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THE VEGETATION OF THE RHEBAN SPIT, TASMANIA

by A.R. Bowden and J.B. Kirkpatrick

Geography Department, University of Tasmania

(with one table, three text-figures and four plates)

ABSTRACT

The vegetation of the Rheban spit, Tasmania is described and discussed. The vegetation on the frontal dunes, which have largely been developed in the last twenty years, can be divided into three zones, one dominated by *Ammophila arenaria*, one dominated by small herbs, and one dominated by *Pteridium esculentum* and *Banksia marginata*. The beach ridge vegetation cannot be divided so clearly into zones, but continuous variation is demonstrated through the use of polar ordination. The saltmarsh vegetation is briefly described, and the case for the preservation of the vegetation of the spit outlined.

INTRODUCTION

There are few accounts of the coastal vegetation of Tasmania. Stephens and Cane (1938) superficially described the vegetation and soils of the north-east coastal region, and Davis (1941) published a preliminary account of the vegetation of the New Harbour area in the south-west of Tasmania. This article describes the vegetation of the Rheban spit which is located approximately 10 km south-east of Orford on the east coast of Tasmania (figure 1).

The spit consists of a set of frontal dunes, backed by sets of lower, subparallel beach ridges, which are bounded to the west by a tidal lagoon. The maximum width of the frontal dunes is at present 140 m, while the beach ridges extend at their maximum 650 m inland from their contact with the frontal dunes.

No climatological data are available for the spit itself but the precipitation data from Triabunna and the temperature data from Swansea (table 1) probably approximate conditions on the spit.

The Rheban area was first settled in the late nineteenth century. The spit has been used, at least in recent years, for rough grazing in winter when the marsh areas become too waterlogged for this activity. The northern portion of the spit was cleared between 1946 and 1966, and there is evidence of firing, probably initiated to improve grazing on the uncleared part of the spit. Both the spit and the adjoining tidal lagoon are included in a sanctuary, but while the area remains private land, subject to grazing, clearing and firing this status affords little protection for the flora and fauna.

METHODS

The transect C-D (figure 1) was surveyed with a dumpy level and Carr-staff. Two pits were dug to observe soil characteristics, and these data were augmented through hand augering to a depth of 1.7 m at twenty-four localities along the surveyed line. Horizon depths, soil colour and soil texture were recorded.

The vegetation was sampled at twenty-four localities along the surveyed line (Figure 2). Each sample area consisted of ten one m^2 quadrats, aligned with the ridges and swales, each quadrat being separated by one metre. All species of vascular plant occurring within each quadrat were recorded. A plant was considered to be present in a quadrat if any of its aerial organs were situated directly above the quadrat. This

