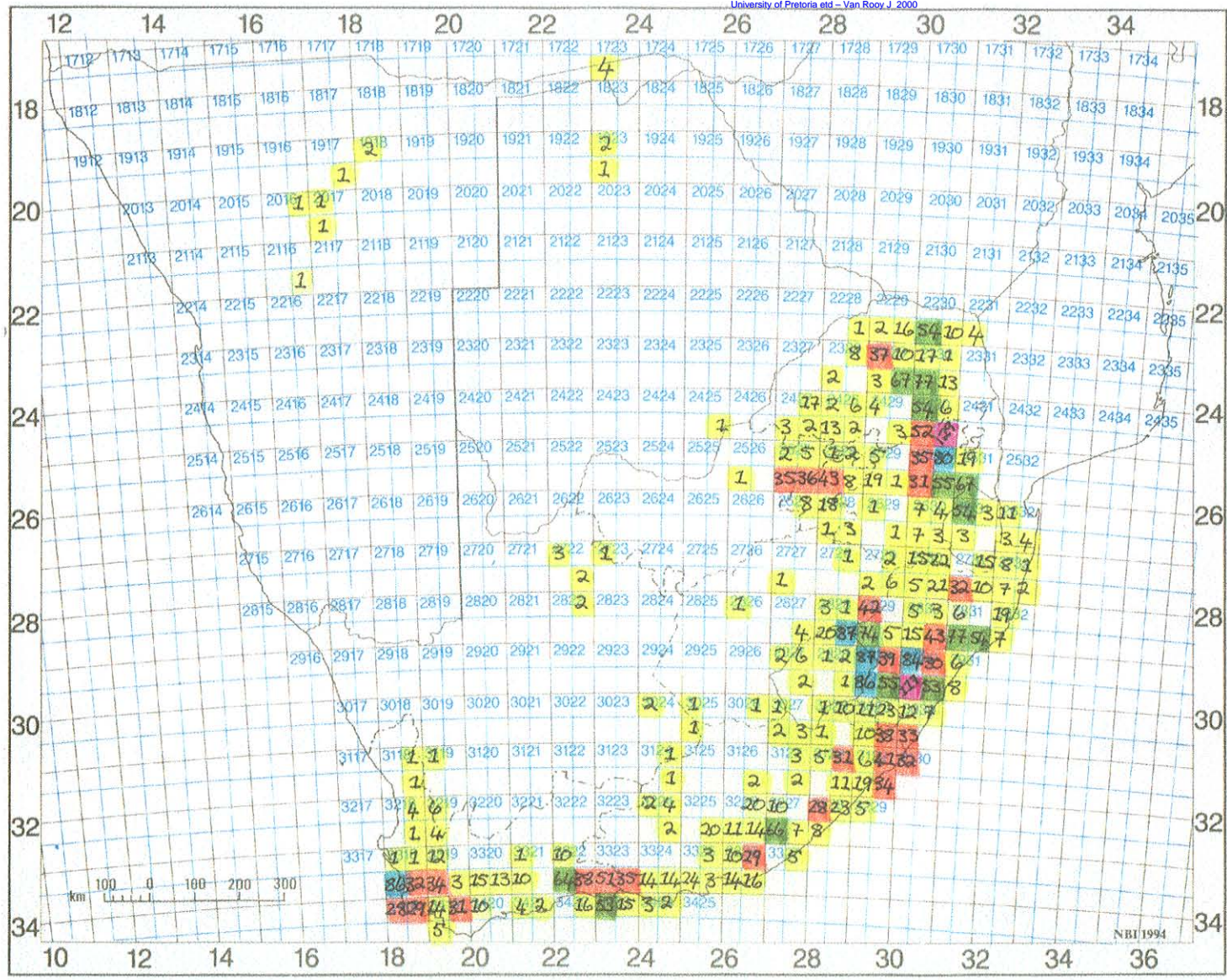


Figure 55. The geographic distribution of the **Afromontane Forest Element** or element 2/4 (TWINSPAN 3+ species classification, 2nd level of division, group 4). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

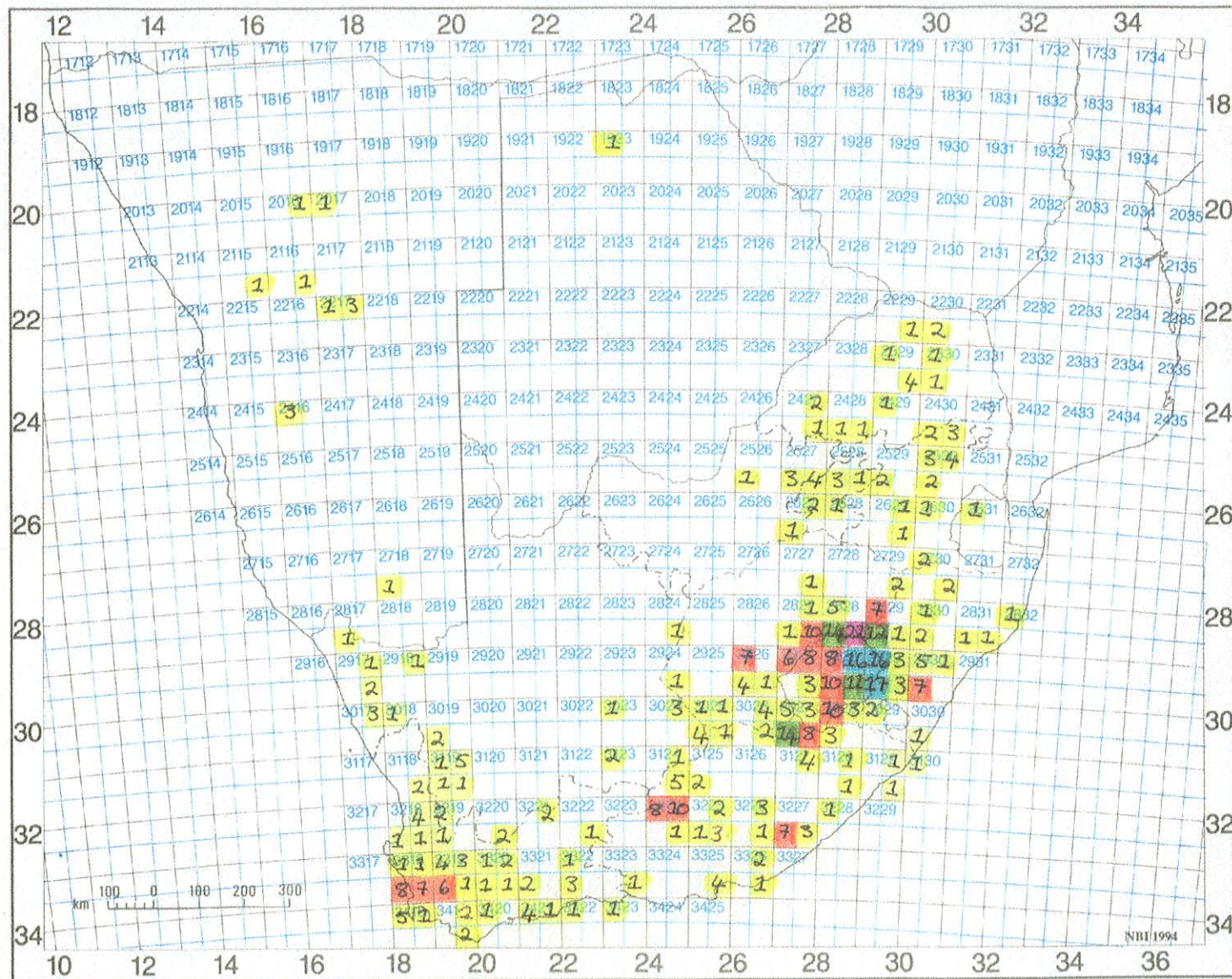


Figure 56. The geographic distribution of the **Mont Aux Sources Subelement** or element 3/1 (TWINSPAN 3+ species classification, 3rd level of division, group 1). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

