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THE VEGETATION AT WALKERVILLE, VICTORIA

A Further Application of the Zürich-Montpellier Technique

By P. D. CHEAL*

ABSTRACT: The native vegetation of the Cape Liptrap-Walkerville area is classified using the Zürich-Montpellier system of phytosociology. Eight distinct plant communities are distinguished and their regional relationships discussed. The primary determinants of these communities appear to be various edaphic factors, particularly the nutrient status and fluctuations in the depth of the water-table. Although the dominants may be differential species of these communities, their distributions are frequently unrelated to community boundaries and their use as the sole community determinants elsewhere is questioned.

INTRODUCTION

The Cape Liptrap-Walkerville area is a small remnant of uncleared land surrounded by cleared pasture, on the coast immediately west of Wilsons Promontory, Victoria. The Cape itself is a rocky headland jutting out into Bass Strait, with long stretches of more or less consolidated high dunes on the western side, and a coastline of high cliffs and rocky bays and beaches on the eastern side. It is one of the few remaining sizeable areas of native vegetation between Port Phillip Bay and Wilsons Promontory which had not been studied from the botanical point of view.

The aim of this investigation was to provide a workable vegetation classification. The Zürich-Montpellier system of phytosociology seemed to provide the most comprehensive analytical procedure and was chosen for this purpose. The relative advantages and disadvantages of the Zürich-Montpellier system have been adequately discussed elsewhere (Poore 1955a, b, c, 1956, Moore 1962, Greig-Smith 1964, Moore *et al.* 1970 and Gullan 1975). Broadly, it is an easily used, universally understood and non-subjective phytosociological system. Furthermore, as the species involved become better understood the particular species assemblages outlined indicate much about the local environment (e.g. rainfall, edaphic conditions, frequency of fires, grazing pressure) and also give an indication of the regional relationships and recent history of the flora.

CLIMATE

The Cape Liptrap – Walkerville region experiences the uniform climate expected at an exposed maritime location. Data from the Wilsons Promontory recording station, which is likely to experience a similar climate, shows the hottest months to be January and February with mean maxima of 20.1°C and 20.7°C and mean minima of 13.8°C and 14.5°C, respectively. This small difference between the mean monthly maxima and minima is also found in the coldest month, July, when the mean maximum is 12.3°C and mean minimum 8.1°C. Occasional extreme temperatures are experienced in summer; the highest recorded being 41.4°C in January. The maritime location apparently exerts a greater influence on minimum temperatures than it does on maximum temperatures. Minima less than 2°C are only very rarely reported. The lowest recorded (June) minimum is −1.1°C. Frost rarely if ever occurs.

The mean annual rainfall recorded at Walkerville is 1026 mm (1039 mm at Wilsons Promontory), and is more or less evenly distributed throughout the year, with a moderate winter maximum. July is the wettest month with a mean monthly rainfall of 121 mm and February the driest with 38 mm. However, the mean summer (December to February) rainfall is relatively high at 157 mm. The chance of receiving rainfall equal to or greater than the 'effective amount' (see Gibbs 1951) is quite high in all seasons except summer.

*Departments of Zoology and Botany, Monash University, Victoria.
Current address: National Parks Service (Victoria), 240 Victoria Parade, East Melbourne, Victoria 3002.

