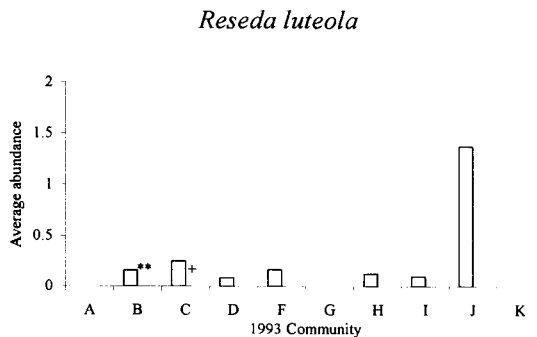
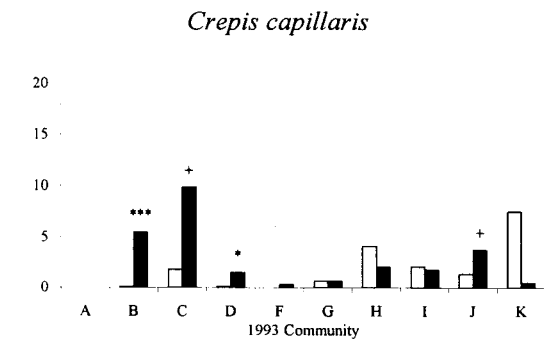
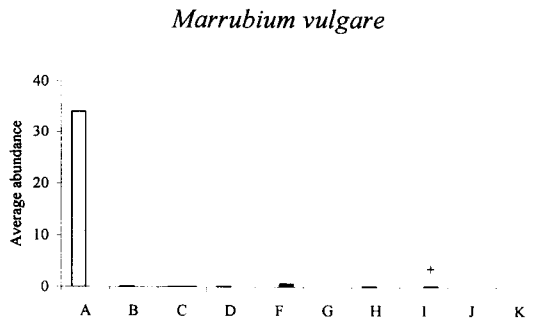
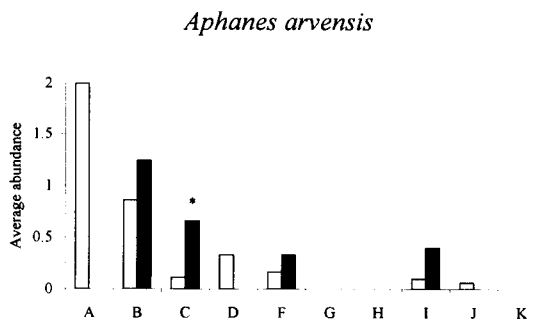
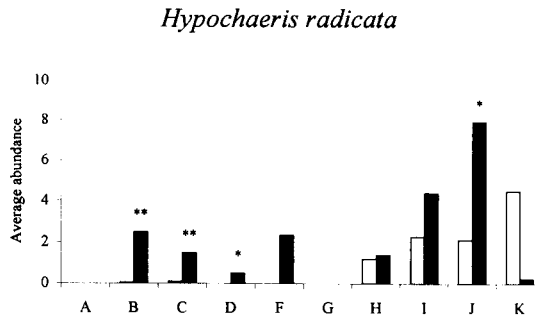
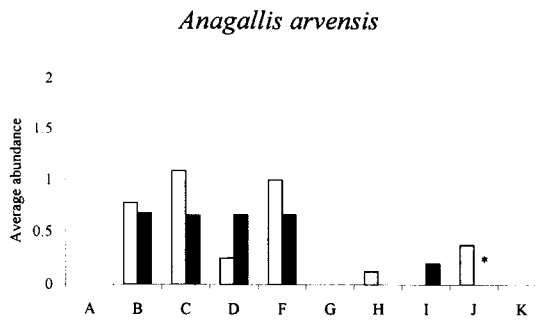
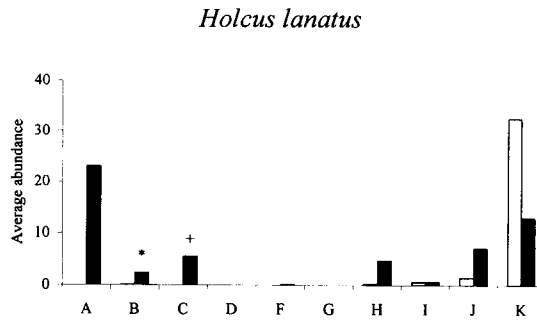
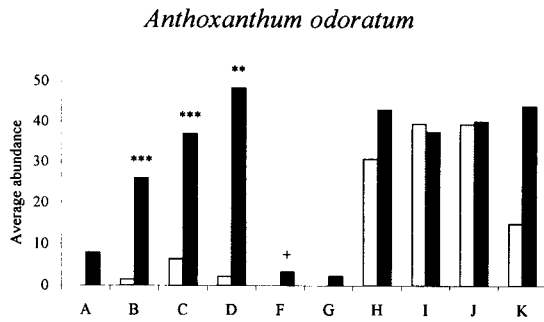
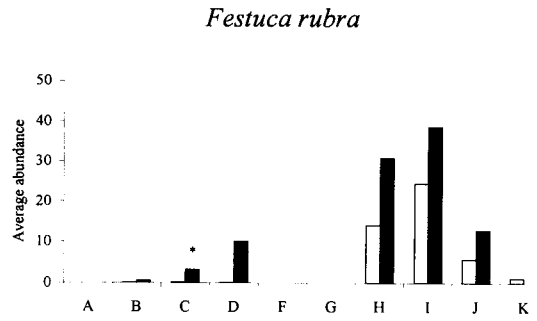
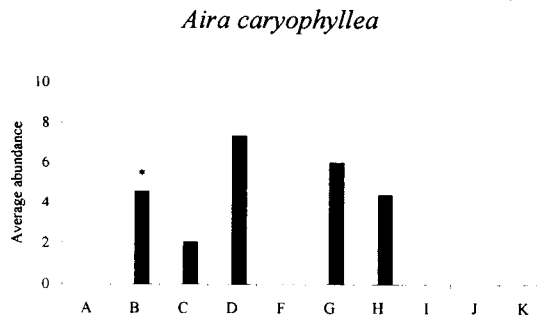
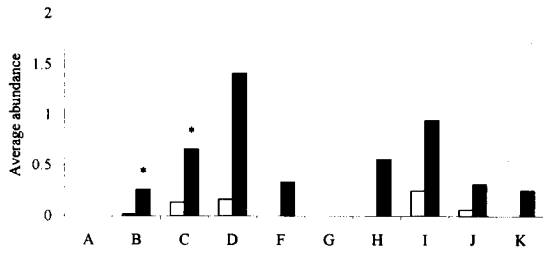