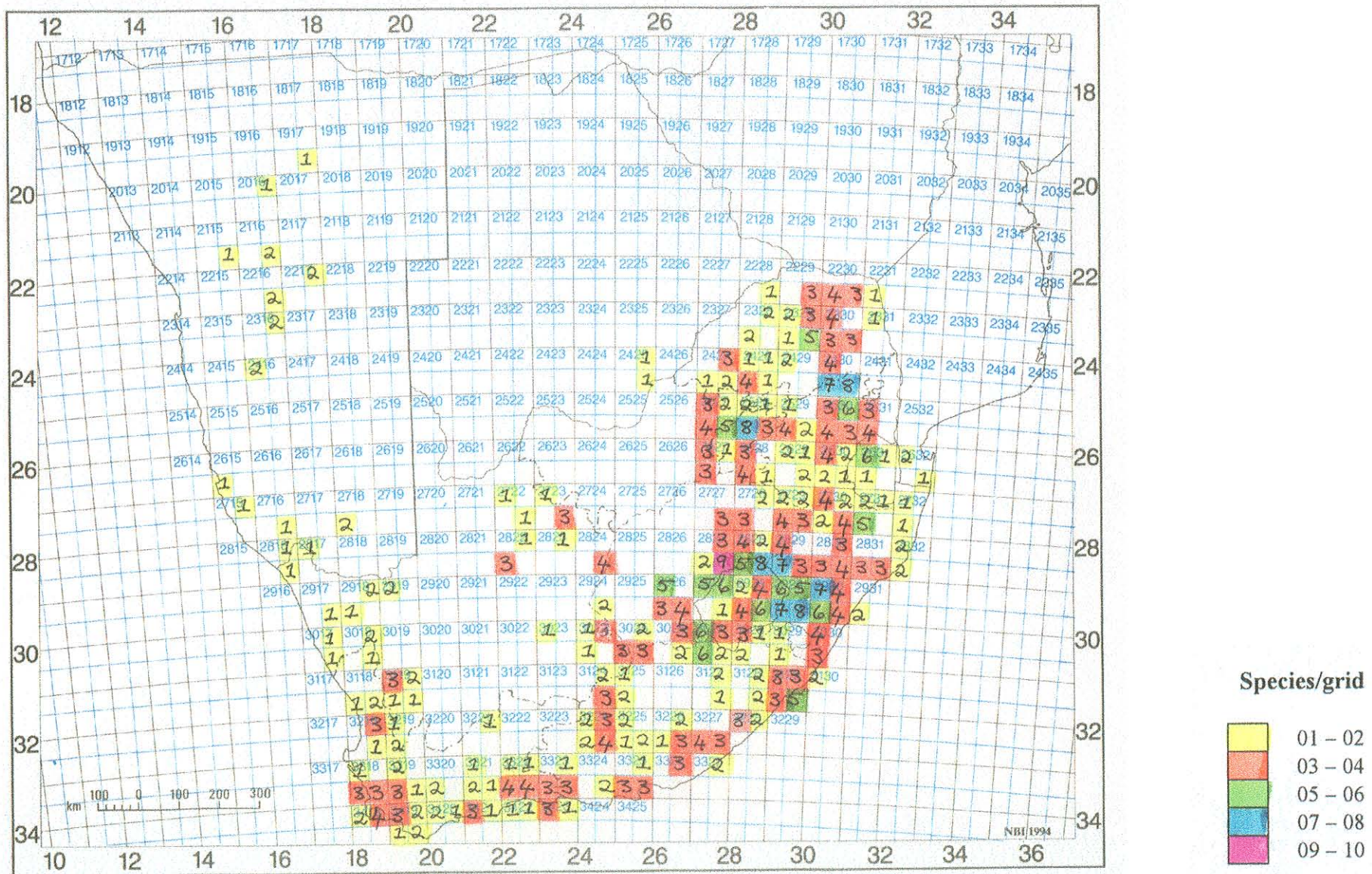


Figure 57. The geographic distribution of the **Widespread Subelement** or element 3/2 (TWINSPAN 3+ species classification, 3rd level of division, group 2). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

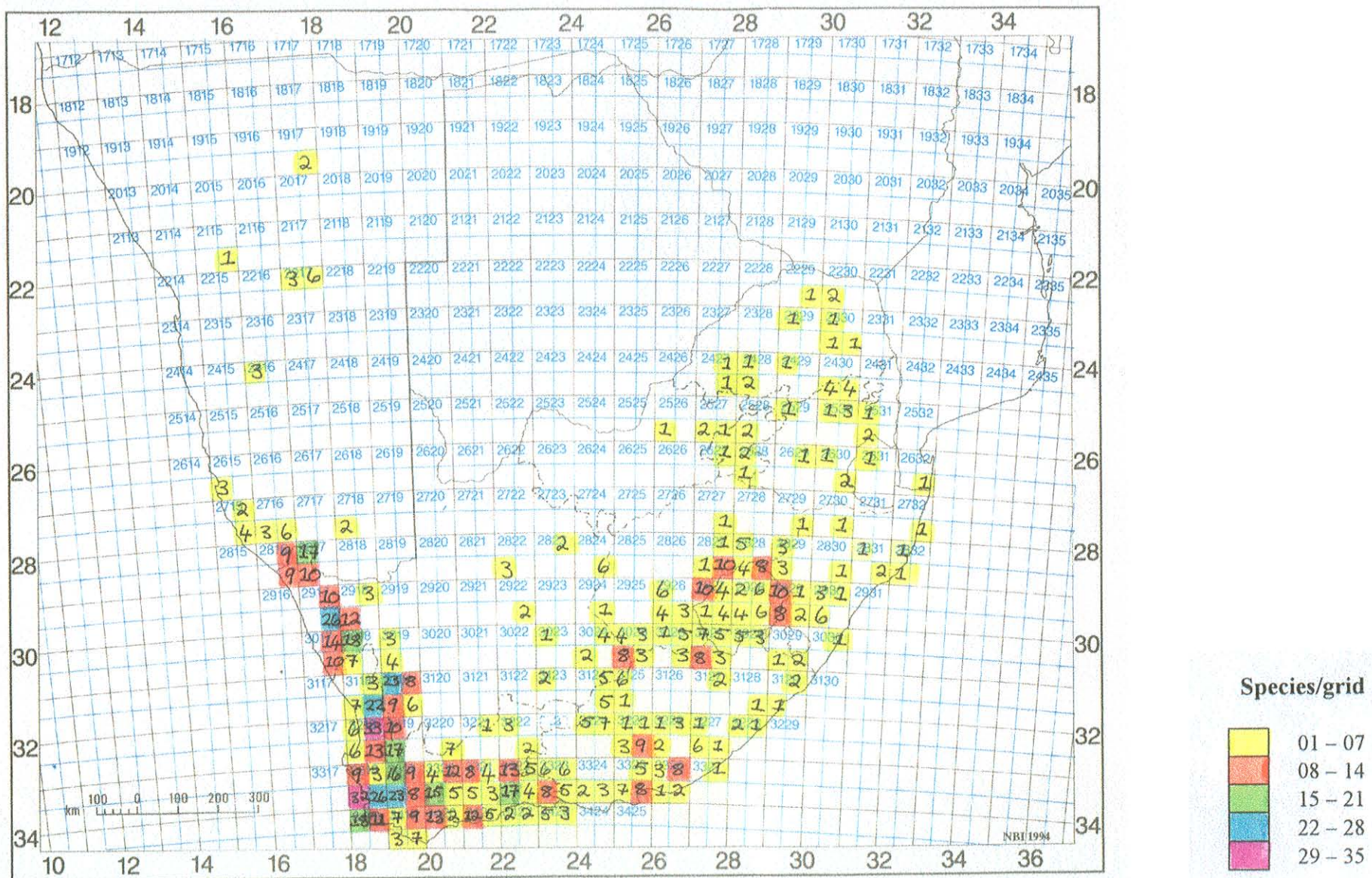


Figure 58. The geographic distribution of the **West Coast Subelement** or element 3/3 (TWINSPAN 3+ species classification, 3rd level of division, group 3). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

