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# THE VEGETATION OF THE VICTORIAN COAST

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Abstract: The structure and floristics of the major Victorian coastal plant communities are described, and their distribution related to coastal physiography and lithology. The impact of Aboriginal and European man on coastal vegetation is assessed, and the importance of conservation of the coastal flora for fauna conservation, shoreline stabilization, scientific and educational purposes, and as a recreation resource is discussed.

## INTRODUCTION

The coastline of Victoria extends for some 1600 km and provides many diverse plant habitats, including cliffs, beaches, dunes, estuaries, lagoons and swamps. Changes in the orientation of the coast provide variations in aspect and a range of exposures to the prevailing westerly to south-westerly winds and salt spray. Mean annual rainfall varies from 500 mm on the western shores of Port Phillip to over 1000 mm in the Otway Ranges and at Wilson's Promontory (Turner, Ashton & Bird 1968). Variations in lithology, geomorphology, tidal amplitude and salinity further contribute to the diversity of coastal habitats.

The plant communities are discussed according to the physiography and geology of their habitats. Plant nomenclature follows Willis (1970, 1972); structural classification of the communities is based on Specht (1970).

## VEGETATION OF THE CLIFFS

Along the cliffed sectors of Victoria's coastline, vegetation varies in response to a number of factors including lithology, exposure to salt spray and prevailing winds, and cliff morphology. Structural characteristics of the rock material and degree of exposure to strong wave action influence the development of the cliff profile, and consequently the pattern of vegetation on the cliff face. On plunging cliffs such as those at the southern tip of Wilson's Promontory, vegetation is restricted to cliff-tops and occasional crevices; similarly where cliffs are vertical, plants only grow on ledges and in cracks. On more gently sloping cliffs, there may be sufficient soil to support a prolific growth of shrubs and trees. Cliffs cut in poorly consolidated materials, such as the Tertiary sediments of the Otway region, frequently have terraced profiles where large scale slumping has occurred. Small perched swamps sometimes form behind the lips of these slumps.

The structure of cliff-top vegetation is also influenced by the nature of the parent material; cliffs cut in granite, sandstone or limestone support shrub growth, whereas on basalt, tussock grassland is common. Some species differentiation also occurs with change in underlying rock type; although most coastal plants grow on a variety of soil types, some species occur more commonly on dune calcarenites.

The plant zonation frequently observed on cliffs is related to the ability of species to withstand damage by salt spray. Halophytic plants often occur in the zone of continual salt spray accession immediately above high tide level, and on the cliff and cliff-tops along high wave energy sectors of the coast.

### Basalt Cliffs

On the Portland Peninsula, cliffs cut in basalt, and overlain by calcarenite support scattered succulent species, *Salicornia quinqueflora, Samolus repens* and *Senecio lautis*. On the heavy clay soils of steep basalt cliffs near Flinders on the Mornington Peninsula and on Phillip Island, *Salicornia quinqueflora* and *Disphyma blackii* are found in the splash zone, accompanied by *Samolus repens*, while on the gentler, upper slopes *Poa poiformis* closed-tussock grassland occurs with *Calocephalus lacteus* or shrubs of *Calocephalus brownii*. On Phillip Island the addition of nutrients to the soil from guano deposited by seabirds has resulted in

the vigorous growth of *Tetragonia implexicoma* in the penguin rookeries (D. H. Ashton pers. comm.). The cliff-tops which were once covered by open-woodlands of *Casuarina stricta*, with *Melaleuca ericifolia* on the wetter sites, have largely been cleared and sown with pasture grasses (Calder 1975). On sheltered sectors of Western-port Bay, gently sloping basaltic bluffs may have trees such as *Casuarina stricta* growing down to the shoreline. At several sites north of Point Leo where grassy dunes front low basalt bluffs, the treefern *Cyathea australis* grows beneath *Pittosporum undulatum* and *Banksia integrifolia* (D. H. Ashton pers. comm.).

### Limestone and Sandstone Cliffs

The Tertiary limestone cliffs of the Port Campbell coast support few plants on their unstable vertical faces. Suitable sites within the splash zone may be occupied by *Salicornia quinqueflora, Calocephalus brownii, Carpobrotus* sp. and *Senecio lautus* wherever the slope of the cliff permits. Cliff-top shrubs include *Leucopogon parviflorus, Olearia axillaris, Alyxia buxifolia*, and *Helichrysum paralium*. These low open-shrubland communities are more extensive where wind-blown sands have accumulated as cliff-top dunes, for example behind Crofter's and Martyr's Bays. Elsewhere the cliff-tops are usually covered by low heaths which are severely wind-pruned and affected by salt; in winter they are frequently waterlogged. Groves of *Casuarina stricta* and *Eucalyptus obliqua* occur within the heaths, and *Leptospermum myrsinoides* and *Casuarina paludosa* are locally dominant species. In some places the heaths extend to the edge of the cliff. Grazing has severely modified the vegetation of unprotected sectors of this coast; at Flaxman's Hill, *Acrotriche affinis, Banksia marginata* and *Correa reflexa*, remnants of a more extensive heath, are found with *Alyxia buxifolia, Calocephalus brownii* and *Leucopogon parviflorus* on the cliff edge.