▨ 1993 ■ 1997

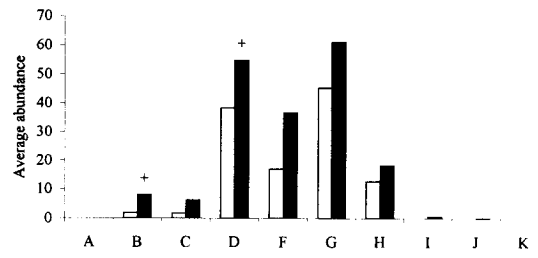


Appendix 4b Exotic species which showed significant changes in average abundance between the September 1993 and the September 1997 sampling times, in one or more of the ten resampled 1993 communities. Significant changes are indicated thus:
 + = $0.10 > P > 0.05$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$

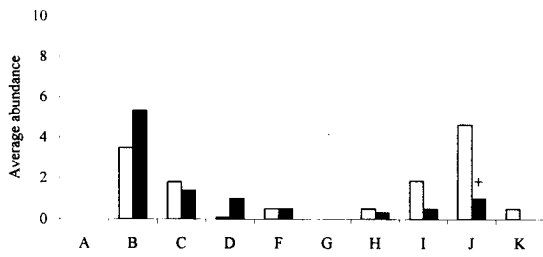
Rosa rubiginosa



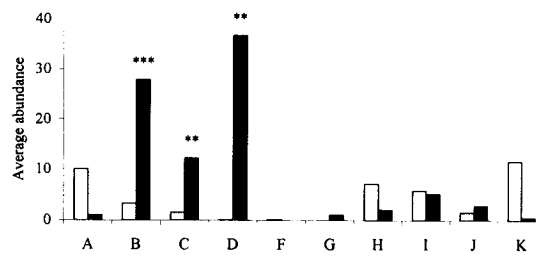
Thymus vulgaris



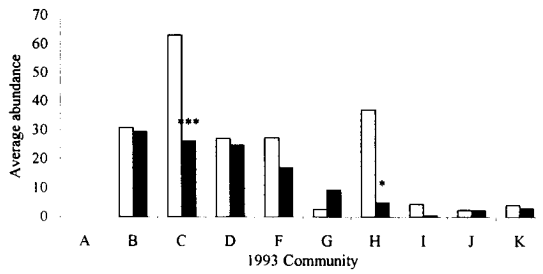
Rumex acetosella



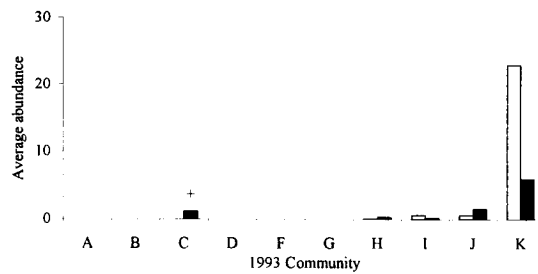
Trifolium arvense



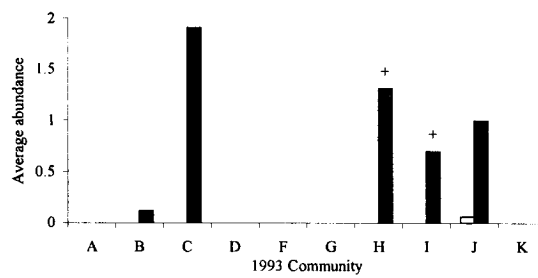
Sedum acre



Trifolium repens



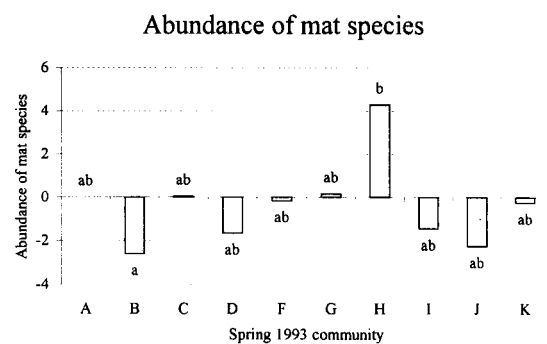
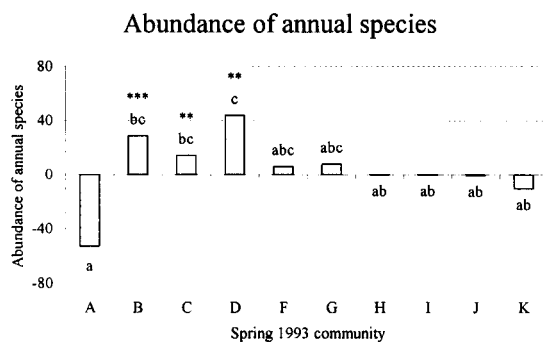
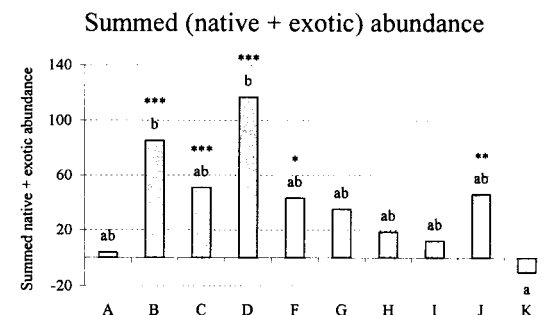
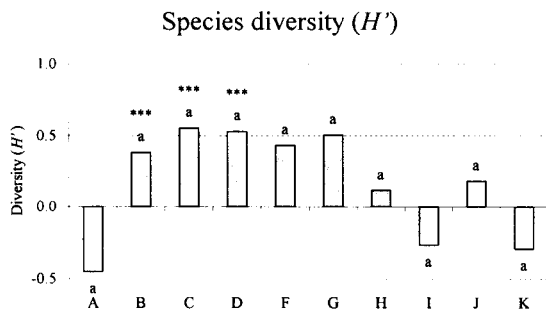
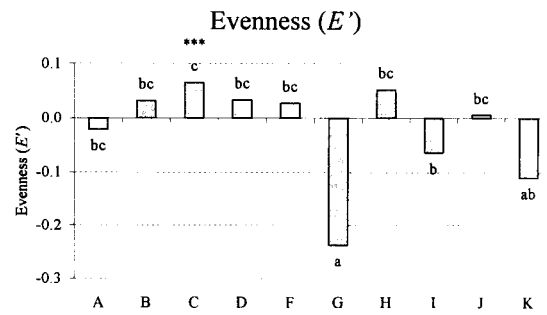
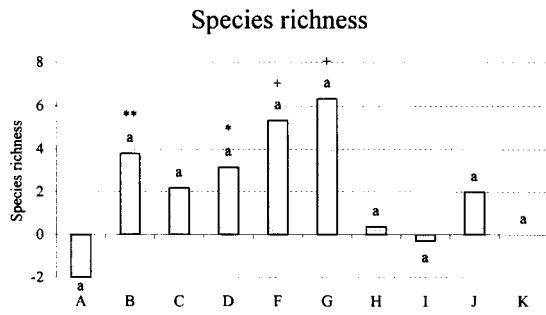
Vicia sativa



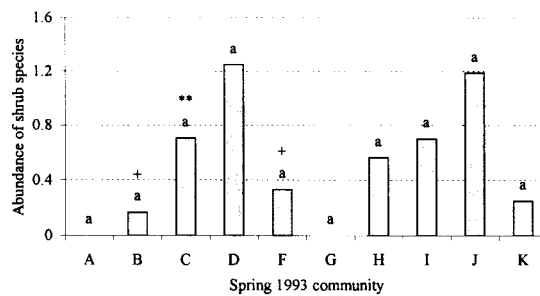
Appendix 4b cont...

Appendix 5 Overall changes, and the probability of no difference, in average vegetation characteristics in the 88 resampled study sites on Flat Top Hill.