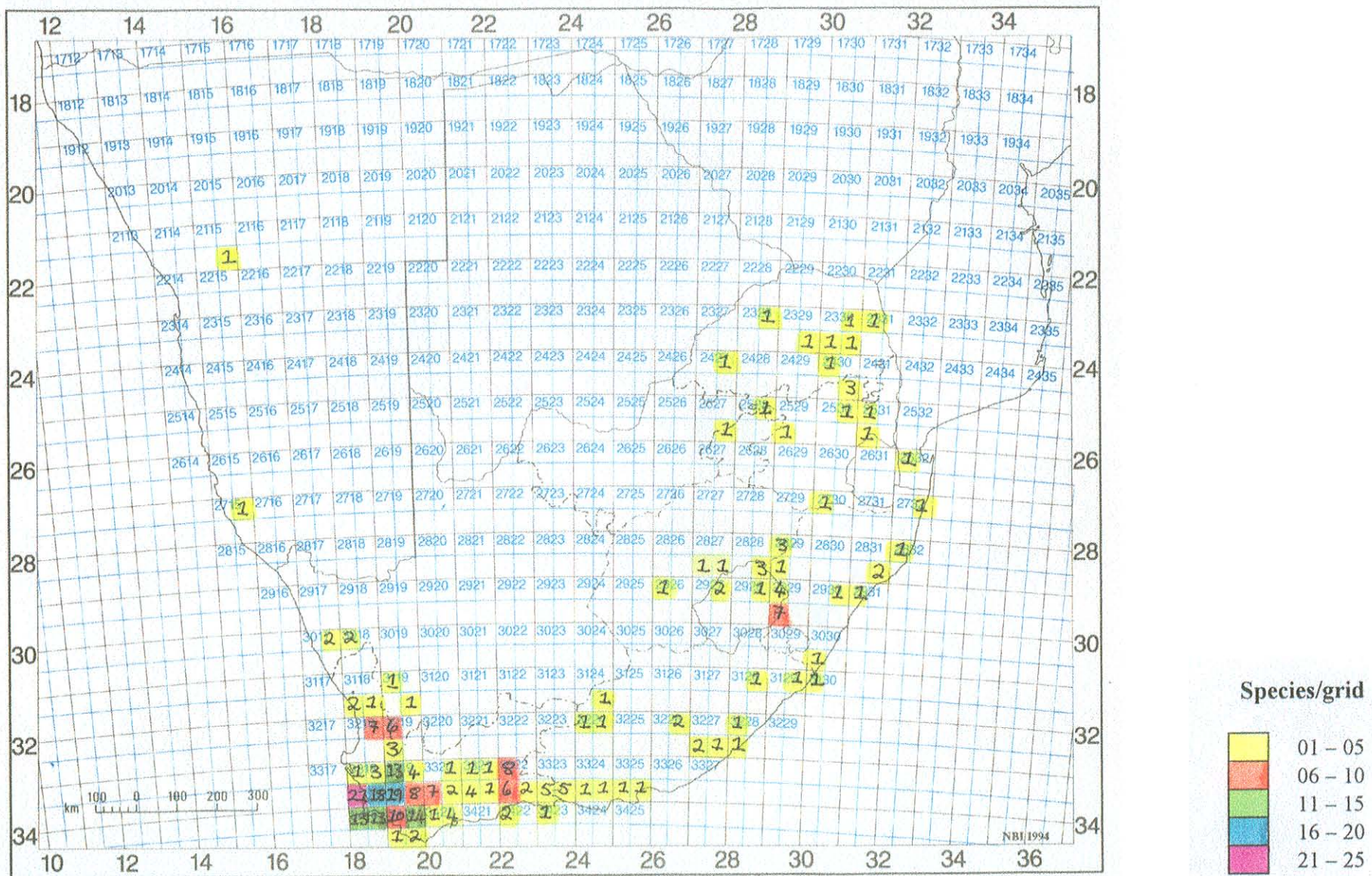


Figure 59. The geographic distribution of the **Boland Subelement** or element 3/4 (TWINSpan 3+ species classification, 3rd level of division, group 4). The numbering of the groups is the same as in the dendrogram of the TWINSpan 3+ species classification (Figure 49).