Heaths also occur on other cliffed sectors of Tertiary sediments (mainly sandstones and clays with some limestones) on the Victorian coast. Cliffs cut in sandstones and clays along the Otways coast are characterised by slump terraces, which may be covered by a closed-scrub of *Leucopogon parviflorus* and *Leptospermum juniperinum*, sometimes with *Pultenea daphnoides* and occasional clumps of *Casuarina stricta*. *Phragmites communis* is frequently found in swampy basins and seeps within the slumps. On the cliff-top, heaths grow on very infertile highly acidic soils; *Leptospermum juniperinum* and *Leptospermum myrsinoides* are often co-dominant, and occur with *Casuarina pusilla, Gahnia radula* and many other species (Parsons, Kirkpatrick & Carr 1977). Stunted *Eucalyptus baxteri* and *Eucalyptus nitida* are found occasionally in the heath.

In the Anglesea district, coastal heaths are found on cliffs cut in Tertiary sands and clays. These low closed-heaths, dominated by *Lepidosperma congestum, Leptospermum myrsinoides* and *Casuarina pusilla*, grade into a low woodland of wind-pruned *Eucalyptus obliqua* with a tall heath understorey. Cliff-top vegetation on the Tertiary sandstones on the eastern shoreline of Port Phillip is predominantly a closed-scrub of *Leptospermum laevigatum*, with *Casuarina stricta, Myoporum insulare* and *Leucopogon parviflorus* on cliff-top dune deposits.

In eastern Victoria between Mallacoota and the Benedore River, heaths are found on exposed and seasonally water-logged coastal plateaux where Palaeozoic sandstones are overlain by a thin veneer of Tertiary clayey sands (Pl. 5, fig. 1). Several types of heath community occur here, *Casuarina paludosa* closed-heath, *Melaleuca squarrosa-Leptospermum juniperinum* closed-heath, and *Xanthorrhea resinosa* closed-heath; *Eucalyptus baxteri* and *Eucalyptus gummifera* form mallee clumps within the heath (Cameron 1973). At some sites there is a cliff-top fringe of *Leptospermum laevigatum* or *Melaleuca armillaris* closed-scrub.

Other exposed cliff-top sites which support heaths include the Cretaceous felspathic sandstone coast of the Otways and the Devonian metamorphic rocks of Cape Liptrap. At Cape Liptrap where quartzose dune sands overlie hard sandstones, *Leptospermum laevigatum* dominates the tall heath community of the cliff-tops, whilst wet heaths of *Melaleuca squarrosa, Calorophus lateriflorus, Leptospermum juniperinum* and *Selaginella uliginosa* occur where a perched hard-pan layer 10-20 cm beneath the soil surface impedes drainage. In the Otways wet heaths occur on windswept sites where species such as *Melaleuca squarrosa, Sprengelia incarnata, Casuarina paludosa, Epacris lanuginosa* and *Gymnoschoenus sphaerocephalus* are common (Parsons *et al.* 1977). The steeply plunging cliff faces support few plants, but on protected sites along the eastern flank of the Otways, steep coastal slopes are vegetated by shrub species including *Leptospermum juniperinum* almost down to the back of the shore platform.




PLATE 5

FIG. 1—Cliff-top low heath east of Little Rame Head, East Gippsland.

FIG. 2—(a) Fringing *Avicennia marina* with (b) *Arthrocnemum arbusculum* and *Salicornia quinqueflora* herbfield backed by a narrow zone of *Melaleuca ericifolia*. Sandy ridges landward of the salt marsh are dominated by *Eucalyptus viminalis* woodland.

FIG. 3—*Phragmites communis* closed grassland fringing Lake Connewarre.