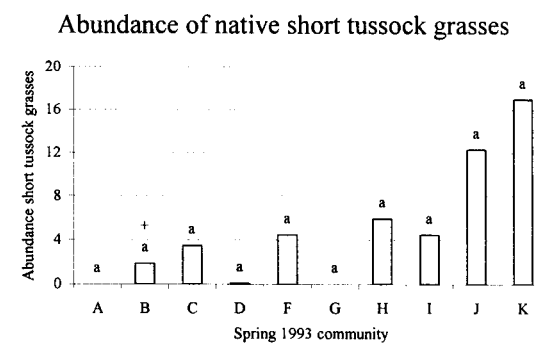
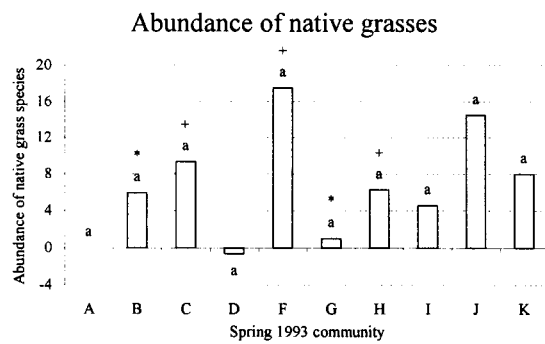
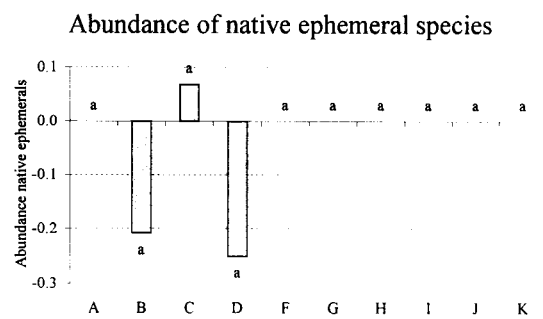
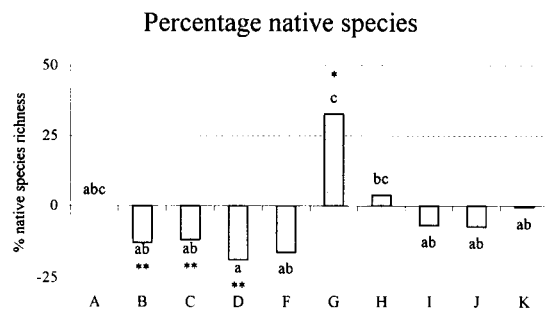
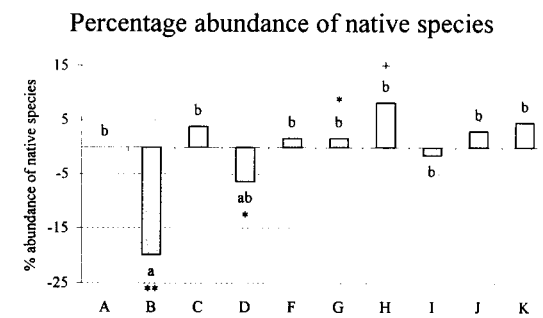
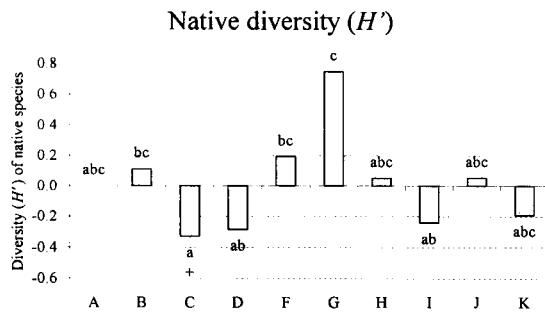
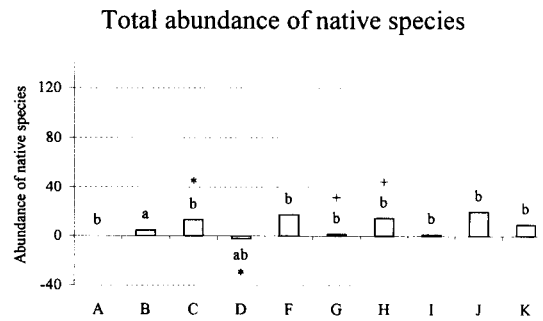
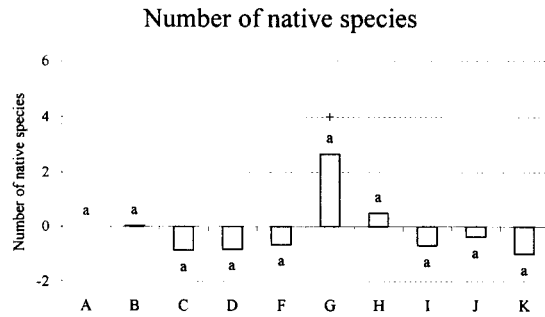
	1993	1997	<i>P</i> (probability of no difference)
Species richness	12.71 ± 0.50	15.10 ± 0.54	0.001 **
Diversity (<i>H</i>)	1.51 ± 0.05	1.81 ± 0.05	<0.001 ***
Evenness (<i>E</i>)	0.31 ± 0.01	0.32 ± 0.01	0.240
Total abundance	94.12 ± 3.43	148.86 ± 5.00	<0.001
All annuals	6.89 ± 1.22	20.95 ± 2.87	<0.001 ***
Mat species	6.44 ± 1.16	5.08 ± 0.99	0.372
Shrub species	0.31 ± 0.16	0.89 ± 0.25	0.053+
Number of exotics	7.23 ± 0.28	9.91 ± 0.29	<0.001 ***
Exotic diversity (<i>H</i>)	0.93 ± 0.05	1.37 ± 0.04	<0.001 ***
Exotics: total abundance	73.32 ± 3.83	119.38 ± 5.14	<0.001 ***
Exotics: abundance annual grasses	0.00 ± 0.00	3.15 ± 0.81	<0.001
Exotics: abundance perennial grasses	20.84 ± 3.13	53.76 ± 4.02	<0.001 ***
Number of native species	5.48 ± 0.38	5.19 ± 0.38	0.594
Native diversity (<i>H</i>)	1.02 ± 0.06	0.96 ± 0.06	0.487
Natives: total abundance	20.80 ± 2.00	29.48 ± 2.93	0.016
Percentage native species	39.66 ± 2.02	31.25 ± 1.62	0.001 **
Percentage native abundance	24.07 ± 2.51	20.01 ± 1.93	0.201
Abundance native ephemerals	0.12 ± 0.07	0.06 ± 0.04	0.454
Abundance native grasses	7.55 ± 1.06	14.68 ± 1.85	0.001 **
Abundance native short tussock grasses	1.65 ± 0.54	5.76 ± 1.27	0.003 **