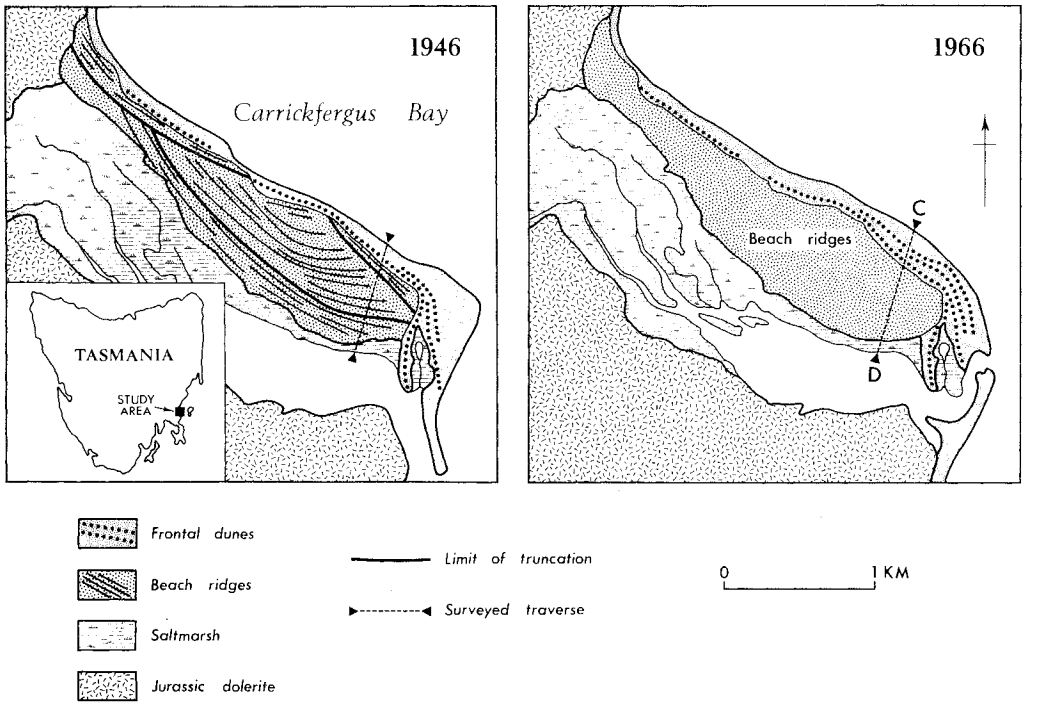

FIG. 1.- The Rheban spit, showing its evolution between 1946 and 1966 and the location of the transect.

TABLE 1

CLIMATIC DATA FOR SWANSEA AND TRIABUNNA

A = Precipitation (mm); B = No. of raindays (Prec. ≥ 0.25 mm);
C = Mean daily maximum temperature (°C); D = Mean daily minimum temperature (°C).

Swansea

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Year
A	4.1	4.8	6.3	5.8	4.2	6.4	5.0	3.5	3.8	5.5	4.7	6.3	60.4
B	9	8	10	11	10	12	12	12	12	13	11	11	131
C	21.6	21.9	20.4	17.7	15.2	12.9	12.6	13.6	15.5	17.4	19.3	20.7	
D	11.2	11.7	10.2	8.1	5.8	4.4	3.8	4.2	5.7	7.2	8.8	10.3	

Triabunna

A	4.1	5.4	7.1	6.3	4.3	7.4	5.0	4.1	3.9	6.4	4.9	7.7	66.6
B	7	6	7	9	7	9	8	9	9	11	9	9	100

procedure gave a frequency rating out of ten for each species in each sample area. The frequency figures give an index of the relative abundance of single species through the transect, but do not indicate relative dominance of species within the sample areas.

The sampling took place in August 1972 so some geophytes and annuals have almost certainly been missed. The sampling was augmented by observations elsewhere on the spit and in the saltmarsh in both August 1972 and December 1972. All plant species observed during both visits were collected and where possible identified to the species level.

RESULTS AND DISCUSSION

The levelling traverse revealed that the beach ridges and swales generally increase in height towards the lagoon (figure 2). From general observation it seems that this is the case in all but the northern part of the spit where Davies (1961) probably located his survey lines. The anomolous results reported by Davies *(loc. cit.)* for the Rheban spit seem thus to be the result of selecting for surveying an atypical cross-section of the spit. Davies *(loc. cit.)* explains the typical Tasmanian decrease of ridge and swale height towards the sea in terms of a steady lowering of sea level. However, a combination of other factors such as a general decline in constructive swell intensity or a decrease in sediment supply may produce a similar result. Local difference in ridge spacing, height and alignment can be accounted for by shorter term changes in condition in the offshore regime related to wind patterns, storm frequency, swell direction and wave size (Davies 1959).

At Rheban the different phases in beach ridge building have been separated by periods of erosion which are demonstrated by the manner in which the more recent sets of beach ridges truncate the older sets. In this context the use of linear regression as an analytical tool (Davies 1961) is inappropriate as the extent, number and dimensions of the eroded beach ridges cannot be ascertained.