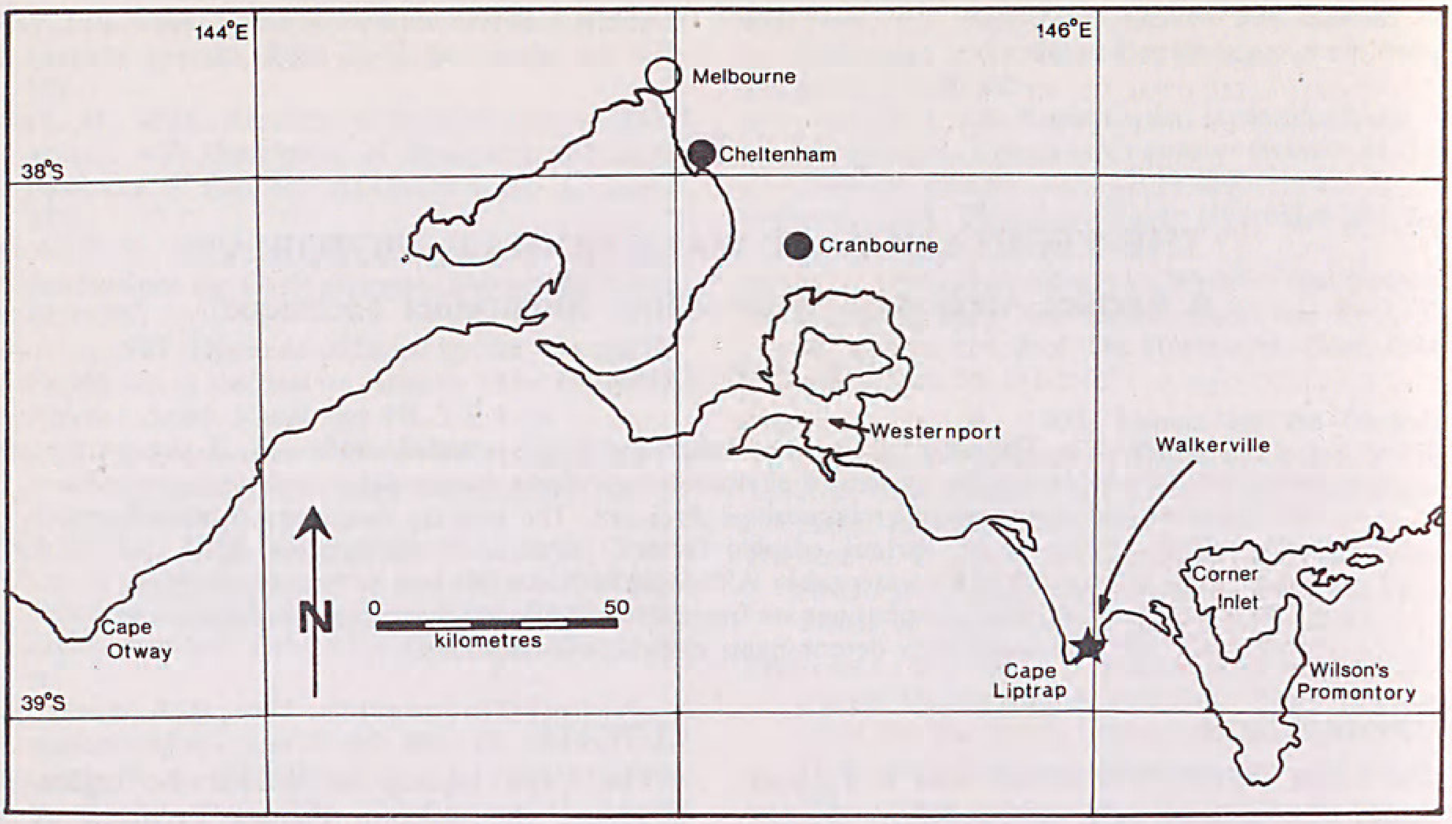

FIG. 1 — Location of Study Area (and selected localities mentioned in the text).

For Wilsons Promontory the percentage chance of receiving effective rainfall in this period is 78% for December, 59% for January and 62% for February. Droughts (i.e. consecutive months of less than effective rainfall) are infrequent. Dry periods lasting two to three months have been recorded between November and March but are not common.

Although dependent on local weather conditions, hours of sunshine vary from 200 to 250 hours for each summer month to between 100 and 150 hours for each winter month.

In summary, the climate is remarkably uniform and rarely experiences either extended periods of rainfall deficiency or extremes of temperature.

PHYSIOGRAPHY

The predominant geological feature is the Liptrap Formation, a dark grey Lower Devonian mudstone/shale that is extremely well-bedded. Sandstone, grit and pebble bands, to greater than 1 m thick, are rhythmically interbedded and there are sporadic massive units of gritty and pebbly sandstone (Singleton 1973). The strike is more or less constant to the north, with dips generally fairly steep to the west. Occasional slump conglomerates with pebbles of chert, jasper and greenstone contain limestone boulders probably originating from the Waratah Limestone. This limestone is a massively bedded Lower Devonian deposit outcropping rarely and mostly covered by Tertiary deposits (Douglas 1972/5).

Overlying much of the Palaeozoic deposits are semi-consolidated or compacted sandy gravels and sandstone conglomerates of Pliocene alluvial and lacustrine paludal sedimentary origin. These chocolate brown to grey sands generally weather to a characteristic mottled yellow colour. White angular quartz gravels are also locally prominent in the Walkerville South area. Recent stream alluvium (sand, silt etc.) has been deposited along the beds and margins of the deeply incised streams.

Altitudes vary from near sea level to just over 180 m at Mt. Liptrap (2.7 km inland). The local topography is an undulating surface with the slopes of broad crests attaining to 10° or more and leading down to deeply incised streams, up to 60 m below the crests. Perched depressions of various sizes are frequent on the crests, where there are also occasional small rocky outcrops. High cliffs (to 80 m) line the western shoreline at the Cape and this rocky coastline continues around the east towards Venus Bay.

Infertile soils with impeded drainage are common throughout the area. Here the soil profile shows a duplex light to dark grey clayey silt to 30 cm, over a yellow-mottled medium to heavy-textured clay to 1 m, the latter covering decomposed rock (Grant, K., in press). The restricted internal drainage of these soils means that they are frequently waterlogged to the surface during the wetter (winter) months. Under such anaerobic and strongly acidic conditions there is a substantial accumulation of undecomposed fibrous plant material in the surface horizons. In extreme situations an amorphous peat or mull develops, particularly where sphagnum moss is prevalent. Leaching, the predominant soil-forming process here, has led to a profile that is strongly acidic throughout and markedly deficient in plant nutrients, particularly phosphorus (Paton & Hosking 1970).