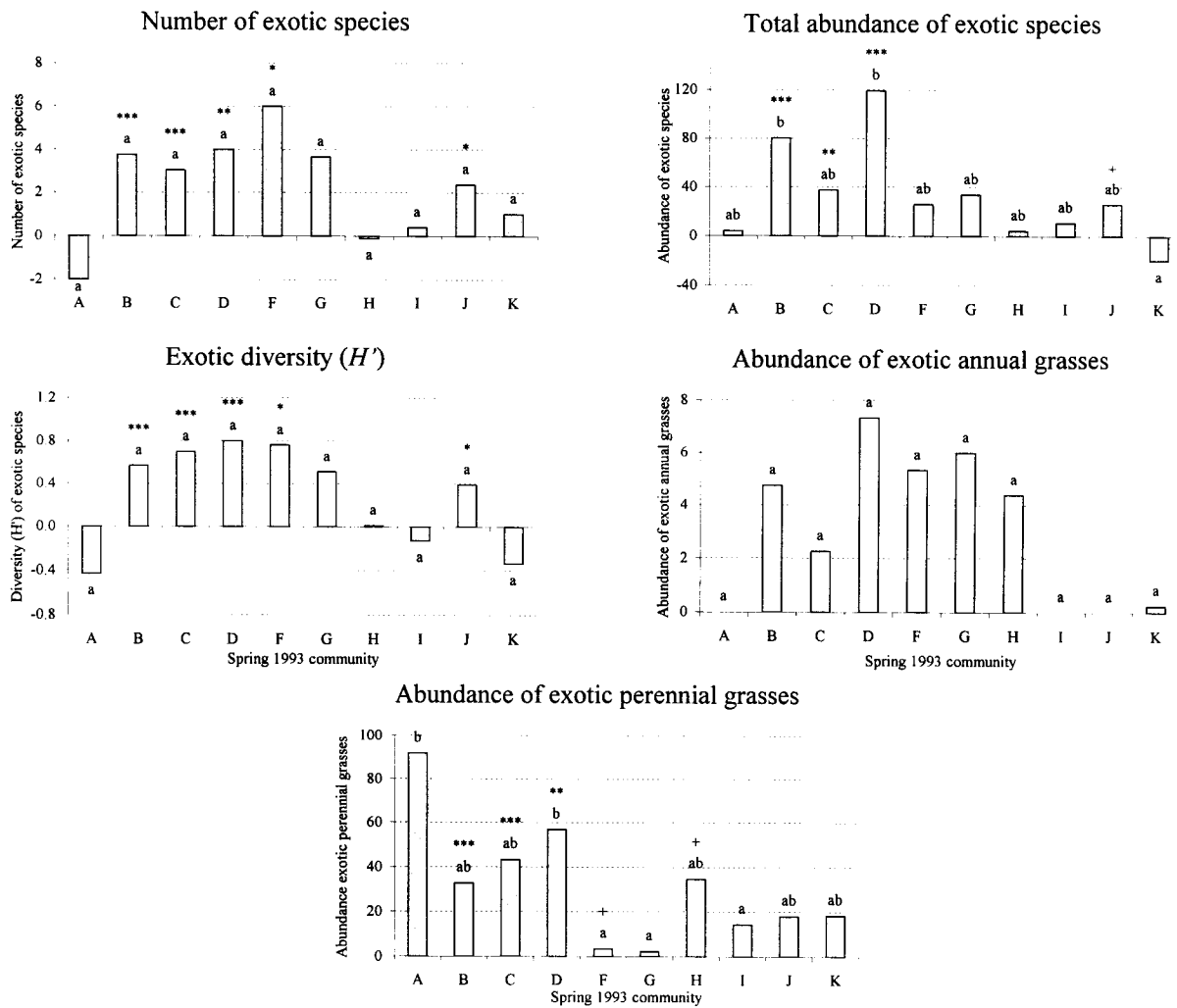
Abundance of tall shrub species



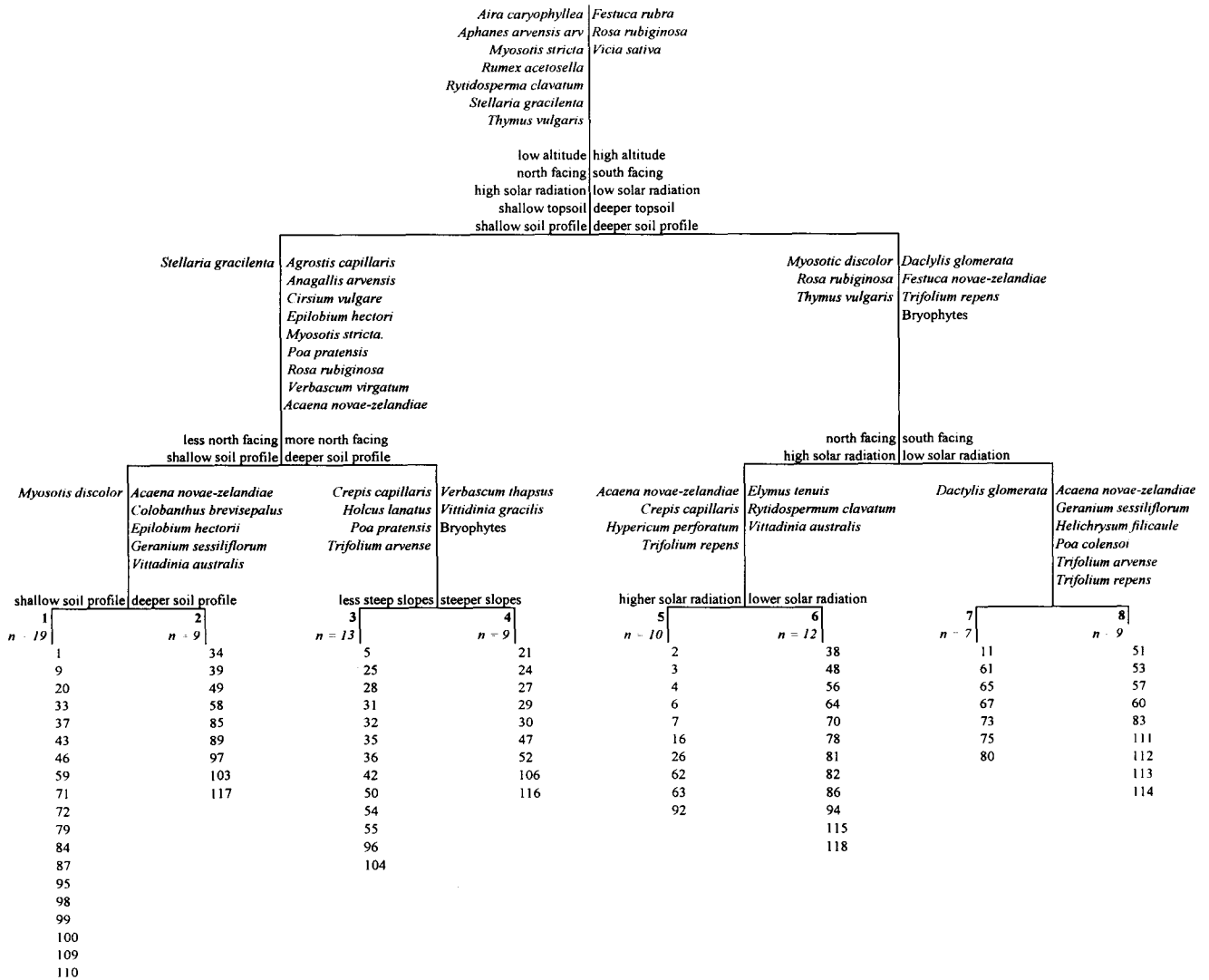
Appendix 6a Changes in average values of vegetation characteristics between September 1993 and September 1997 in the ten resampled 1993 communities. Significant changes are indicated thus. += 0.10>P>0.05; * = P<0.05; ** = P<0.01; *** = P<0.001. Lower case letters in common between communities indicate average values are not significantly different (P<0.05 by Duncan's New Multiple Range Test).