Unlike most Tasmanian beach ridge systems which are eroding at their seaward margins (Davies 1957), the Rheban system has been actively advancing since at least 1946. Measurements from vertical aerial photographs taken in 1946 and 1966 and from the surveyed traverse reveal that the spit is growing seaward at a rate of approximately five m per annum. However, this rate of aggradation is confined to the southern end of the spit, while in the north the coast has been relatively stable (figure 1) and in parts the ridges are being actively undercut. This erosion is most likely due to concentrated wave attack initiated by the presence of a deeper channel (7.5 m) normal to the beach which extends 250 m to 2.5 km or more offshore. In parts of the south of the spit two high dunes have formed since 1946. The frontal dunes are both steeper and, on the whole, taller than the older beach ridges. These differences may relate to the introduction of marram grass, *Ammophila arenaria*, which has displaced *Festuca littoralis* as the sand binder on the spit, and which appears to be a more efficient performer of this function than the native grass.

The transect crossed two major soil types separated by a sharp boundary (figure 2). On the two major frontal dunes little or no pedologic development has taken place, although the soil on the more inland of these dunes exhibits some darkening of the surface layer with organic matter. These soils are classified as Uc 1.21 (Northcote 1971) and are composed of white (10YR 7/3 dry) sand with a low content of shell fragments. In the swales in the foredune complex the soils exhibit some weak mottling (5YR 5/8 wet) immediately above the watertable, which in December 1972 was located at a depth of approximately 50 cm.

A weak podzol has developed on the beach ridge system. The Northcote notation for this soil is Uc2.21. The following description characterizes the soil:

Horizon 1	0-15 cm	very dark greyish brown (10YR 3/2 moist) sand.
Horizon 2	15-23 cm	light grey (10YR 7/2 moist) sand (gradational change from horizon 1)
Horizon 3	23-200 cm+	brownish yellow (10YR 6/6 moist) sand (sharp change from horizon 2) becoming progressively yellower with depth.

The soil in the saltmarsh on the margins of the lagoon consists of peat to approximately 30 cm underlain by a gleyed sand.

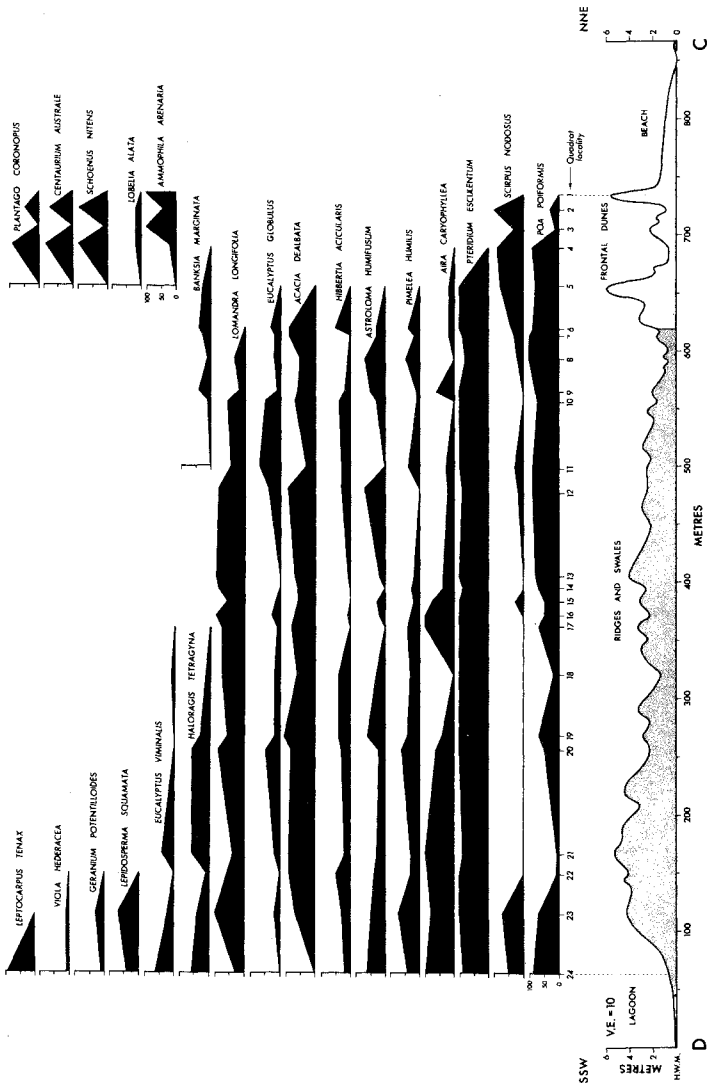

FIG. 2.- The percentage frequency of selected species through the transect.