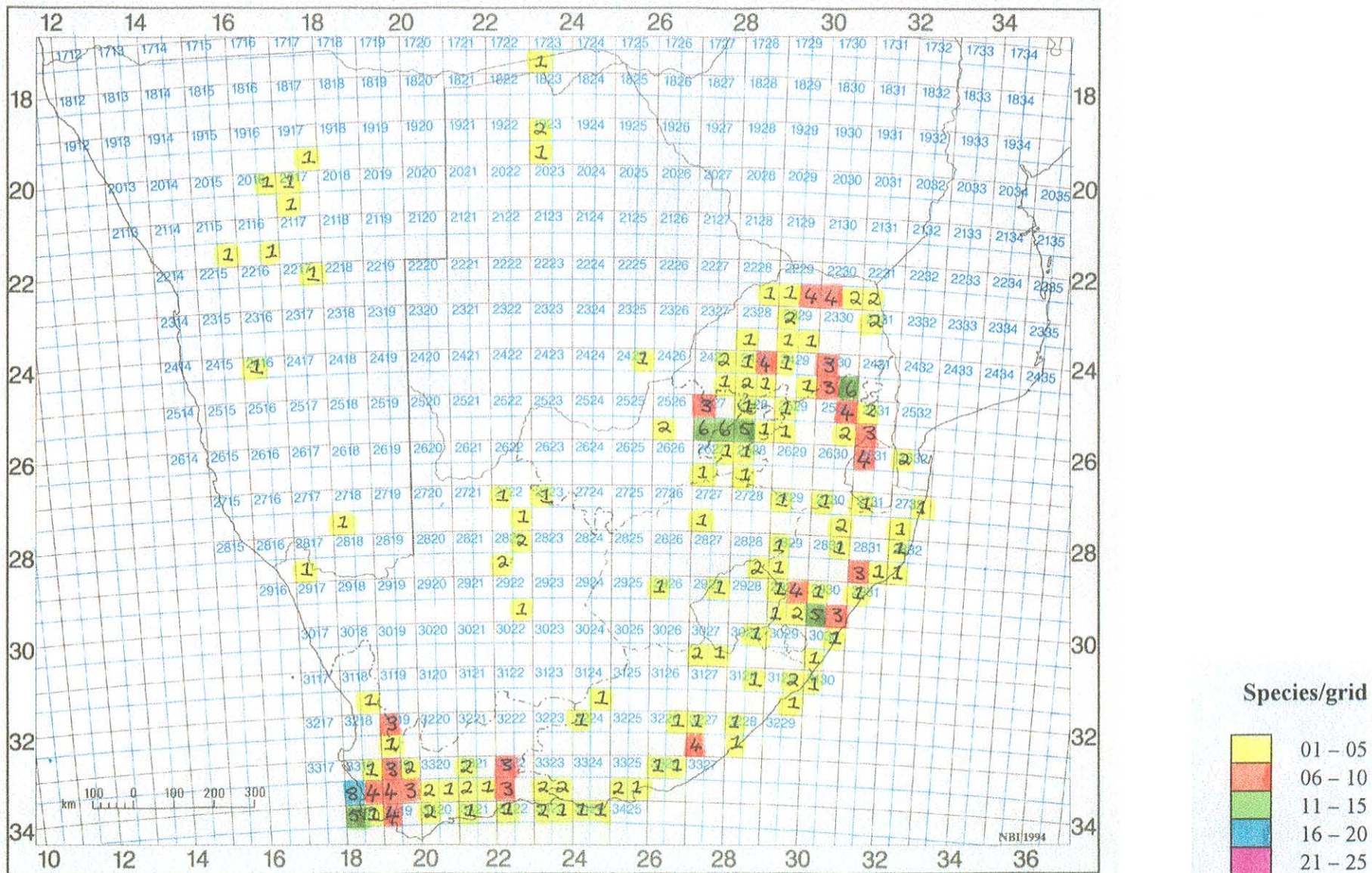


Figure 60. The geographic distribution of the **Disjunct Cape Peninsula Subelement** or element 3/5 (TWINSPAN 3+ species classification, 3rd level of division, group 5). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

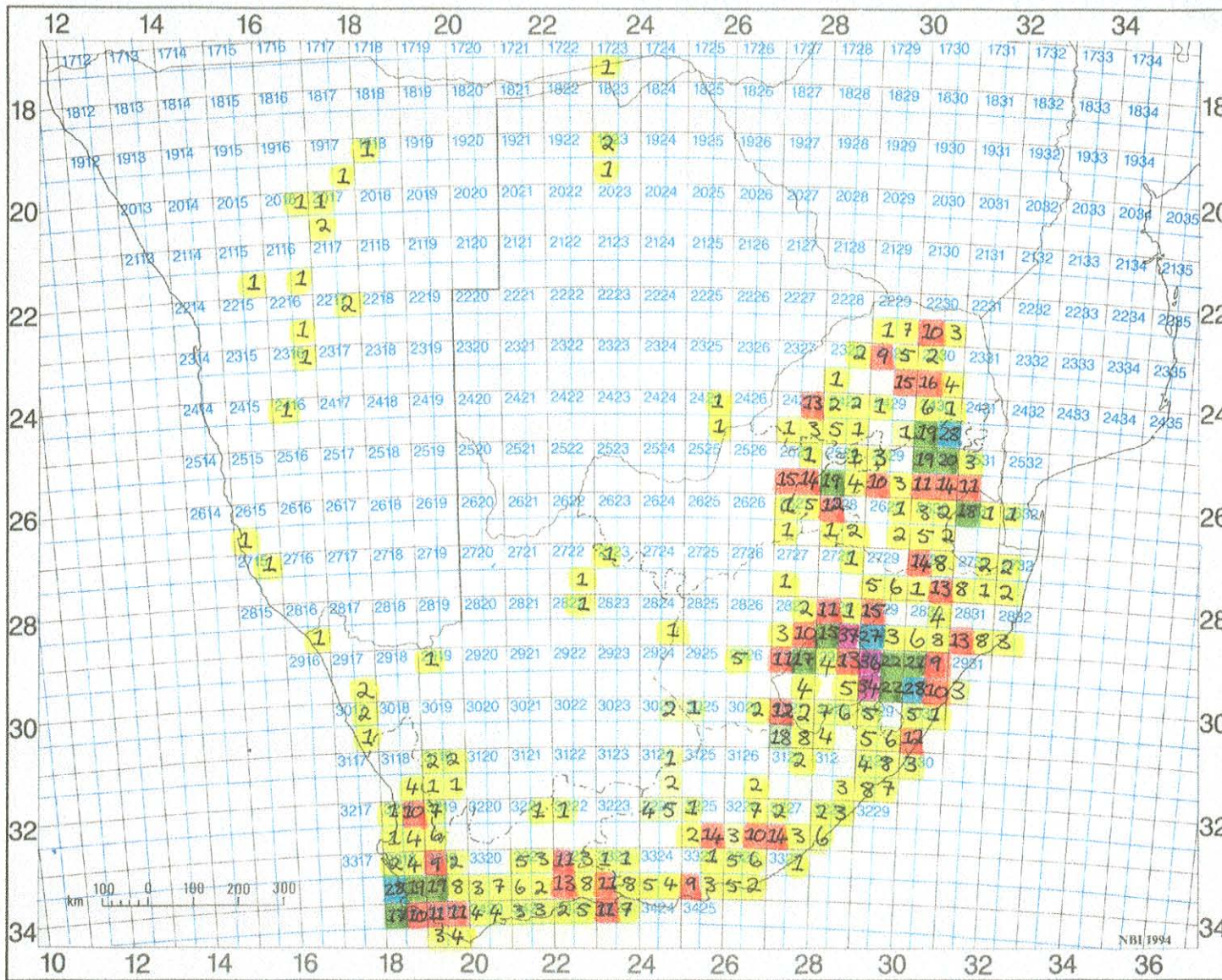


Figure 61. The geographic distribution of the **Drakensberg Subelement** or element 3/6 (TWINSPAN 3+ species classification, 3rd level of division, group 6). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