Appendix 6b Changes in average values of vegetation characteristics between September 1993 and September 1997 in the ten resampled 1993 communities. Significant changes are indicated thus: + = $0.10 > P > 0.05$; * = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$. Lower case letters in common between communities indicate average values are not significantly different ($P < 0.05$ by Duncan's New Multiple Range Test).



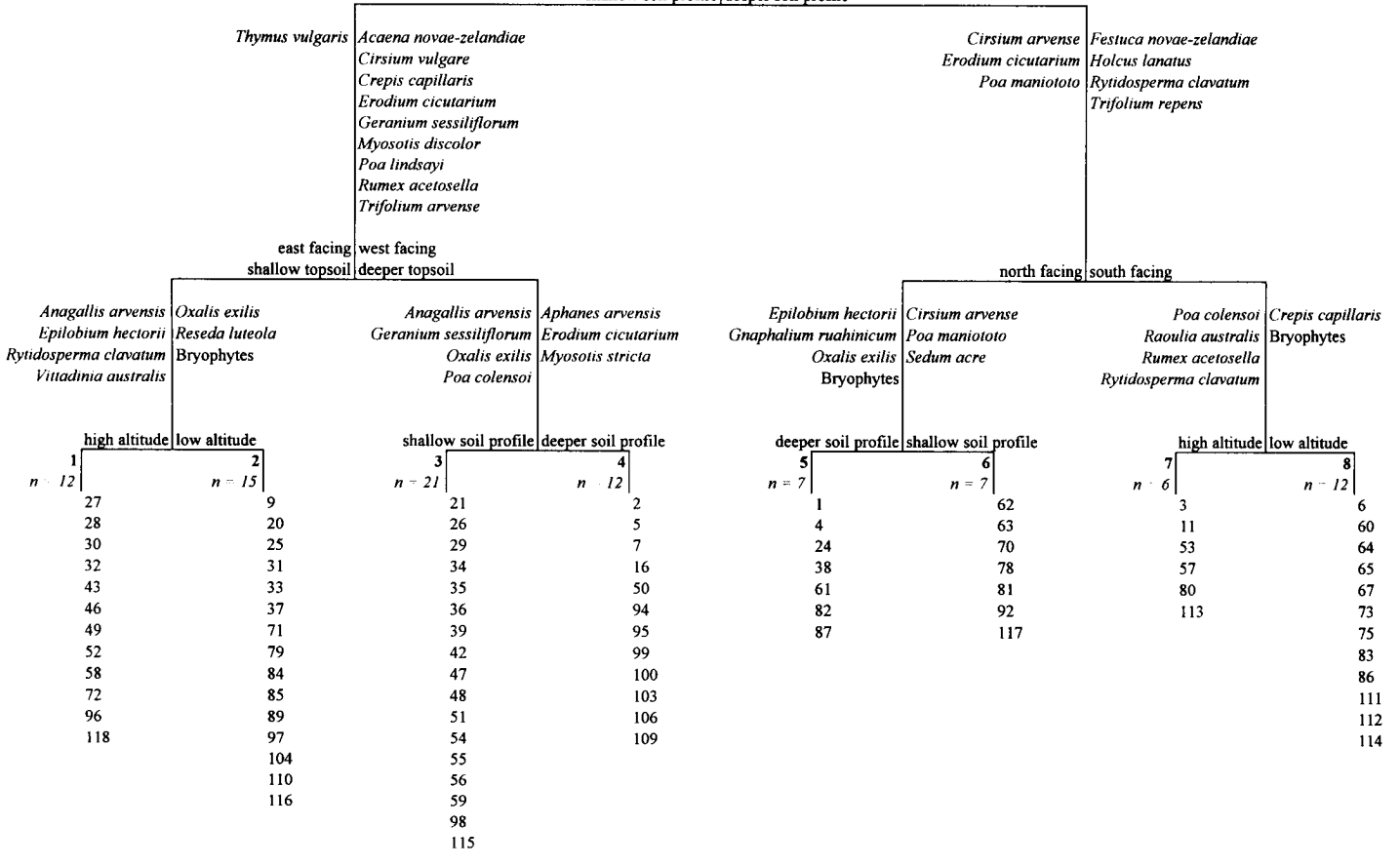
Appendix 6c Changes in average values of vegetation characteristics between September 1993 and September 1997 in the ten resampled 1993 communities. Significant changes are indicated thus. += 0.10 > P > 0.05; * = P < 0.05; ** = P < 0.01; *** = P < 0.001. Lower case letters in common between communities indicate average values are not significantly different (P < 0.05 by Duncan's New Multiple Range Test).