Figure 2 shows the relative frequency of several of the more important species along the surveyed line. A list of species collected is appended along with some indication of their relative occurrence in the four main vegetation zones of the spit.

In the south of the spit the foredune is almost entirely vegetated by *Ammophila arenaria* on its crest and seaward slope (plate 1). However, *Sonchus megalocarpus* occurs sporadically among the tussocks, and on the upper part of the beach occasional individuals of *Cakile edentula* were found in December but not August. As mentioned earlier *Ammophila arenaria* appears to have almost totally displaced *Festuca littoralis* which was observed to occur quite rarely, but generally to the seaward of *Ammophila*. On the inland slope of the foredune *Ammophila* is dominant for the most part, but is suppressed in some areas where low shrubs of *Acacia longifolia* var. *sophorae* have become established. *Ammophila* maintains dominance on the second smaller frontal dune where *Acacia longifolia*, *Scirpus nodosus*, *Poa poiformis* and *Hypochaeris radicata* are also quite common.

PLATE 1.- The seaward slope of the foredune dominated by *Ammophila arenaria*. An embryonic dune can be seen in the middleground, where occasional individuals of *Cakile edentula* are also evident.

The third and largest of the frontal dunes has a contrasting vegetation, although pedologically it is similar to the first two dunes. This dune is covered with *Pteridium esculentum*, which is interspersed with tussocks of *Poa poiformis*, and quite frequently overshadowed by *Banksia marginata* (plate 3). *Ammophila*, although present on this dune, is rare.

The swales in the foredune complex are vegetated largely by a low mat of herbaceous species including *Schoenus nitens*, *Cotula reptans* *Centaurium erythraea*, *Samolus repens* and *Lobelia alata*. *Poa poiformis*, *Scirpus nodosus* and *Juncus* spp. form a slightly taller but more sparsely distributed stratum, and there is some minor colonization by *Acacia longifolia* (plate 2).

PLATE 2.- The vegetation of the frontal dunes and swales. A recent fire has killed *Acacia longifolia* in the middleground and *Banksia marginata* in the foreground.

The break in soil type from the largely undifferentiated sands of the foredune complex to the weak podzol of the beach ridge system corresponds with a dramatic change in the floristics and physiognomy of the vegetation (plate 3).

The beach ridge complex is covered by an open forest (Specht 1971) dominated by *Eucalyptus globulus*, although towards the lagoon end of the transect *E. viminalis* is equally as common.

PLATE 3.- The junction between the frontal dunes and the beach ridge system. On the frontal dune in the foreground there is a ground cover of *Pteridium esculentum* and *Poa poiformis*. Also visible are some shrubs of *Banksia marginata*. The beach ridge system in the middle and back ground supports an *Eucalyptus globulus* open-forest with a dense understory of *Acacia dealbata*.

The trees are even-aged and generally rather sparsely spaced (plate 4). Clumps of *Acacia dealbata* form a second stratum 2-3 tall over much of the beach ridge area. A third stratum generally 1 m tall is dominated by *Pteridium esculentum, Poa poiformis* and *Lomandra longifolia*. The fourth, least consistent stratum, is dominated by small prostrate shrubs, mainly *Astroloma humifusum* and *Hibbertia aciculare*.

Although the physiognomy of the beach ridge vegetation remained constant throughout the transect, some variation in floristic composition was evident (figure 2). Several species such as *Banksia marginata, Scirpus nodosus* and *Carpobrotus rossii* were common on the seaward ridges and swales but rare or absent towards the lagoon. Other species such as *Eucalyptus viminalis, Haloragis tetragyna* and *Lepidosperma squamata* were common towards the lagoon end of the transect but rare or absent elsewhere.