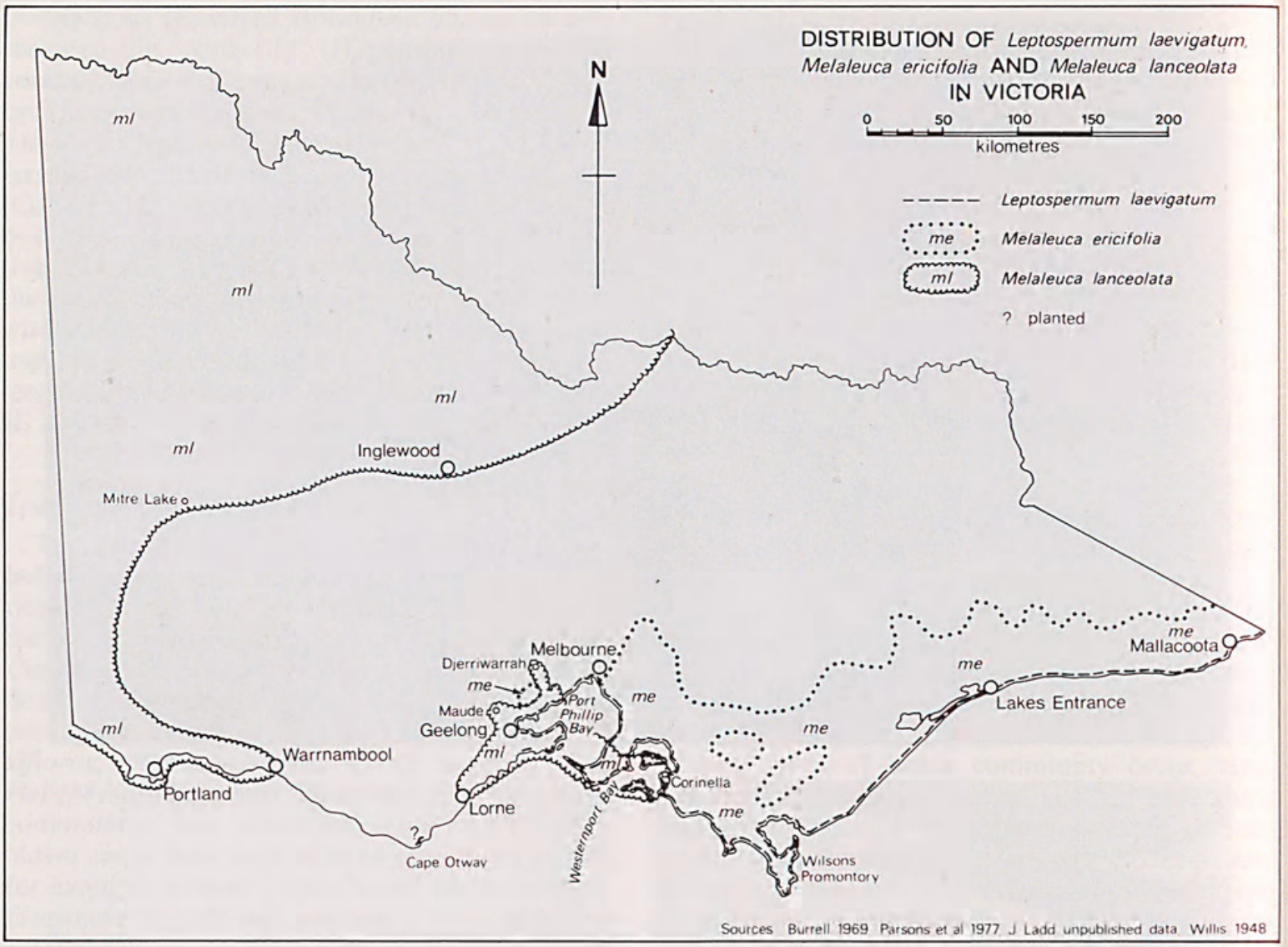


FIG. 1—The distribution of *Leptospermum laevigatum, Melaleuca ericifolia* and *Melaleuca lanceolata* in Victoria. Occurrences of *Leptospermum laevigatum* on the coast between Cape Otway and Nelson (at Lady Bay, Warrnambool, Port Fairy and near Point Danger) are thought to have been planted, or escaped from gardens. The absolute western limit of indigenous stands is uncertain (Parsons *et al.* 1977). Information from Burrell (1969), Parsons *et al.* (1977), Willis (1948), and J. Ladd (unpubl. data).

### CALCARENITE CLIFFS

Coastal cliffs cut in Pleistocene dune calcarenite occur west of Wilson's Promontory, usually on south-west facing sectors of the coast, where exposure to prevailing onshore winds is greatest. High cliffs and extensive shore platforms have developed where the calcarenite extends below present sealevel; it also frequently occurs as a capping over cliffs cut into underlying basement rocks. Calcarenite deposits are usually surmounted by unconsolidated dune sands, and thus share many plant species with coastal dunes. These may include shrubs such as *Acacia longifolia, Myoporum insulare, Leucopogon parviflorus, Olearia axillaris, Rhagodia baccata, Calocephalus brownii* and *Alyxia buxifolia*, as well as some grass and sedge species.

Plants characteristic of dune calcarenite coasts include the shrubs *Beyeria leschenaultii, Olearia glutinosa* and *Pimelea serpyllifolia*. *Melaleuca lanceolata* and *Acacia retinodes* also occur on most calcarenite deposits along the coast.