Appendix 7a Dendrogram showing the divisions of the classification of sites based on the quantitative data for September 1993. Species names on either side of each division indicate the indicator species for that division, while the environmental factors indicate that factor was significantly higher in the group of sites on that side of the division. The numbers of the communities are given in bold, and *n* denotes the number of sites in each community.

Anagallis arvensis | *Festuca rubra*
Poa maniototo | *Anthoxanthum odoratum*
Raoulia beauverdi | *Hypochaeris radicata*
Stellaria gracilent | *Crepis capillaris*
Thymus vulgaris
Vitadina australis

less steep | steep slopes
 low altitude | high altitude
 north facing | south facing
 high solar radiation | low solar radiation
 shallow topsoil | deeper topsoil
 shallow soil profile | deeper soil profile



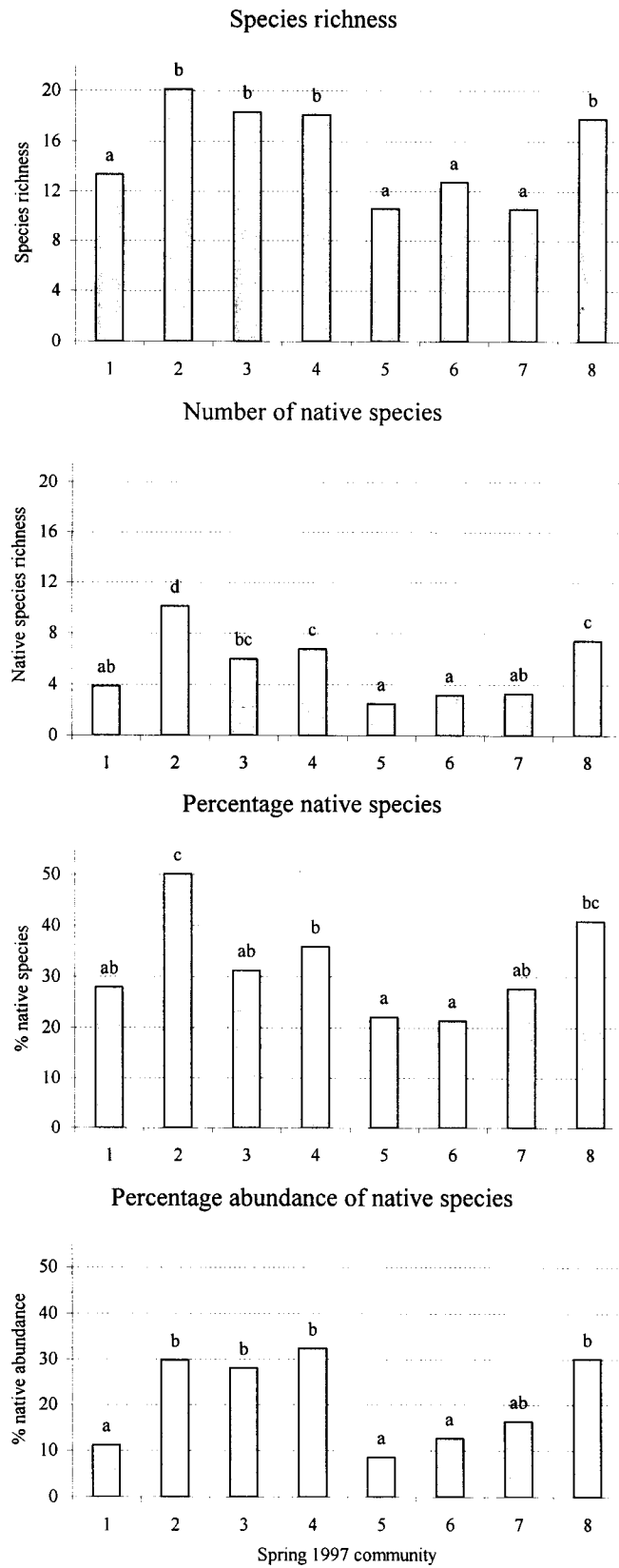
Appendix 7b Dendrogram showing the divisions of the classification of sites based on the quantitative data for September 1997. Species names on either side of each division indicate the indicator species for that division, while the environmental factors indicate that factor was significantly higher in the group of sites on that side of the division. The numbers of the communities are given in bold, and n denotes the number of sites in each community.

Appendix 8 Averages of environmental factors for sites on each side of the divisions of the classification to the level of eight groups of sites (Communities 1 to 8; Appendix 7). Significant differences (by 't' tests) are indicated beside the higher average value thus: += 0.10>P>0.05; * = P<0.05; ** = P<0.01; *** = P<0.001.