To clarify the nature of this change the beach ridge complex sample areas were ordinated on the basis of the frequency data using the polar ordination technique of Bray and Curtis (1957). The highest coefficient of distance (calculated by the formula $D = 100 - \frac{2w}{a + b}$ where w = the sum of the lower scores for each species in the two stands being compared, a = the sum of scores for one stand, and b = the sum of scores for the other stand) was found to be between the swale sample area 10 and sample area 24 (D = 75.3). This latter sample area, unlike all the others, was not situated in a swale or on a ridge, but rather was located on the lower part of the slope leading into the saltmarsh. However, its affinities proved to be more with the ridge sample areas in the lagoon end of the transect than with the swale sample areas in the same part of the transect.

PLATE 4.- Typical tree spacing on the beach ridge system. The main visible components of the flora are *E. globulus, A. dealbata, Lomandra longifolia* and *Pteridium esculentum*.

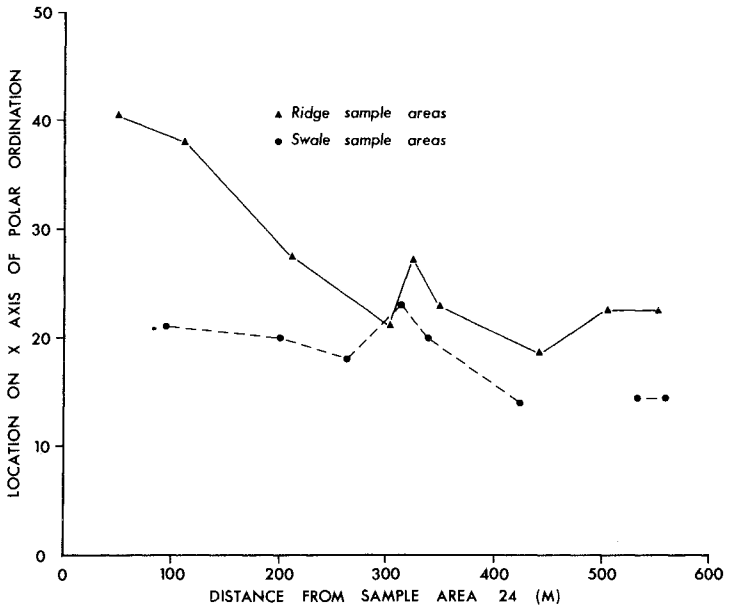

FIG. 3.- Ordination of the beach ridge system sample areas. The relationship between scores on the x axis of the polar ordination and distance from sample area 24 is shown. Sample areas 10 and 24, the poles of the x axis ordination, are omitted from the figure.

Figure 3 shows the relationship between the scores of the beach ridge system sample areas on the axis defined by sample areas 10 and 24, and distance from sample 24. This figure reveals that the vegetal variation within the beach ridge system is continuous. Interestingly, it also reveals that there is much more variation in the vegetation of the ridges than in that of the swales, and that the swale sample areas, almost without exception, have greater affinities with sample area 10 than the ridge sample areas.

The saltmarsh was not included in the transect. However, general observations revealed that several zones could be distinguished which seemed to be related to drainage and elevation. In the better-drained and higher parts of the marsh there is a dense growth of *Poa poiformis*. In these parts of the saltmarsh there is no peat development. On the most ill-drained and lowest portions of the marsh *Salicornia quinqueflora*, *Samolus repens* and *Suaeda australis* form a low succulent mat. In the imtermediate areas, which comprise most of the saltmarsh, *Juncus maritimus* is found in variable mixture with *Leptocarpus tenax* and *Gahnia trifida*, with a ground layer of the succulents.

From the previous descriptions it can be seen that there are two major vegetation zones on the spit (excluding the saltmarsh) which correspond with two distinct soil types. Although the change from one major vegetation type to the other is abrupt, as is the soil boundary, within these vegetation zones there is more or less continuous variation in vegetation. The frontal dunes can be divided into three subzones, one dominated by *Ammophila*, one dominated by low herbs, and one dominated by *Pteridium esculentum* and *Banksia marginata*. The first is essentially a colonizing community, *Ammophila* acting as a sand binder and dune builder, and tending to become less important with increasing shelter and sand stability. In 1946 the present third dune on the transect was the foredune (figure 1), and appears to have been largely covered with *Ammophila*. Since 1946 this dune has become increasingly further from the sea, with a consequent increase in shelter, and *Ammophila* although present is a minor component of the flora and mostly senescent. The ameliorated conditions have allowed the invasion of species from the beach ridge system, an invasion which is still continuing as evidenced by the presence of several sapling *Eycalyptus globulus*.