Deeper Tertiary sands occur as isolated rises throughout and as more extensive patches in the north of the area investigated. Here the depth of the surface horizon, somewhat darkened with organic matter, is more variable (< 1 m) and passes into a bleached subsurface horizon (to more than 2 m; Grant, *loc. cit.*). These soils are rarely if ever waterlogged, with the pH of the surface ranging between 4.8 and 5.7. Such deep infertile leached sands and badly drained peaty sands have been described as normal for heaths (Kirkpatrick 1975).

Occasionally the parent material outcrops at the surface and here the characteristically stony or gravelly shallow soils that develop are closely dependent on the nature of this parent rock e.g. the pH can be substantially raised where the outcropping rock is limestone.

Elsewhere deeper, humic soils typically less acid in reaction at the surface have developed over yellow-clay subsoils. Leaching may not be excessive and this may have led to a less deficient nutrient status, with drainage between the excessively draining and severely impeded soils described above. Combined with the moderate water-retaining capacity of these soils, this means that the vegetation growing here is unlikely to experience great fluctuations in available soil-water (Groves 1965).

DATA COLLECTION AND SYNTHESIS

Sampling Methods: Unlike other Zürich-Montpellier vegetation analyses e.g., Coetzee (1974) and Bridgewater (1976), all relevē sites were not selected individually in apparently homogeneous units. As the vegetation assessment formed part of a study attempting to determine the habitat utilization and preferences of small mammal species, relevēs were located along trapping lines at regular intervals of 10 m. These trapping lines were selected so that the first two or three relevēs were located in apparently homogeneous vegetation units. However, rarely were the final relevēs of the line located in the same association as the initial ones.

As these relevēs were a predetermined set distance apart (10 m) and all four corners were also predetermined, a relevē occasionally included a marked vegetation discontinuity and/or two apparently distinct communities. These samples were not discarded but were included in the final analysis and treated the same as other apparently homogeneous samples. This inclusion of samples containing marked vegetation discontinuities (so that *all* relevēs sampled were included in the analysis) must reduce the criticism, frequently levelled at the Zürich-Montpellier system, that selection for vegetation homogeneity at the sampling site over-emphasizes the discontinuity between communities (Poore 1955a, Goodall 1961, Bouxin 1975).

Before selecting an appropriate relevē size minimal area curves were drawn up for four greatly differing community types (i.e. forest, mature 'dry' heath, recently-burnt 'wet' heath and severely wind-pruned heath). These curves all indicated as suitable the relevē size of 9-16 m^2 which has been found before in similar vegetation (Grant 1974, Gullan 1975). However releves of 100 m^2 (10 m x 10 m squares) were used to coincide with the intended trapping program.

Vegetation description was as outlined in Bridgewater (1971), with all vascular plant, bryophyte and larger lichen species, including epiphytes, recorded and assigned a value on the cover abundance scale of Braun-Blanquet (1964). 'Cover' was defined as the amount of ground space that would be covered by an irregular polygon tracing the outline of the plant. Species were not assigned a value on a sociability scale. Special note was made of any marked local biological or physical discontinuities (e.g. tracks, sphagnum patches, road drains). All data were recorded on cards providing a list of species likely to occur in the area. This greatly reduced the amount of time required to adequately assess the relevēs.

The vegetation was sampled on various occasions between June and December with most relevēs assessed only once. Unlike vegetation types where there is a strongly seasonal climate (e.g. the Mallee) and where time of year of sampling and recent weather conditions are of crucial importance in association determination (Holland 1971), few species were missed in this single sample. This is probably due to the uniform maritime climate.

Community Analysis: Although it is possible to synthesize meaningful vegetation associations without the assistance of computers, as outlined by Bridgewater (1971), the amount and complexity of the data collected meant that a hand-sort of that type would have been so time-consuming as to be impracticable. Consequently, the initial complexity of the data was reduced by computer sorting using programs devised by Gullan (1975).

The data collected were coded onto cards with the ability to store information on up to 250 species. This meant that only those species that occurred very infrequently (generally in less than 4 relevés) were omitted from the analysis. The data were then analysed using the CARJAC/ ZUMONT (CANDE NAME = MAGIC) sorting program, a non-hierarchical, polythetic, agglomerative process based on the Carlson Cluster technique (Carlson 1972) using the Jaccard coefficient of similarity (see Gullan 1975). This initial sort so reduced the complexity of the data that the analysis was completed by hand-sorting using the printing program ZUMONT/ NEW (CANDE NAME = BUFF).

PLANT COMMUNITIES

Unlike previous Zürich-Montpellier studies the communities distinguished were not assigned names. Ideally, the determination and naming of a hierarchical classification, as outlined by Bridgewater (1971), should await a regional synthesis. Consequently the groups determined were referred to as Community One, Community Two etc. with a further descriptive name derived from the system of Specht (1972).

COMMUNITY ONE — CLOSED SCRUB (*Melaleuca ericifolia* dominant).