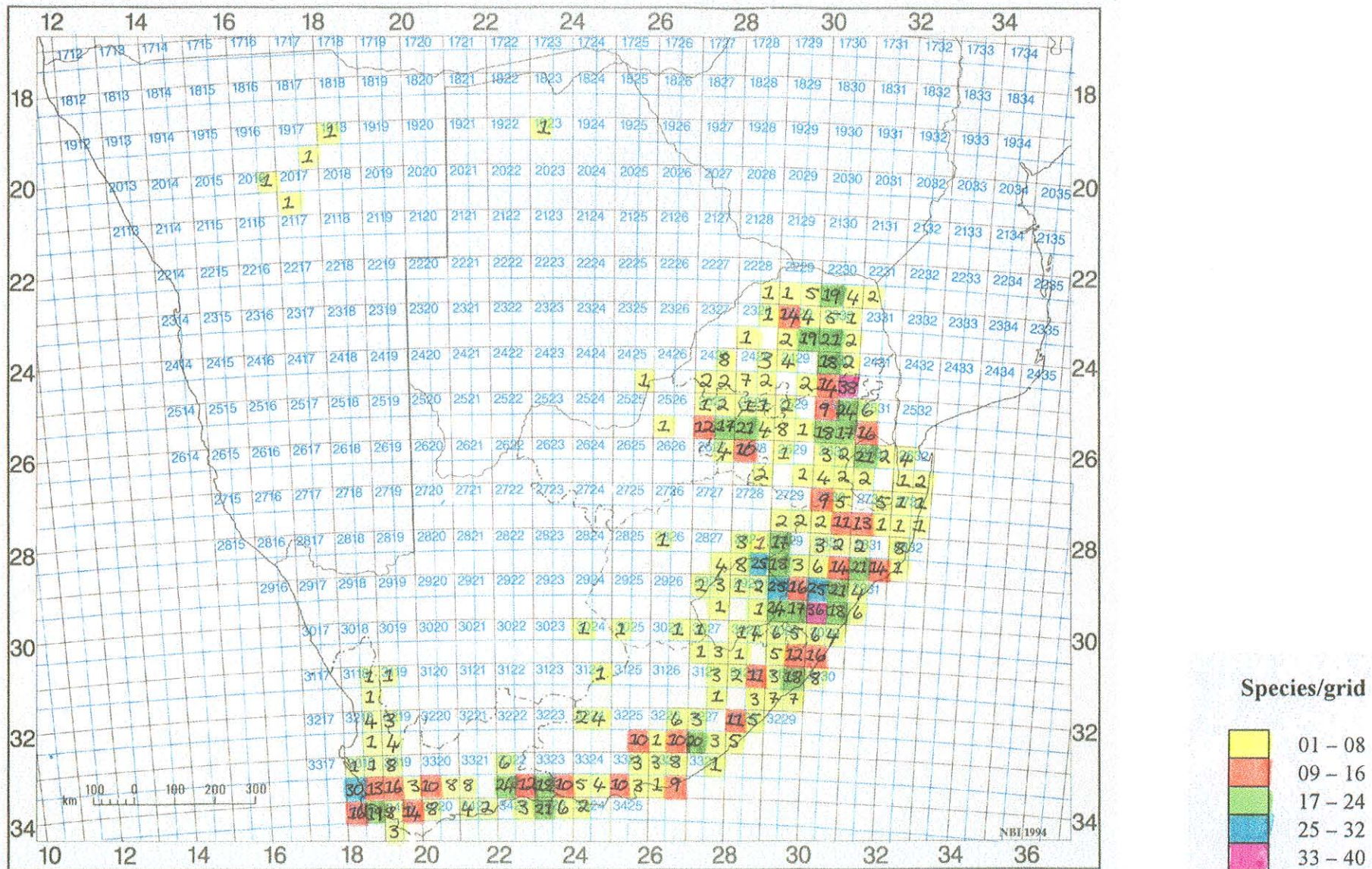


Figure 62. The geographic distribution of the **Widespread Afromontane Subelement** or element 3/7 (TWINSPAN 3+ species classification, 3rd level of division, group 7). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

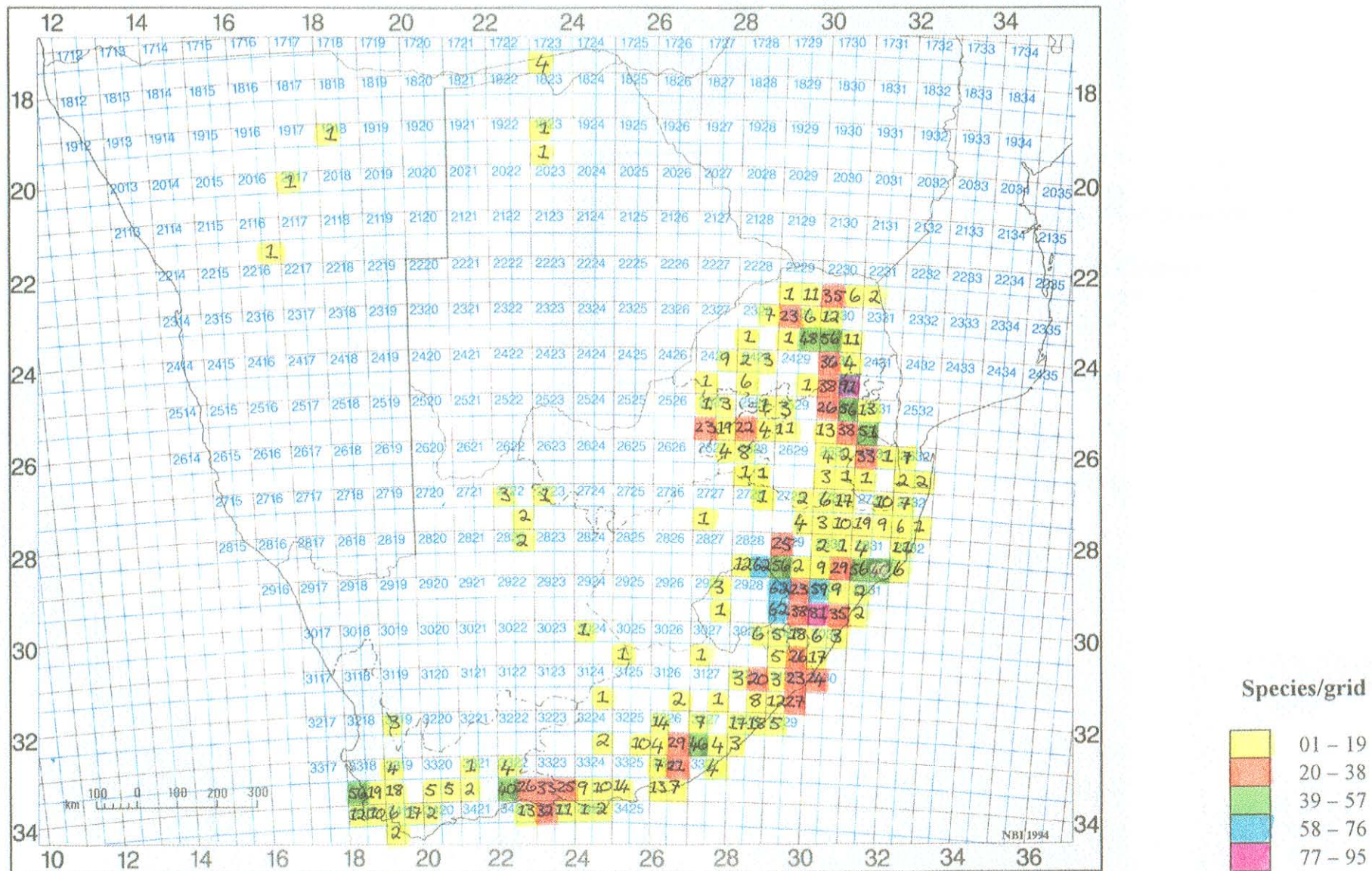


Figure 63. The geographic distribution of the **Tropical Afrotentative Subelement** or element 3/8 (TWINSPAN 3+ species classification, 3rd level of division, group 8). The numbering of the groups is the same as in the dendrogram of the TWINSPAN 3+ species classification (Figure 49).