The swale community is probably related to the relatively shallow depth of the watertable, and the probability of occasional waterlogged conditions. This community has suffered the most from cattle grazing, and has the largest number of exotic species of any natural community in the study area.

The sharp break in soil and vegetation type at the junction of the frontal dunes and the beach ridge system suggests that a considerable time intervened between the formation of the most seaward and presumably youngest beach ridge and the oldest of the frontal dunes. The relative uniformity of the soils and vegetation of the beach ridge complex further suggests that the period between the formation of the youngest and oldest beach ridge was considerably less than the period between the formation of the youngest beach ridge and the oldest frontal dune. Variation in the vegetation of the beach ridge complex may partially relate to height above sealevel and its effect on available moisture in the deep permeable sands. However, there is a distinct possibility that this variation may also partially relate to subtle changes in edaphic conditions consequent upon variation in the age of the ridges.

One of the most interesting features of the vegetation of the Rheban spit is the presence of *E. globulus*. This eucalypt is only rarely found on deep siliceous sands, only two other such occurrences being known (Kirkpatrick, in preparation). The spit also presents one of the few opportunities in Tasmania to study succession on currently forming beach ridges, and is also of considerable geomorphic interest. The vegetation of the spit, although obviously deleteriously effected by grazing, is reasonably typical of beach ridge vegetation in Tasmania. Much of this type of vegetation is disappearing under the pressures of agricultural and recreational development. Thus there are strong reasons for conserving the vegetation of this area by granting it a more secure status than it enjoys at present.

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APPENDIX

Species collected from the Rheban Spit

1 = the frontal dunes (excluding the swales) 3 = the beach ridge system
2 = the swales between the frontal dunes 4 = the saltmarsh
vc = very common; c = common; o = occasional; r = rare; + = alien species

SPECIES	1	2	3	4
Dennstaedtiaceae				
Pteridium esculentum (Forst. f.) Nakai	c	-	vc	-
Gramineae				
+Aira caryophyllea L.	c	c	c	-
+Ammophila arenaria (L.) Link.	vc	o	-	-
Danthonia setacea R. Br.	o	-	c	-
Dichelachne crinita (L.f.) Hook. f.	o	-	c	-
Distichlis distichophylla (Labill.) Fassett	-	-	-	c
Festuca littoralis Labill.	o	-	-	-
+Holcus lanatus L.	-	o	-	-
Poa poiformis (Labill.) Druce	c	c	vc	c
+Sporolobus virginicus (L.) Kunth.	-	o	-	-
Stipa compacta D.K. Hughes	o	-	o	-
Cyperaceae				
Gahnia trifida Labill.	-	-	-	c
Lepidosperma squamata Labill.	-	-	o	-
Machaerina juncea (R. Br.) Koyama	-	o	-	-
Schoenus nitens (R. Br.) Poir.	-	c	-	o
S. tenuissimus Benth.	-	o	-	-
Scirpus nodosus Rottb.	c	c	o	o
Restionaceae				
Leptocarpus tenax (Labill.) R. Br.	-	-	r	c
Juncaceae				
Juncus bufonius L.	-	o	-	-
J. maritimus Lam.	-	r	-	vc
J. pallidus R. Br.	-	r	r	r
J. planifolius R. Br.	-	o	-	-
Luzula campestris (L.) DC.	-	-	o	-