Easily distinguished structurally by the dominance of *Melaleuca ericifolia* as the sole caopy species at cover values of greater than 80%, this community's main differential species are *Ptychomnion aciculare, Festuca hookerana, Luzula meridionalis, Poa tenera, Ranunculus glabrifolius, Dichondra repens* and *Geranium solanderi*. Shrub species are very infrequent; only two are commonly recorded (*Acacia verticillata* and *Helichrysum dendroideum*).

This community, identifiable as the *Melaleuca ericifolia* thicket association of Parsons (1966) and Community Five (*Melaleuca ericifolia*) of Grant (1974), is restricted to a broad, flat, elevated drainage line between forested slopes. The humic soils, with significant clay content at depth and high water-table, probably result in little fluctuation in available water. This consistently high water-table may be the main factor in excluding both the *Eucalyptus* species of the adjoining forest and the species otherwise widespread throughout the other communities (i.e. *Drosera auriculata, Gonocarpus tetragynus* and *Epacris impressa*).

COMMUNITY TWO — OPEN FOREST (*Eucalyptus obliqua* dominant).

The ubiquitous occurrence of *Eucalyptus obliqua* as the sole canopy species and *Tetrarrhena juncea* as a physiognomic dominant of the lower vegetation readily distinguishes this widespread community which is undoubtedly the predominant forest-type of the area. Although structurally very distinct, this vegetation type shares many species with Community One, principally a group of eight herbs (*Acaena anserinifolia, Cotula australis, Galium gaudichaudii, Geranium potentilloides, Hydrocotyle hirta, Hypericum gramineum, Lagenophora stipitata* and *Oxalis corniculata*), the mosses *Thuidium furfurosum* and *Hypnum cupressiforme*, and the lichen *Ramalina menziesii*. *Melaleuca ericifolia*, a canopy dominant of Community One (cover 80%), also occurs throughout Commmunity Two, but here as the major understorey component at cover values of not greater than 45%.

This community occurs only on the eastern slopes, where it is sheltered from the prevailing westerly winds, and on humic podsols of moderate fertility. Four species dominate to the extent of comprising by far the greater proportion of the photosynthetic biomass (ignoring woody parts) i.e. *Eucalyptus obliqua, Melaleuca ericifolia, Tetrarrhena juncea* and *Pteridium esculentum*. This may be due to a severe fire in 1971 as isolated individuals of more fire-sensitive species (e.g. *Coprosma quadrifida, Olearia lirata*) occur throughout this forest-type.

COMMUNITY THREE — OPEN FOREST (*Eucalyptus radiata/E. obliqua* dominant).

The primary differential species of this forest-type are *Pultenaea daphnoides, Chaetophyllopus whiteleggei, Lepidosperma laterale, Lomandra filiformis* and *Acrotriche serrulata*. This community is structurally similar to Community Two but there are many significant floristic differences. *E. obliqua* and *E. radiata* occur as codominants and the major understorey species are *P. daphnoides, Leptospermum juniperinum* and *Acacia stricta*. *Tetrarrhena juncea* remains as an important, (though less so) component but the many small herbaceous hemicryptophytes so distinctive of the previous two communities are absent. Instead, the taller, more sclerophyllous *Lomandra filiformis*, *Diplarrena moraea* and *Lepidosperma laterale* and the dwarf shrub *Acrotriche serrulata* typify the field layer.

This forest-type occurs on the more exposed rounded hill-tops. The soils are less humic and have a greater sand content and more variable moisture status than those of the preceding Community Two. Although structurally similar to Community Two this community is more closely related, floristically, to the following vegetation type.

COMMUNITY FOUR — LOW WOODLAND
(*Eucalyptus radiata* dominant).

Although falling within the definition of a Low Woodland this vegetation type could be more realistically described as a Closed Heath with an occasional emergent *E. radiata*. This community is somewhat transitional between Community Three and the following heath communities. A number of species is shared with the forest communities (e.g. *E. radiata, A. stricta, Galium gaudichaudii, Viola hederacea*) and there is a further group of more typically heathland species (e.g. *Selaginella uliginosa, Calorophus lateriflorus, Hypolaena fastigiata, Leptospermum myrsinoides*). However certain species which are otherwise widespread and common in heath communities are noticeably absent (e.g. *Cassytha* spp., *Casuarina* spp., *Dillwynia* spp., *Leptocarpus tenax, Xanthosia pusilla*). This community occurs as a single patch, less than 5 ha, isolated from other heath communities by an extensive area of Community Three. It is believed that this distinct local variant is a response to frequent fires from the adjoining road and farmland, and an infertile sandy soil in an area of otherwise moderately fertile humic loams over yellow clay.

COMMUNITY FIVE — CLOSED HEATH
(*Melaleuca squarrosa/Leptospermum juniperinum/ Casuarina paludosa* dominant).