1997 Community	Altitude (m a.s.l.)	Slope (°)	Solar radiation (mJ m ⁻² yr ⁻¹)	North aspect (° North)	East aspect (° East)	Topsoil depth (cm)	Soil profile depth (cm)
1+2+3+4	412.50	14.40	6700***	104.16*	86.48	0.90	26.51
5+6+7+8	452.13**	17.95+	5930	78.03	103.03	5.29**	34.24**
1+2	426.43+	13.07	6595	92.93	88.64	0.72	21.88
3+4	394.77	16.09	6834	118.45+	83.73	1.19	33.75**
5+6	432.32	16.59	6261*	97.82**	102.64	4.84	33.79
7+8	479.38	19.81	5476	50.81	103.56	6.15	35.10
1	427.89	14.11	6690	91.68	100.84	0.18	18.71
2	423.33	10.89	6395	95.56	62.89	1.88	28.63*
3	408.08	12.77	6812	119.92	81.00	2.11+	34.56
4	375.56	20.89*	6865	116.33	87.67	0.00	32.71
5	417.10	17.30	6748*	107.90	111.50	4.00	34.70
6	445.00	16.00	5855	89.42	95.25	5.78	32.78
7	471.43	19.29	5929	46.43	123.00	8.08	31.17
8	485.56	20.22	5124	54.22	88.44	3.25	41.00

Two-way table of the sites and species on Flat Top Hill in September 1997. Vertical divisions represent the eight 1997 'communities'. The percentage local frequency (abundance) of species is represented on a scale of 1 to 10.

	Q1	Q72	Q110	Q103	Q50	Q29	Q7	Q48	Q11	Q113
	Q9	Q79	Q34	Q5	Q54	Q30	Q16	Q56	Q61	Q112
	Q20	Q84	Q117	Q25	Q55	Q47	Q26	Q64	Q65	Q53
	Q33	Q87	Q39	Q28	Q96	Q52	Q62	Q70	Q67	Q57
	Q37	Q95	Q49	Q31	Q104	Q106	Q63	Q78	Q73	Q60
	Q43	Q98	Q58	Q32	Q21	Q2	Q92	Q81	Q75	Q83
	Q46	Q99	Q85	Q35	Q116	Q3	Q38	Q82	Q80	Q11
	Q59	Q100	Q89	Q36	Q24	Q4	Q118	Q86	Q51	Q11
	Q71	Q109	Q97	Q42	Q27	Q6	Q115	Q94	Q114	
Acaena agnipila	+	+	+	1	+	+	+	+	+	+
Aira caryophylla	3	1	+11	+212	+2	+	+	+	+	+
Colobanthus brevisepalus	+	+	+	+++	+	+	+	+	+	+
Erodium cicutarium	+	+	+	+	+	+	+	+	+	+
Erophila verna	+	+	+	+	+	+	+	+	+	+
Gnaphalium ruahinicum	+	+	+	+	+	+	+	+	+	+
Hypericum perforatum	+	+	+	+	+	+	+	+	+	+
Myosotis discolor	+	+	+	+	+	+	+	+	+	+
Oreomyrrhis rigida	+	+	+	+	+	+	+	+	+	+
Poa maniototo	+	+	+	+	+	+	+	+	+	+
Rumex acetosella	+++	++	+	++++	1	+++	3	2	+	+
Raoulia beauvardii	1	+	+	+++	2	+	+	+	+	+
Raoulia australis	1	+	+	23332	1	+	+	+	+	+
Rytidosperma clavatum	+	+	+	+	+	+	+	+	+	+
Sedum acre	5	+	+	211422	+	+	+	+	+	+
Stellaria gracilentia	+	+	+	+	+	+	+	+	+	+
Trifolium arvense	34	+	+	674	+	+	+	+	+	+
Thymus vulgaris	+	+	+	547651445661	5	5	2	+	+	+
Agrostis capillaris										
Veronica verna	+1									
Verbascum virgatum										
Acaena novae-zelandiae										
Vittadinia australis	+	+								
Aphanes arvensis	+	+								
Anagallis arvensis	+	+								
Cirsium arvense	+									
Cirsium vulgare										
Elymus fascens										
Epilobium hectorii										
Euphorbia pepulus										
Geranium sessiliflorum	+	+								
Myosotis pygmaea										
Myosotis stricta	+++	++	++++							
Oxalis exilis										
Poa lindsayi										
Poa "tiny"										
Poa pratensis										
Rytidosperma racemosa										
Rytidosperma cf maculatum										
Taraxacum officinale	+									
Echium vulgare	+									
Lolium perenne										
Marrubium vulgare	+									
Vulpia bromioides	+	1								
Verbascum thapsus	+									
Vittadinia gracilis	+									
Acaena buchananii										
Coprosma propinqua										
Colobanthus strictus										
Elymus tenuis	+	++	2							
Hieracium pilosella										
Melicytus alpinus										
Microtis unifolia										
Anthoxanthum odoratum	55	+	+	5862	+	+	+	+	+	+
Carex breviculmis										
Crepis capillaris	+	+	+	1	+	+	+	+	+	+
Cerastium fontanum										
Dichelachne crinita										
Vicia sativa										
Festuca rubra	1									
Holcus lanatus										
Hypocharis radicata	++	+++	++	2	+	+	+	+	+	+
Lichen	++	1422	++	2	+	+	+	+	+	+
Moss	+	+	+	+	+	+	+	+	+	+
Rosa rubiginosa										
Trifolium dubium										
Acaena caesiiglauca										
Celmisia gracilentia										
Dactylis glomerata										
Elymus solandri	1									
Festuca novae-zelandiae										
Helichrysum filicaule										
Raoulia subsericea										
Trifolium repens										
Blechnum penna-marina										
Bromus tectorum										
Poa colensoi		++								
Poa cita										
Thelymitra sp.										



Appendix 10 Four vegetation characteristics of the 1997 plant communities on Flat Top Hill. Lower case letters in common between communities indicate average values are not significantly different ($P < 0.05$ by Duncan's New Multiple Range Test).