Apart from the compact shrub, *Calocephalus brownii*, few plants are found on the cliff faces, as these tend to be unstable and subject to constant sand blasting. The cliff edge is commonly almost unvegetated, especially where wind erosion, accelerated by grazing and trampling, has removed the unconsolidated sand to expose a hard calcrete layer. On the cliff-top, low wind-pruned shrubs of the species listed above grade into a closed-scrub. The dominant species vary regionally. In western Victoria on the Portland Peninsula, *Melaleuca lanceolata* is co-dominant with *Eucalyptus diver-*

*sifolia* (not found elsewhere in Victoria); in the Otways and at Princetown *Acacia longifolia* and *Leucopogon parviflorus* form a closed-scrub on dune sands, but *Melaleuca lanceolata* is absent. *Melaleuca lanceolata* is co-dominant with *Acacia retinodes* on dune calcarenite at Point Roadnight near Anglesea, and these species together with *Leptospermum laevigatum*, form closed-scrubs at Mt. Coolite near Barwon Heads, and on the Nepean Peninsula. *Melaleuca lanceolata* does not extend further east than Corinella (Willis 1948). Figure 1 shows the distribution of *Leptospermum laevigatum* and *Melaleuca lanceolata* on the Victorian coast.

### Granite cliffs

Plunging granite cliffs and rocky headlands usually support a closed-scrub of *Leptospermum laevigatum* and associated species. On the west coast of Wilson's Promontory the lichens *Verrucaria* sp. and *Caloplacca marina* are found just above high water mark and *Disphyma* sp. and *Salicornia* sp. occur within the splash zone. Above the splash zone are wind-pruned shrubs of *Correa alba* and *Calocephalus brownii*, with a closed-scrub of *Leptospermum laevigatum, Pultenea daphnoides* and *Kunzea ambigua* on shallow gravelly loams further upslope (D. H. Ashton pers. comm.). *Casuarina stricta* thickets occur above the zone of salt spray on slightly deeper soils, together with *Kunzea* and *Leptospermum* (Parsons 1966).

On rocky granitic headlands of the East Gippsland coast *Stipa teretifolia* tussock grassland (with *Distichlis distichophylla* and herbs such as *Apium prostratum, Scaevola calendulacea, Disphyma australe* and *Carpobrotus rossii*) fringes exposed western and southern shores. Where dunes surmount headlands the dune slopes carry wind-pruned low heaths of *Correa alba, Banksia integrifolia, Monotoca elliptica* and *Leptospermum laevigatum*. More sheltered slopes support a taller closed-scrub of the last 3 species and *Melaleuca armillaris* (Smith & Parr-Smith in press).

The windswept granite headlands of Cape Woolamai (on Phillip Island) support *Poa poiformis* and *Stipa teretifolia* tussock grassland, with shrubs on less exposed sites (Teh 1966). On Rabbit Island, off the east coast of Wilson's Promontory, *Poa poiformis* is the dominant species (Norman 1967). However since the decimation of the rabbit population in 1965, shrub species such as *Leptospermum laevigatum, Leucopogon parviflorus* and *Correa alba* are re-establishing here (Pl. 6, fig. 5).

## VEGETATION OF SALT MARSHES AND SWAMPS

Extensive intertidal plant communities occur in sheltered situations along low wave energy sectors of the coast, in embayments, along the lower reaches of estuaries and estuarine lagoons, behind barrier islands and in the lee of spits (see Fig. 2). Variations in salinity, water depth, extent and duration of tidal submergence and nature of the substrate (which may be mud, sand, gravel or rock), influence the distribution of these intertidal communities. In response to these factors, plants commonly grow in zones parallel to the shore. Within estuaries and estuarine lagoons changes in the vegetation occur as tidal influence and salinity levels diminish with increasing distance from the sea.

Salt marshes are best developed between Barwon Heads and Corner Inlet, their lateral extent being related to the relatively large tidal ranges experienced along this part of the coast. The marshes are frequently fringed by *Avicennia marina* var. *resinifera* (Fig.2, Pl. 6, fig. 6), which has its southern most occurrence at 38°55′ in Corner Inlet (Bird 1972). West of Barwon Heads, patches of salt marsh are found at Breamlea, at the mouth of the Anglesea River and Airey's Inlet, at Port Fairy, and in the Glenelg River estuary. Salt marshes also fringe shorelines within the Gippsland Lakes, and are thought to have become more extensive following a salinity increase resulting from the cutting of the artificial entrance to the lakes (Bird 1962). Along the East Gippsland coast salt marshes are found at Wingan Inlet, Mallacoota, and the mouth of the Snowy River.

Many of the salt marsh plants found in Victoria belong to the family Chenopodiaceae, whose members frequently have succulent foliage, and are well adapted to saline conditions. The genera *Salicornia, Arthrocnemum, Suaeda, Samolus*, and *Triglochin*, found in Victorian salt marches are cosmopolitan. Some species, such as *Selliera radicans* and *Wilsonia* spp. are typically Australasian in distribution (Bridgewater 1975). The number of species occurring within the salt marsh is not large, the total number of salt marsh species present in Western Port being 49, including introduced plants.