The primary differential species for this association are the dominant *Melaleuca squarrosa*, and *Calorophus lateriflorus, Sprengelia incarnata, Boronia parviflora* and *Cassytha pubescens. Pultenaea stricta* is also frequent and restricted to this vegetation type but this may be a reponse to recent fires. The overriding impression of this vegetation type is an exceedingly dense closed heath (canopy coverage 95%), approximately 1 m tall and variously dominated by *M. squarrosa, C. paludosa* and/or *Leptospermum juniperinum. Leptocarpus tenax* frequently emerges to heights of 1.5 to 2 m. In a mature community, herbaceous species are rare and of low coverage. However, after a fire the species richness is very high, frequently up to 45 vascular species per 100 m^2 relevé.

This community occupies the largest area of extant native vegetation. It is analogous to Association C (Melaleuca-Selaginelletum of Grant (1974)), particularly the Sub-association C2-Casuarinetosum, and also shows some similarities to the *Melaleuca squarrosa* heath association of Parsons (1966) and to Group 6 of Gullan (1976), which is characterized by *Melaleuca squarrosa, Leptospermum juniperinum* and *Gahnia sieberana.*

The characteristic soils of Community Five are shallow, loamy sands overlying clays at about 30 cm depth with a compacted, drainage-impeding layer close to the surface. During the winter months a perched water-table develops and the whole A horizon becomes waterlogged. Locally there may be extended periods when there is free surface water. The nutrient status of these infertile soils, the soil/water relations and the growth of the vegetation is more fully discussed by Groves and Specht (1965).

A variant (or distinct association) occurs in small patches throughout this community. The differential species are *Sphagnum cymbifoliodes, Machaerina tetragona, Epacris microphylla, Villarsia exaltata* and *Xyris operculata.* The canopy of *Melaleuca squarrosa* and *Leptospermum juniperinum* is stunted and much more open than in the adjacent Community Five, and many of the low sclerophyllous 'heath' species are absent. The field layer is frequently a dense stand of a few species of sedges. The highly organic, acid soils (peats) are permanently waterlogged, with free surface water in winter as the slopes are negligible.

COMMUNITY SIX — CLOSED HEATH
(*Casuarina pusilla/Leptospermum myrsinoides* dominant).

Differential species for this distinct community are *Gompholobium huegelii, Leucopogon virgatus, Monotoca scoparia, Acacia suaveolens* and *Casuarina pusilla.* Although structurally very similar to Community Five, the dominant species are *Casuarina pusilla, Leptospermum myrsinoides* and *Banksia marginata; Leptospermum juniperinum* is also frequent. The zone of transition between Communities Five and Six is frequently no greater than 1 m wide, particularly in mature vegetation. This may be a direct response to a fluctuating water-table or an indirect response to changes in available nutrients, particularly phosphorus, as the water-table rises and falls (see Jones 1975).

This community occurs on isolated rises where deep Tertiary siliceous sands overlie the soils typical of Community Five. An almost identical community has been reported from other localities in Victoria with similar soils e.g. Cranbourne (Groups 1 and 2 of Gullan 1976), Westernport (the Leptospermo-Monotocetum association of Grant 1974) and Wilsons Promontory (Parsons 1966). The water-table does not approach the soil surface, as it does in the *Melaleuca squarrosa* dominated heathland, and the soils are much less organic.

COMMUNITY SEVEN — OPEN HEATH
(*Casuarina* spp./*Hakea sericea*/*Acacia myrtifolia* dominant).

Limestone outcrops at the northwestern end of one of the ridges and here there is a very shallow rocky soil of higher pH and nutrient status than is typical for the adjoining heathland. The vegetation type that has developed on these very exposed slopes is structurally and floristically distinct. Primary differential species are *Acacia myrtifolia, Drosera pygmaea, Hakea sericea* and *Sphaerolobium vimineum*. There are occasional very stunted shrubs of *Eucalyptus radiata*. Although the species generally restricted to Community Five are absent, *Casuarina paludosa* and *Lindsaya linearis* are frequent indicating that this is not a local variant of Community Six, but rather a distinct species association.

This community can be further divided into a variant of the shallowest soils of the most exposed locations, typified by a low species diversity and the presence of *Lepidosperma laterale, Diplarrena moraea* and *Xanthosia tridentata*, and a variant of deeper soils, where some of the species typical of Community Six may be found.

COMMUNITY EIGHT — CLOSED HEATH
(*Leptospermum laevigatum*/*Leptospermum juniperinum*/*Casuarina paludosa* dominant).

In this community the differential species include the dominant *Leptospermum laevigatum* and the most frequent understorey species *Machaerina juncea*. Further differential species are *Hibbertia sericea, Astroloma humifusum, Comesperma volubile* and the distinct variety *Acacia verticillata* var. *ovoidea*. This community is undoubtedly most closely related to Community Six but there is a number of important differences i.e. the absence of *Acacia suaveolens, Casuarina pusilla, Gompholobium huegelii* and *Monotoca scoparia*, important differential species of that community, and the consistent presence of *Casuarina paludosa, Acrotriche serrulata* and *Viola sieberana*.