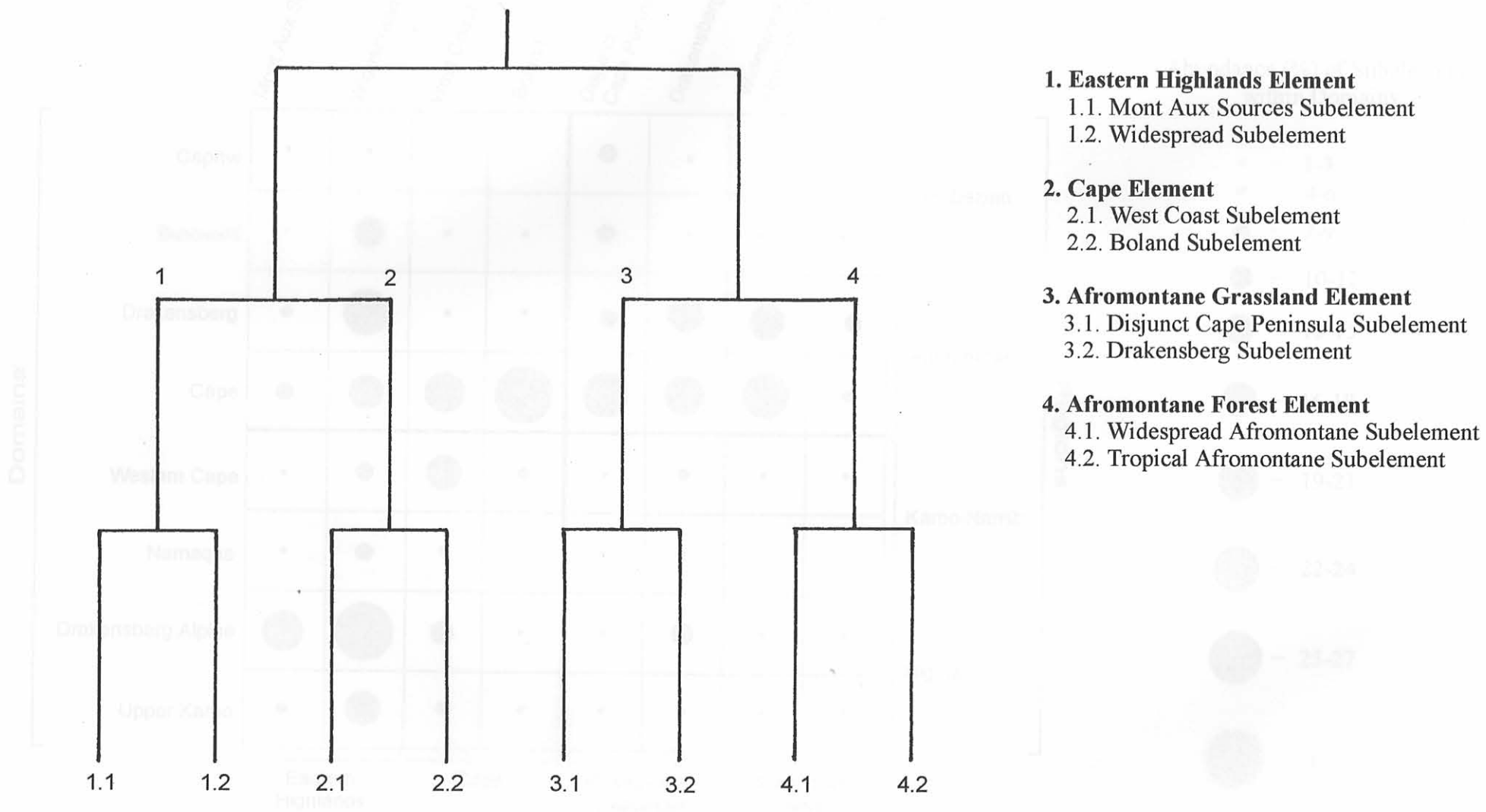


Figure 64. Hierarchical classification of the bryofloristic Elements and Subelements of southern Africa.

Figure 65. Summarized two-way table of the TWOTABLE output. The classification of the eight southern bryofloristic Domains is indicated by arbitrary codes only.

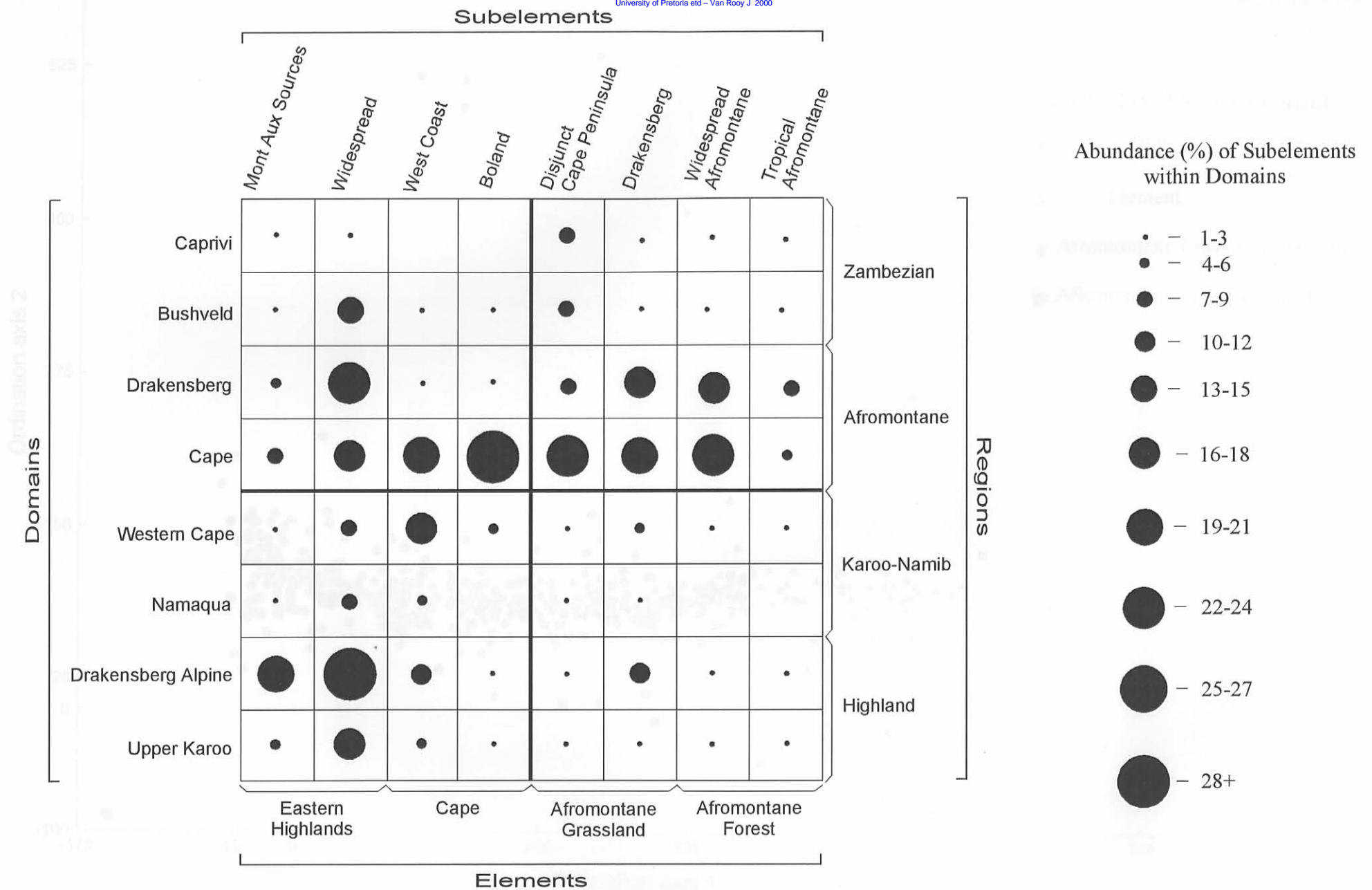


Figure 65. Summarized two-way table of the TWINSpan 3+ results. The abundance of the eight bryofloristic Subelements in the eight bryofloristic Domains is indicated by different sized dots.