Victorian salt marshes show some regional variations in their structure and floristics. Common communities include tall shrubland or open-scrub of *Avicennia marina, Arthrocnemum* spp. low shrubland, *Stipa teretifolia-Juncus maritimus* open-tussock grassland, sedgeland, and herbfields frequently dominated by *Salicornia quinqueflora.*

*Melaleuca ericifolia* closed-scrub is often found above maximum high tide level on the landward side of the salt marshes. However, not all these communities may be represented at a particular locality.

Many of the species found in the highly developed salt marshes of Western Port do not commonly occur in other Victorian salt marshes; the shrubby *Arthrocnemum* species are not found east of The Lakes National Park (Sperm Whale Head), and only occasionally west of Breamlea near Barwon Heads. In East Gippsland, salt marshes are of limited occurrence and have few species. At Wingan and Mallacoota Inlets salt marshes are reduced to *Juncus* open-tussock grassland and *Salicornia* herbfield, with only 4 or 5 species present. A decrease in the number of species present is also observed in western Victorian salt marshes (Barson 1976).

In many Victorian salt marshes the characteristic zonation of halophytes parallel to the shore is complicated by small changes in marsh level. Such minor topographic variations may be related to the development of pans and tidal creeks, or the deposition of sandy or shelly cheniers on a generally muddy substrate. Differences in level of a few centimetres may favour the establishment of a particular species over another. The salt marshes behind Observation Point on Phillip Island show a particularly complex species distribution pattern due to the presence of veneers of sandy sediment across the marsh. Within the marsh, stranded sandy ridges, common in the salt marshes of Western Port and at Barwon Heads support a community dominated by *Stipa teretifolia*, a species not common elsewhere in these marshes.

A distinction may be made between 'wet' and 'dry' salt marshes in Victoria. The wet form is typified by salt marshes around Western Port, where the average annual rainfall is 800 mm. Landward of the mangrove fringe are zones of *Arthrocnemum arbusculum* low shrubland and herbfield of *Salicornia quinqueflora* with *Suaeda australis, Selliera radicans, Samolus repens* and *Hemichroa pentandra* as frequent components. These often fade into a zone dominated by grasses such as *Distichlis distichophylla*, sedges and rushes such as *Juncus maritimus*, with occasional small, unvegetated salt pans in front of *Melaleuca ericifolia* closed-scrub (Pl. 5, fig. 2). Climax vegetation was probably *Eucalyptus viminalis-Eucalyptus ovata* woodland with *Melaleuca ericifolia* and a sedge stratum, but most of this stage has been removed by clearing (Ashton 1972). Along some sectors of the Western Port shoreline, *Eucalyptus viminalis* woodland grows on low sandy ridges landward of the *Melaleuca* thickets.

'Dry' salt marshes are found on the west coast of Port Phillip, where average annual rainfall is 500 mm or less. Mangroves which once fringed some sectors of this coast are now largely restricted to Limeburner's Bay and Williamstown. Extensive zones of *Arthrocnemum arbusculum* are common, sometimes with a scattered understory of succulent herbs; towards the landward limits of these marshes there is frequently a broad zone of salt pan (dry in summer, inundated in winter), supporting *Frankenia pauciflora* and scattered *Arthrocnemum halocnemoides*, a species which forms extensive communities on South Australian salt marshes (Specht 1972). According to Ashton (1972), the climax stage was probably a grassy *Muehlenbeckia cunninghamii* scrub, perhaps with occasional *Eucalyptus camaldulensis*, but this too has been obliterated by clearing.

As tidal influence decreases towards the upper reaches of estuaries and estuarine lagoons, halophytic species are replaced by fresh or brackish water plant communities; reed swamps and closed-scrubs. A zone of *Phragmites communis* (Pl. 5, fig. 3) sometimes in association with *Typha* spp., fringes such fresh and brackish water environments, but east of the Snowy River only scattered small clumps of *Phragmites* are found around the shores of lakes and estuaries, the reed swamps (principally around lakeshores) being dominated by such species as *Baumea rubiginosa, Cladium procerum* and *Eleocharis sphacelata.*

Landward of the reed fringe on areas still prone to flooding, are closed-scrubs, dominated either by *Melaleuca ericifolia* or *Leptospermum lanigerum* depending on the location of the site. *Melaleuca ericifolia* is thought to be restricted in Victoria to swampy sites east of the You Yangs (J. Ladd pers. comm., Fig. 1), while in western Victoria, *Leptospermum lanigerum* forms closed-scrub around some lake shorelines and along rivers. *Melaleuca lanceolata* occurs on swampy sites at the mouth of the Anglesea River and along the Barwon, but throughout the rest of its range it is a species of elevated, well-drained sites (Parsons *et al.* 1977).

The presence of reedswamps around the shores of lagoons and some estuaries is contributing to the gradual infilling of the sites. Submerged pondweeds (commonly *Potamogeton* and *Vallisneria* in fresh, and *Zostera* in brackish water) build up the level of the floor by adding debris and collecting silt, to a depth where reed and sedge species can




PLATE 6

FIG. 4—Closed scrub of *Leptospermum laevigatum* and *Banksia integrifolia* east of Point Hicks, East Gippsland.