This community is found only on the elevated headland of the Cape, but is widespread there. The surface has a relatively high pH (6 to 6.2) and is subject to considerable wind-borne salt input. However the profile soon increases in acidity (pH 4.8 to 5 at 20 mm depth) and then remains more or less constant throughout the leached, yellow sands of the A horizon (pH 5.2 at 39 cm). An impeding coffee-rock layer (organically cemented sand) may still form, although this is rarely close enough to the surface to induce anaerobic conditions approaching those of the soils of Community Five in winter. This strongly acid hardpan (pH 4.5) may be as close as 0.2 m to the surface or much deeper, to greater than 0.6 m.

On more protected slopes, often nearer the sea, where the soils are the deep calcareous dunes typical of coastal locations in many parts of Victoria, there is an abrupt transition to a Closed Scrub (*L. laevigatum* dominant) community. This is the *L. laevigatum* thicket of Parsons (1966) and the Leptospermo-Leucopogetum association of Grant (1974). The boundary is frequently marked by the hybrid *Banksia integrifolia* x *Banksia marginata*.

Communities 5, 6, 7 and 8 are not only structurally similar (all heathland) but have certain species in common as well. These species, indicating relationship at a higher hierarchical level, are *Banksia marginata, Cladia aggregata, Hypolaena fastigiata, Patersonia fragilis, Schoenus tenuissimus* and *Xanthosia pusilla*.

Similarly, communities 3 to 8 inclusive, share *Burchardia umbellata, Leptospermum juniperinum* and *Opercularia varia*.

The most generally distributed species occur more or less evenly and regularly throughout all communities except Community One, which is the most floristically and structurally distinct of the species assemblages. These widespread species are *Campylopus introflexus, Drosera auriculata, Epacris impressa* and *Gonocarpus tetragynus*.

A species group worthy of particular mention is found in the five species *Drosera peltata, Laxmannia gracilis, Marianthus procumbens, Platysace heterophylla* and *Tetrarrhena distichophylla*. These herbs are all of similar procumbent habit and occur throughout Community Seven and in those areas of Community Five that were recently burnt. This group appears to be a response to a particular structural situation (i.e. a more open canopy with greater light penetration throughout and a greater light intensity at ground level) in heathland areas of seasonally high water-table. As these burnt areas mature these species will presumably decrease in importance. They are of only very sporadic occurrence in mature heaths of Community Five. Conversely, *Epacris obtusifolia* occurs solely in mature vegetation (of Community Five) where there is no evidence of a recent fire.

There are a few species which, although not infrequent, have distributions which do not conform to the community types distinguished and discussed above. For example, *Leucopogon australis* is not uncommon in Communities One, Three and Four and reappears consistently in *Sphagnum*-dominated areas of Community Five. There is a relatively high light intensity at ground level and consistently and reliably high soil moisture in these locations. Elsewhere either the light intensity at ground level is lower or the soil moisture is more variable. *Cladonia* spp. (at least two — *C. pityrea* and *C. verticillata* — and possibly more) occur sporadically throughout the area, but consistently in locations that have not experienced a fire for some time.

DISCUSSION

These plant communities comprehensively account for all the non-coastal vegetation of the uncleared land in the Cape Liptrap-Walkerville area. The major community determinants appear to be the nutrient status of the soil, fluctuations in the depth of the water-table and the presence of an impeding layer close to the surface.

It is important to note that the Zürich-Montpellier Association Analysis takes account of the complete species complement of the vegetation and not just the dominants or uppermost stratum species. Although physiognomically dominant species were often also differential species for particular communities, the recognition of communities by dominant species would have led to a different result. For example, *Eucalyptus kitsoniana* and *Eucalyptus viminalis* var. *racemosa* were occasionally emergent above stands of Community Five. Yet no other floristic differences were apparent between those relevés with and those without these trees; consequently there is no basis for distinguishing two more communities solely on the presence or absence of these two species. Similarly, consideration of the species of the uppermost stratum only would have ignored the frequently precise community change between Community Five and the *Sphagnum*-dominated variant.

Consideration of the total species complement may further help in determining community relationships. Although Communities One and Two are very different structurally and in their dominants, the large number of species shared in common implies greater similarity and a much closer relationship between these two communities than there at first appears. Conversely, Communities Two and Three, although in the same structural category (Open Forest), have few species in common and are not closely related floristically.

The regional relationships of the flora are difficult to determine as the author is aware of few Zurich-Montpellier studies, apart from those of Grant (1974) and Gullan (1975), in comparable vegetation. However, certain of the communities distinguished are recognizable in vegetation studies using other techniques. Community Six, Closed Heath (*Casuarina pusilla/Leptospermum myrsinoides* dominant), is apparently widespread in southern Victoria, as other workers have reported a more or less identical association in similar soils e.g. at Cranbourne (Gullan 1975), Westernport (Grant 1974), Wilsons Promontory (Groves and Specht 1965, Parsons 1966). Furthermore this may be the same vegetation type reported from Corner Inlet (Turner *et al.* 1962), Cheltenham (Patton 1933) and from extensive sandplains at Keith in South Australia (Specht & Rayson 1957), although in these localities the vegetation is less compatibly defined.