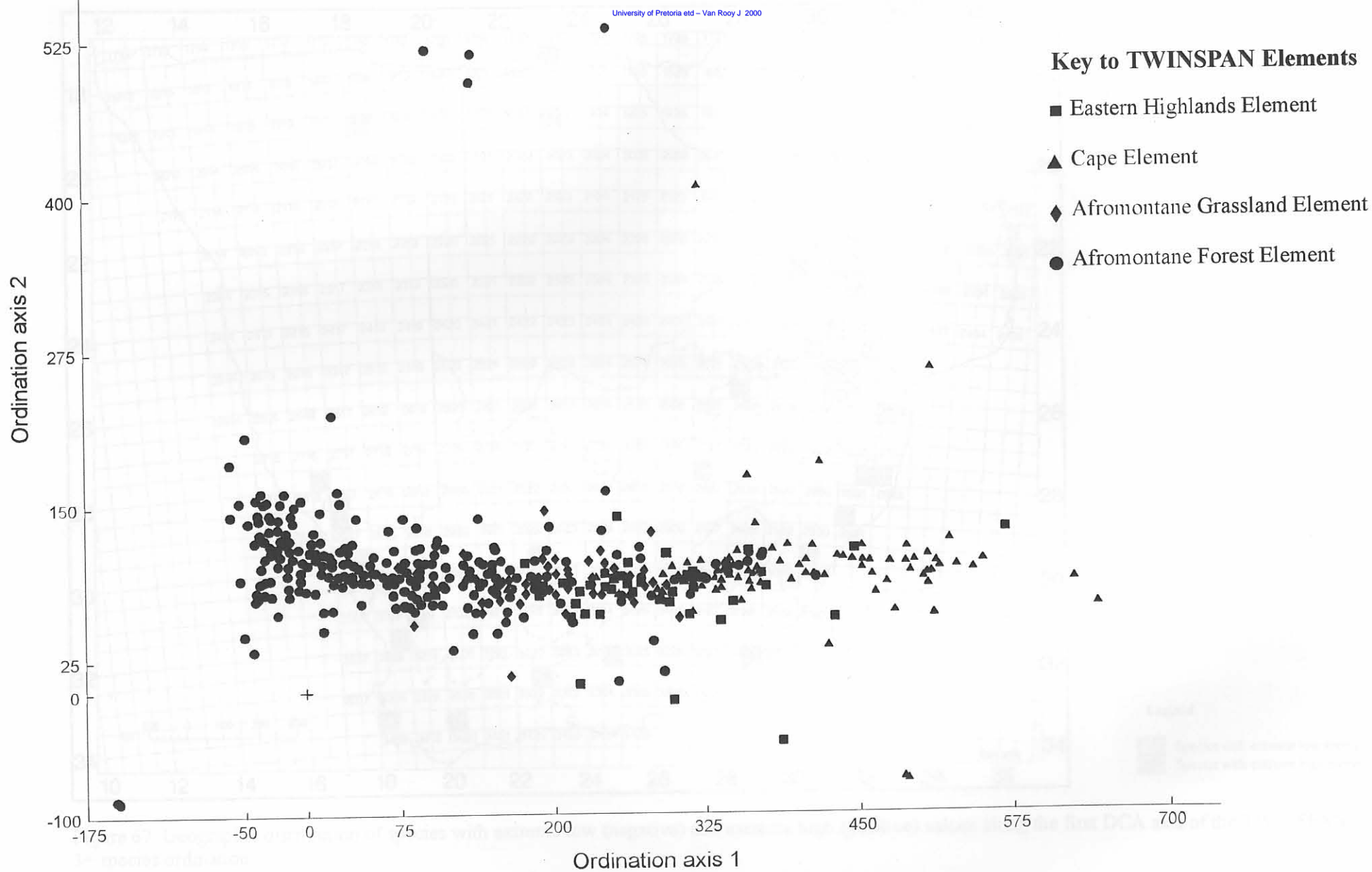


Figure 66. Distribution of TWINSPAN 3+ Elements along the first two axes of a DCA ordination of TWINSPAN 3+ species. Scale marks are in standard deviation (SD) units.

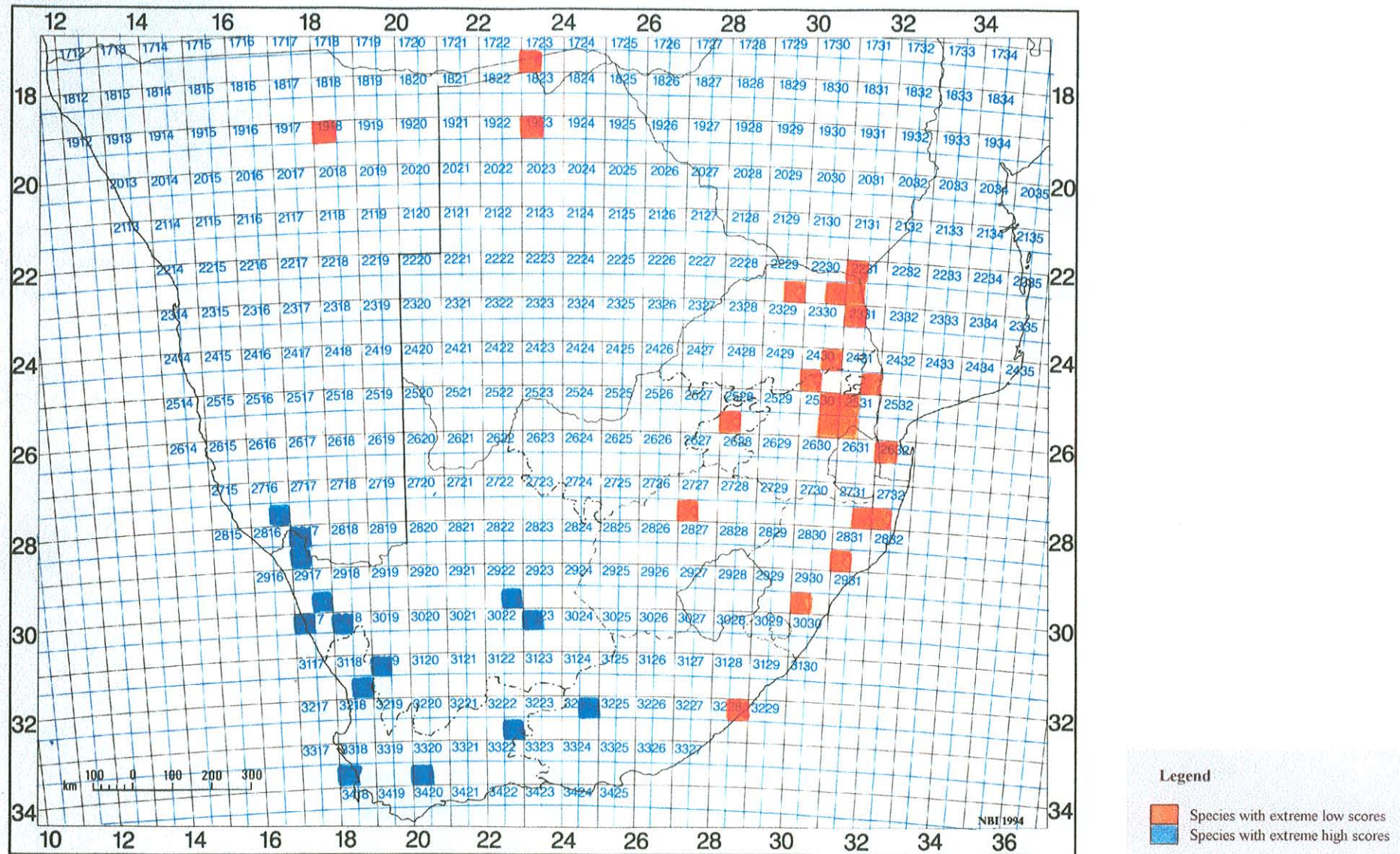


Figure 67. Geographic distribution of species with extreme low (negative) and extreme high (positive) values along the first DCA axis of the TWINSpan 3+ species ordination.