Liliaceae				
Dianella revoluta R. Br.	-	-	r	-
Lomandra longifolia Labill.	-	-	vc	-
Orchidaceae				
Corybas diemenicus (Lindl.) H.M.R. Rupp	-	-	o	-
Pterostylis alata (Labill.) Reichenb. f.	-	-	o	-
Casuarinaceae				
Casuarina littoralis Salisb.	-	-	r	-
Proteaceae				
Banksia marginata Cav.	c	-	c	-
Santalaceae				
Exocarpos cupressiformis Labill.	-	-	r	-
E. strictus R. Br.	-	-	o	-
Polygonaceae				
+Rumex acetosella	o	o	o	-
Chenopodiaceae				
Salicornia quinqueflora Bunge ex Ung. - Sternb.	-	-	-	vc
Suaeda australis (R. Br.) Moq.	-	-	-	c
Ficoidaceae				
Carpobrotus rossii (Haw.) N.E. Br.	o	o	o	-
Caryophyllaceae				
Scleranthus biflorus (Forst. et Forst. f.) Hook. f.	o	-	r	-
Cruciferae				
+Cakile edentula Hook.	o	-	-	-
Rosaceae				
Acaena anserinifolia (Forst. et Forst. f.) Druce	o	o	-	-
A. ovina A. Cunn.	-	r	-	-
Mimosaceae				
Acacia dealbata Link	-	-	vc	-
A. longifolia (Andr.) Willd.	o	o	-	-
A. melanoxylon R. Br.	-	-	r	-
A. verticillata (Lher.) Willd.	-	r	-	-
Papilionaceae				
Aotus ericoides (Vent.) G. Don.	-	-	o	-
Dillwynia glaberrima Sm.	-	-	o	-
Indigofera australis Willd.	-	-	r	-

SPECIES	1	2	3	4
Kennedia prostrata R. Br.	-	-	o	-
+Lotus corniculatus L.	-	o	-	-
+Trifolium repens L.	-	o	-	-
+Ulex europaeus L.	-	o	o	-
Geraniaceae				
Geranium potentilloides Aucct., non certe Forst. f. ex Willde.	-	-	o	-
Oxalidaceae				
Oxalis corniculata L.	-	o	o	-
Euphorbiaceae				
Amperea xiphoclada (Sieb. ex Spreng.) Druce	-	-	o	-
Dilleniaceae				
Hibbertia aciculars (Labill.) F. Muell.	-	-	c	-
Violaceae				
Viola hederacea Labill.	-	-	r	-
Thymelaceae				
Pimelea humilis R. Br.	-	-	c	-
Myrtaceae				
Eucalyptus globulus Labill.	o	-	vc	-
E. viminalis Labill.	-	-	vc	-
Leptospermum scoparium Forst. et Forst. f.	-	-	r	-
Onagraceae				
Epilobium sp.	o	o	-	-
Haloragaceae				
Haloragis tetragyna (Labill.) Hook. f.	-	-	c	-
Epacridaceae				
Astroloma humifusum (Cav.) R. Br.	-	-	vc	-
Epacris impressa Labill.	-	-	o	-
Leucopogon parviflorus (Andr.) Lindl.	r	-	r	-
Primulaceae				
Samolus repens (Forst. et Forst. f.) Pers.	-	vc	-	vc
Gentianaceae				
+Centaurium erythraea Rafn.	-	c	-	-

SPECIES	1	2	3	4
Convolvulaceae				
Dichondra repens Forst. et Forst. f.	-	-	o	-
Scrophulariaceae				
Veronica calycina R. Br.	-	-	o	-
Plantaginaceae				
+Plantago coronopus L.	-	vc	-	-
Rubiaceae				
Galium sp.	-	-	r	-
Campanulaceae				
Lobelia alata Labill.	-	c	-	o
Wahlenbergia sp.	o	-	o	-
Goodeniaceae				
Selliera radicans Cav.	-	c	-	c
Compositae				
+Cirsium vulgare (Savi) Ten.	-	r	r	-
Cotula reptans (Benth.) Benth.	-	c	-	o
+Gnaphalium candidissimum Lam.	-	c	-	-
Helichrysum apiculatum (Labill.) DC.	o	-	o	-
H. dendroideum N.A. Wakefield	-	-	r	-
+Hypochaeris radicata L.	o	c	o	-
+Leontodon taraxacoides (Vill.) Merat	o	-	o	-
+Picris hieracioides L.	o	-	o	-
Sonchus megalocarpus (Hook. f.) J.M. Black	o	-	-	-