FIG. 5—*Poa poiformis* tussock grassland, Rabbit Island, east of Wilson's Promontory.

FIG. 6—*Avicennia marina* on the Lower Barwon River.

invade. Sedimentation within the reed fringe further reduces water depth, allowing invasion by swamp scrub species, *Melaleuca ericifolia* or *Leptospermum lanigerum* (Bird 1962). This process of encroachment succession is accelerated at several sites along the coast where sand from mobile dunes is invading estuaries and lakes. However, increased salinity levels in some parts of the Gippsland Lakes have resulted in dieback of shoreline *Phragmites* and erosion of land previously created by encroachment of reed swamps which died following the cutting of the artificial entrance in 1889 (Bird 1961a).

## SAND DUNE VEGETATION

Along the Victorian coast, sand dunes are found in Discovery Bay, Waratah Bay and Port Phillip, from Point Lonsdale to Lorne, along the Ninety Mile Beach, on sectors of the East Gippsland coast, and in pockets along the cliffed coastlines of the Otways, Wilson's Promontory and Phillip Island. Dunes east of Wilson's Promontory are predominantly of quartzose sand; those to the west are dominated by calcareous sand (Bird 1976).

A characteristic vegetation zonation occurs where successive dune ridges have formed parallel to the shoreline as in sectors of the outer barrier behind the Ninety Mile Beach. This zonation reflects the succession of vegetation types from the pioneer colonising species (typically grasses) on the foredune, through shrub species to a dune scrub, with woodland or even heath on the older ridges. Extensive rearrangement of parts of older parallel dune systems, as on Sperm Whale Head, has resulted in secondary succession; the parabolic dunes carry younger soils and dune scrub vegetation, whereas the undisturbed parallel ridges are covered by heath or woodland (Bird 1961b). Behind Norman Bay at Wilson's Promontory the older parabolic dunes with acid soils are heath covered, and the more recent parallel dunes support a dense scrub (Parsons 1966).

Most of the common species associated with sand dunes are found all along the coast, exceptions being those particularly associated with highly calcareous sands, and several scrub species of restricted occurrence in Victoria. The earliest colonisers of sandy shorelines above high tide level are the strand plants, *Cakile* spp. and *Atriplex cinerea*. Plants of the foredune are initially grasses, *Spinifex hirsutus*, occasionally *Festuca littoralis*, and the introduced species *Ammophila arenaria* and *Agropyron junceum*. These grasses are subsequently invaded and replaced by shrub species which may include *Myoporum insulare, Acacia longifolia, Correa alba, Olearia axillaris, Helichrysum paralium, Leucopogon parviflorus* and *Rhagodia baccata* and rushes and sedges such as *Scirpus nodosus* and *Lepidosperma gladiatum*. However sandy shorelines in Victoria are generally receding and examples of primary succession on newly-built beach ridges and foredunes are restricted to a few localities, chiefly on spits and cuspate forelands and alongside sand-trapping breakwaters (Bird 1973).

Landward ridges support dune scrub; in eastern and central Victoria this is frequently dominated by *Leptospermum laevigatum* (see Fig. 1) with emergent *Banksia integrifolia* (Pl. 6, fig. 4). Where *Leptospermum* forms a dense canopy the understory species are mainly mosses such as *Hypnum cupressiforme* and *Thuidium furfurosum*, orchids, chiefly species of *Acianthus, Caladenia, Corybas* and *Pterostylis*, herbs and climbers such as *Clematis microphylla, Muehlenbeckia adpressa* and the introduced *Asparagus asparagoides*. In more open degenerate stands dune shrub species may form an understory, whilst on some calcareous dunes *Acacia retinodes* and *Melaleuca lanceolata* may be co-dominant with *Leptospermum laevigatum*. *Leptospermum laevigatum* is only known to occur sporadically west of Barwon Heads (Parsons *et al.* 1977), and at some of these sites it may have been planted. In western Victoria, *Leucopogon parviflorus* forms a low closed-scrub on dunes, sometimes in association with *Melaleuca lanceolata* and *Acacia longifolia*.