Similarly, Community One, Closed Scrub (*Melaleuca ericifolia* dominant) reappears at Westernport and Wilsons Promontory. Structurally similar vegetation with the same canopy dominant is frequent in poorly drained situations in southern Victoria but as the floristics are rarely adequately discussed its identity with Community One is doubtful.

Community Five, Close Heath (*Melaleuca squarrosa/Leptospermum juniperinum/Casuarina paludosa* dominant), may be identical with both the heath association of exposed locations reported from East Gippsland (L.C.C. 1974) and Association C (Melaleuca-Selaginelletum, subassociation C.I) of Grant (1974) at Westernport. A similar possibly identical, community has also been described from Cape Otway by Parsons, Kirkpatrick and Carr (1977). In other areas where *M. squarrosa* dominates the floristics, structure and edaphic conditions indicate a distinctly different association.

Associations similar to Communities 7 and 8, Open Heath (*Casuarina* spp./*Hakea sericea/Acacia myrtifolia* dominant) and Closed Heath (*Leptospermum laevigatum/Leptospermum juniperinum/Casuarina paludosa* dominant) respectively, have not been reported elsewhere.

These two vegetation types are probably a response to a unique set of local conditions and may be restricted to the Walkerville area.

The distribution of the vegetation types represented by Communities Two and Three, Open Forest (*Eucalyptus obliqua* dominant) and Open Forest (*Eucalyptus radiata/Eucalyptus obliqua* dominant) respectively, is unknown (these associations have not been recorded elsewhere). Carolan (1976) records both the dominant species (*E. obliqua* and *E. radiata*) in near-coastal situations on the eastern coast of the Southern Otways and *E. obliqua* at Port Campbell. As climatic and edaphic conditions appear similar to Walkerville these associations may re-occur at the above locations, and elsewhere in western Victoria. *E. obliqua* apparently does not reach the coast east of Wilsons Promontory.

Climatically and edaphically, as well as floristically, the relationships of the Walkerville vegetation appear to lie more with that of southwestern Victoria than with East Gippsland, especially in view of the southwestern or south-central affinities of many of the dominant or characteristic species (e.g. southwestern — *Machaerina acuta, Casuarina pusilla, Isopogon ceratophyllus, Pultenaea stricta;* south-central — *Acacia verticillata* var. *ovoidea, Eucalyptus kitsoniana, Hibbertia procumbens*). With the exception of *Melaleuca ericifolia*, those species with pronounced eastern affinites are rare and sporadic in occurrence e.g. *Banksia serrata, Hakea teretifolia, Sowerbaea juncea, Xanthosia pilosa*, and are neither dominant nor characteristic of the communities. However to further understand the regional relationships of the vegetation much more work is needed, particularly in southwestern Victoria, from the Lower Glenelg River to the eastern Otways.

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TABLE 1

CONSTANCY OF THE MORE COMMON SPECIES IN COMMUNITIES

I — 0 to 9% II — 10 to 19%, etc. to X — 90 to 100%

Community number	1	2	3	4	5	6	7	8
No. vascular plant spp. per 100 sq. m. relevé mean (± s.d.)	26.9 (±3.5)	21.1 (±4.1)	30.6 (±4.3)	36.7 (±3.2)	35.1 (±4.2)	36.2 (±4.8)	43.7 (±5.2)	37.3 (±5.6)
Ptychomnion aciculare	X	II						
Festuca hookerana	VIII							
Luzula meridionalis[1]	X	II	III					
Poa tenera	X	IV						
Ranunculus glabrifolius	X	I						
Dichondra repens	X	III						
Geranium solanderi	IX		III					
Helichrysum dendroideum	VII		II					
Acacia verticillata	X	VIII						
Melaleuca ericifolia	X	X	III					
Acaena anserinifolia	X	IV						
Cotula australis	X	V						
Galium gaudichaudii	X	VIII	II	V				
Geranium potentilloides	X	VII						
Hydrocotyle hirta	X	X	III					
Hypericum gramineum	VI	VII	III					
Lagenophora stipitata	X	X	VIII					
Oxalis corniculata	X	VI						
Thuidium furfurosum	VIII	VI						
Hypnum cupressiforme	X	VII						
Ramalina menziesii	IX	VIII						
Coprosoma quadrifida	X	VIII						
Deyeuxia quadriseta		VIII						
Lophocolea semiteres	II	X	II	III				
Eucalyptus obliqua		X	X					
Tetrarrhena juncea		X	X					
Pultenaea daphnoides		II	IX					
Chaetophyllopus whiteleggei			VIII					
Lepidosperma laterale	II		IX				V	
Lomandra filiformis		I	X		VIII	IX	X	III
Acrotriche serrulata		II	X		II	II	VI	X
Eucalyptus radiata		II	X	X				
Acacia stricta		II	IX	X				
Dianella revoluta		I	III	IX				
Xanthorrhoea minor				X	IV	I	V	

Except where otherwise indicated, (see Table and below) all vascular plant nomenclature follows Churchill and de Corona 1972. 1. pro parte *Luzula campestris*. 2. syn. *Haloragis tetragyna*. 3. sp. nov. Orchard, 1975; pro parte *Haloragis teucrioides*. 4. sp. nov. Vickery 1970; pro parte *Poa australis*.