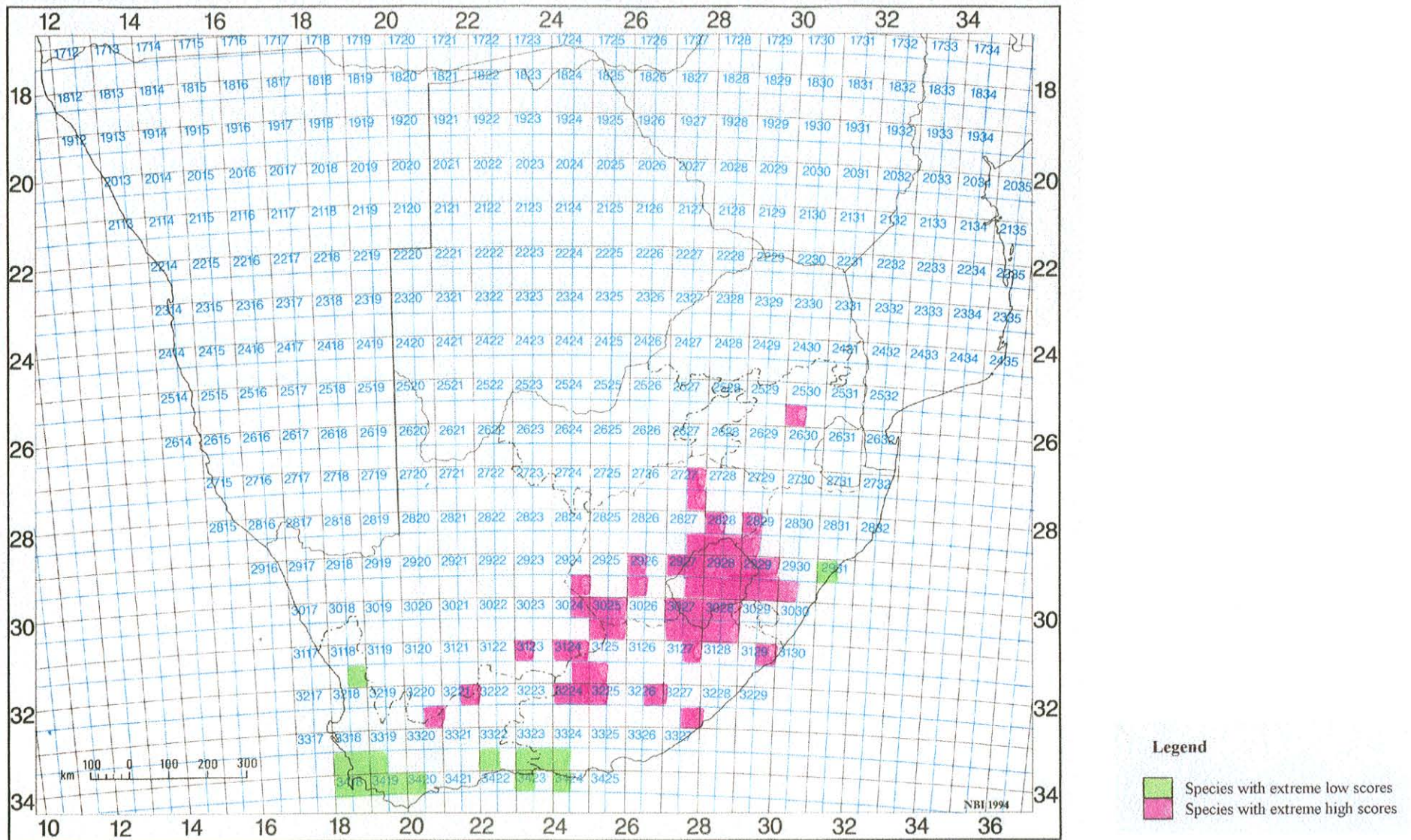


Figure 68. Geographic distribution of species with extreme low (negative) and extreme high (positive) values along the 3rd DCA axis of the TWINSpan 3+ species ordination.

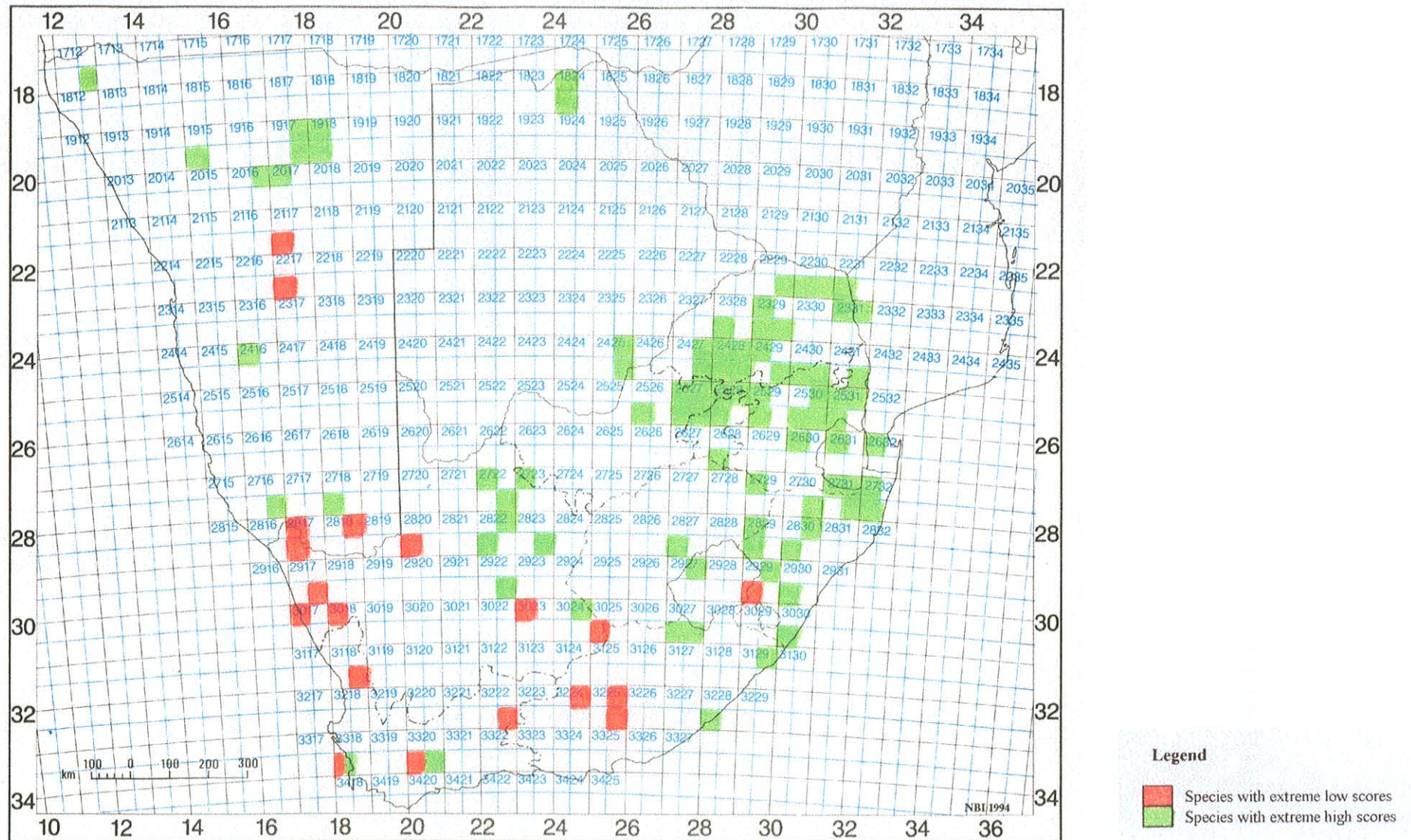


Figure 69. Geographic distribution of species with extreme low (negative) and extreme high (positive) values along the 4th DCA axis of the TWINSPLAN 3+ species ordination.