Older dunes with more deeply leached soils usually support eucalypt woodlands, but on exposed or severely waterlogged sites these sandy areas are frequently heath covered. On dune sands and sand sheets along the East Gippsland coast between Wingan Inlet and Little Rame Head *Eucalyptus gummifera-Angophora floribunda* woodlands occur, with a mosaic of *Casuarina paludosa-Leptospermum juniperinum* or wet heath communities, *Melaleuca ericifolia* scrub, sedges and rushes. Similar heaths are found along the coast from Rame Head to Lake Tyers, with *Eucalyptus botryoides-Eucalyptus baxteri* woodlands (Land Conservation Council 1974). *Eucalyptus viminalis* woodlands with *Banksia serrata, Eucalyptus radiata* and *Eucalyptus bridgesiana* occur on dunes behind the Ninety Mile Beach, with some areas of *Eucalyptus nitida* woodland (Land Conservation Council 1972). *Eucalyptus viminalis* also forms dune woodland with *Banksia serrata* on the barrier islands southwest of the Ninety Mile Beach (Turner, Carr

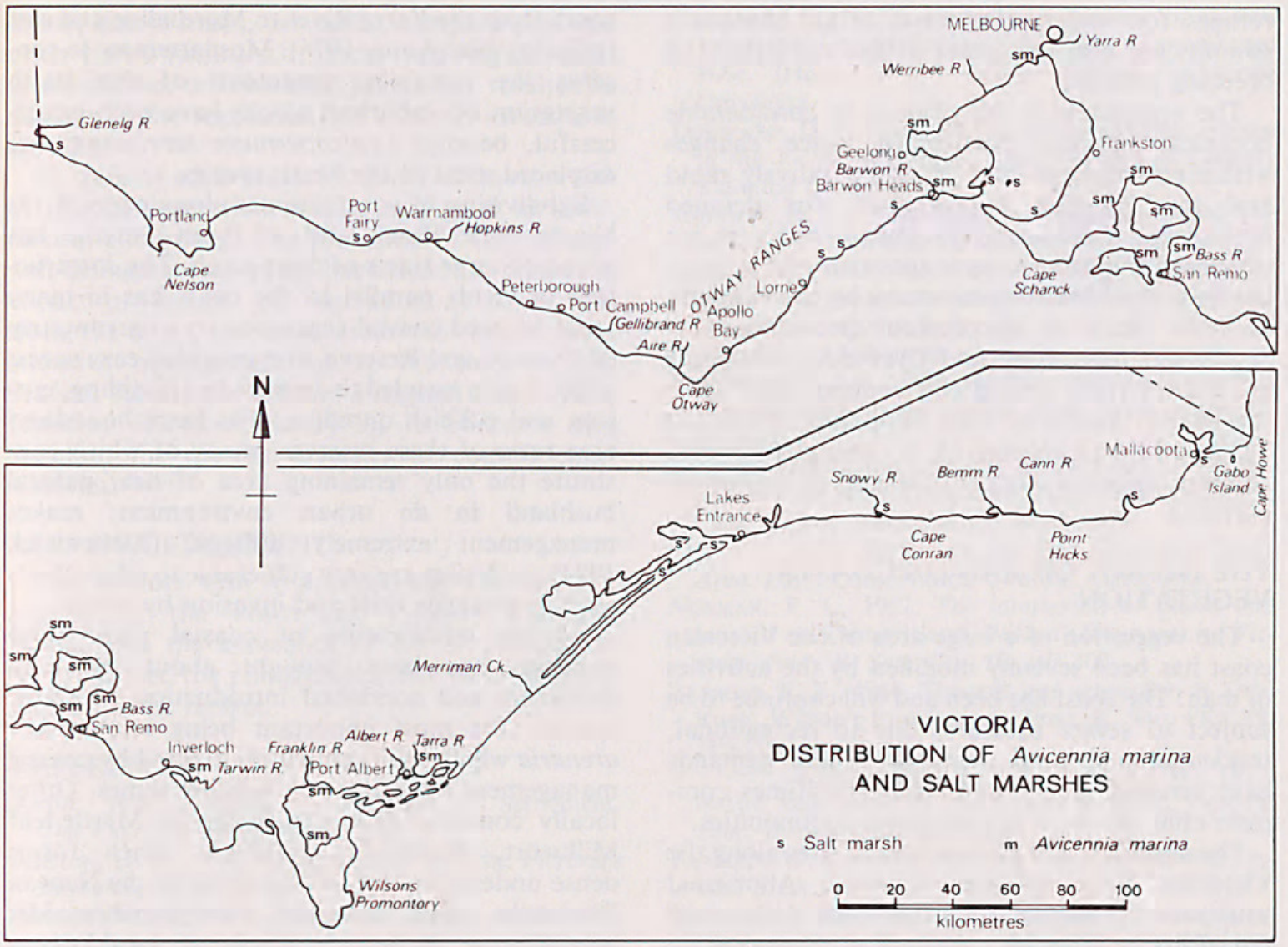


FIG. 2—Distribution of *Avicennia marina* and tidal, salt marsh communities along the Victorian coast.

& Bird 1962), and on older sandy ridges around Western Port and Port Phillip. Where dune woodland occurs on sites west of Port Phillip, it is often dominated by *Eucalyptus obliqua*.