Full tables and a comprehensive list of all plant species collected are available from the author on request. A near-comprehensive herbarium has been collected and is lodged in the Departmental Herbarium, Botany Department, Monash University.

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Community number	1	2	3	4	5	6	7	8
Melaleuca squarrosa				X	X	II		
Calorophus lateriflorus				VI	X	III	I	
Sprengelia incarnata					VIII			
Boronia parviflora					VIII			
Cassytha pubescens					VI			
Pultenaea stricta					VI	III		
Leptocarpus tenax					IX	VI		II
Gompholobium huegelii					IV	VII	III	
Leucopogon virgatus						VIII	VI	IX
Monotoca scoparia					III	VIII	VI	
Acacia suaveolens					III	X	VII	IV
Casuarina pusilla					II	X	VIII	
Acacia myrtifolia						II	X	I
Drosera pygmaea					II	II	VIII	
Hakea sericea							VIII	
Sphaerolobium vimineum						I	X	III
Diplarrena moraea			VI				VIII	
Xanthosia tridentata						I	VIII	IV
Leptospermum laevigatum								X
Machaerina juncea								X
Hibbertia sericea								X
Astroloma humifusum						III		VIII
Comesperma volubile								VI
Acacia verticillata var. ovoidea					II	II	III	VIII
Isopogon ceratophyllus						III	III	X
Lepidosperma concavum					II	X	X	X
Viola sieberana					II	I	IX	IX
Cassytha glabella					IX	IX	X	V
Casuarina paludosa					X	IV	IX	X
Dillwynia glaberrima					IX	X	VII	
Dilwynia sericea					IV	VIII	X	V
Goebelobryum sp.					VI	V	IV	
Helichrysum scorpioides					VI	VIII	VI	III
Laxmannia gracilis					V	V	X	II
Lethocolea spp.					VII	V	VI	I
Lindsaya linearis					X	V	IX	
Patersonia fragilis					IX	X	VI	IX
Pimelea humilis					IV	IX	X	X
Platylobium obtusangulum					V	X	IX	V
Xanthosia pusilla					X	X	X	IX

TABLE 1

CONSTANCY OF THE MORE COMMON SPECIES IN COMMUNITIES

I — 0 to 9%   II — 10 to 19%, etc. to   X — 90 to 100%

Community number	1	2	3	4	5	6	7	8
Amperea xiphoclada				X	VII	X	VI	VII
Banksia marginata				III	X	X	X	X
Hypolaena fastigiata				VI	IX	X	VI	X
Leptospermum myrsinoides				VIII	VII	X	IX	X
Platysace heterophylla				X	V	IV	VI	
Schoenus tenuissimus				X	X	IX	VIII	VIII
Selaginella uliginosa				VI	X	VII	V	
Bryum billardieri	IX	IV	V	II	II			
Billardiera scandens	II	III	VI	X	II			
*Hypochoeris radicata	IX	V	X	VI				
Parmelia spp.	VIII	III	III					
Usnea spp.	I	VIII	III					
Viola hederacea	IX	X	X	VI				
Burchardia umbellata		I	V	X	X	IX	X	X
Cladia aggregata		II	VIII	VI	IX	X	VI	X
Epacris impressa		V	X	X	X	X	X	X
Leptospermum juniperinum		I	X	X	X	X	X	X
Lomandra longifolia		II	III	X	V	IV	IV	VII
Opercularia varia		II	IX	X	IX	VII	X	VII
Campylopus introflexus	II	VIII	X	X	X	X	X	X
Cladonia spp.	VI	IV	VI	II	IX	IX	IV	X
Drosera auriculata	II	VIII	X	X	VI	VIII	X	VII
Gonocarpus tetragynus[2]		X	X	X	X	X	X	X
Pteridium esculentum	V	X	X	X	I	V	II	III
Aotus ericoides						III	III	I
Bauera rubioides			VI	V	III			
Dampiera stricta					V			
Danthonia semiannularis		V	VIII					
Drosera peltata					IV	IV		
Drosera whittakeri					VII	IV		
Exocarpos strictus	VI	I		III				
Gnaphalium japonicum	VI	I	VIII	II				
Gonocarpus humilus[3]	II	V						
Hibbertia acicularis					I	IV		III
Leucopogon australis	VI		VIII	IX	IIII			
Machaerina acuta						II	VI	
Marianthus procumbens					VI	IV	VII	
Mitrasacme pilosa var. stuartii				X	VI	IV	VIII	
Platylobium formosum			II	V				
Poa sieberana[4]		III						
Xanthosia dissecta					III			