## THE IMPORTANCE OF COASTAL VEGETATION

Vegetation is an important agent in the building and stabilization of some coastal landforms. On prograding sandy sectors of the Victorian coast dune building is initiated by grasses such as *Spinifex hirsutus* or the introduced *Ammophila arenaria* (marram grass), and sometimes by the annual *Cakile* spp. These plants trap blown sand, building hummocks, ridges or terraces which may persist as foredunes. The establishment of a new beach ridge in front of the foredune cuts off the sand supply to its successor which becomes relatively stable when the dune grasses are invaded by shrub species. Dune scrub provides sufficient cover to stabilize unconsolidated sands, but subsequent destruction of this cover results in the development of blowouts which may advance inland.

Mangroves and salt marshes also play a role in shoreline stabilization, trapping sediment which would otherwise remain mobile on the intertidal flats. These communities reduce the need for dredging to maintain channels and harbour facilities.

Dune scrub, heaths and salt marshes provide habitats for a wide variety of wildlife, some of which is restricted to coastal areas. One of the world's rarest parrots, the orange bellied parrot (*Neophema chrysogaster*) has been recorded from several coastal localities in Victoria, while the uncommon ground parrot (*Pezoporus wallicus*) is found only in coastal heaths in south-eastern Australia (Johnson 1974). The Victorian coastline is also a natural migration route for many species of waders and seabirds, and our coastal marshes are particularly important as feeding grounds and

refuges for waders (Dorward 1976). Mangrove swamps are also important as fish nurseries and breeding grounds.

The vegetation of the coast is of considerable botanical interest, particularly since changes within communities may be comparatively rapid and thus provide opportunities for detailed monitoring. Comparatively undisturbed sites are of special importance since so much of the coast has been modified to some extent by the activities of man. Rare or uncommon species such as *Asplenium obtusatum* and *Cyathodes oxycedrus* are known from several cliff communities, while the coastal heaths of East Gippsland (Cameron 1973) and Port Campbell (A. C. Beauglehole pers. comm.) support a number of species of limited occurrence.

## THE IMPACT OF MAN ON COASTAL VEGETATION

The vegetation of a large area of the Victorian coast has been severely modified by the activities of man. The coast has been and will continue to be subject to severe pressures due to recreational, residential and rural demands. These demands have resulted in alteration and sometimes complete obliteration of coastal plant communities.

The abundance of archaeological sites along the Victorian coast indicates extensive Aboriginal utilisation of coastal resources. The Aborigines' use of fire to drive out game, or to burn grass to attract fresh game to shoots, and their apparently careless use of campfires (King 1963) probably led to an increased incidence of bushfires in the region.

The practice of frequent burning to provide pasture has been continued along some sectors of coast until quite recently, notably in East Gippsland and the Western District. On dune terrain repeated grazing and burning has in some areas resulted in the development of blowouts, some of which have subsequently been stablized by planting marram grass. Dune scrub between Portland and Warrnambool has now been largely replaced by marram grass, but a few relict stands remain on sites which have escaped grazing and burning. Along the northern shores of Western Port and east of San Remo coastal vegetation has been almost completely replaced by pasture.

Urban expansion and the development of coastal sub-divisions have also resulted in the disappearance of extensive tracts of coastal vegetation. The spread of Melbourne's south-eastern suburbs has led to the reduction of coastal heathlands, which prior to settlement extended south from the Yarra River to Mordialloc and east to Springvale (Anon. 1976). Most attempts to conserve the remaining fragments of this heath vegetation on suburban blocks have been unsuccessful, because *Leptospermum laevigatum* has displaced most of the heath species.

Subdivision of coastal dunes along parts of the Ninety Mile Beach and at Point Smythe has alienated large tracts of dune scrub. The construction of roads parallel to the coast has in many areas reduced coastal vegetation to a narrow strip of Crown Land Reserve, and provided easy access which has in turn led to damage by trampling, erosion and rubbish dumping. The large boundary: area ratio of these reserves, many of which constitute the only remaining area of near natural bushland in an urban environment, makes management extremely difficult (Kirkpatrick 1974); such sites are very vulnerable to edge effects such as pesticide drift and invasion by weeds.

Further modification of coastal plant communities has been brought about by both deliberate and accidental introduction of exotic species, the most important being *Ammophila arenaria* which has been widely planted by coastal management authorities to stabilize dunes. Other locally common exotics include the Myrtle-leaf Milkwort, *Polygayla myrtifolia* which forms dense understory thickets on parts on the Nepean Peninsula, and boneseed, *Chrysanthemoides moniliferum*. Boneseed, which can establish on very poor soils, is able to eliminate smaller native species through competition (Parsons 1973). Many other species occur as garden escapees on dunes in urban areas.

Major destruction of salt marsh and swamp communities has occurred through sanitary landfill and reclamation schemes, as at Hastings and Rhyll on Western Port and at Barwon Heads where municipal tips have been located on salt marshes (Barson 1976). The area of salt marsh has been further reduced by the development of harbour facilities, and the construction of boat jetties and marinas has been an important factor in the disturbance of intertidal communities in Western Port (Bird & Barson 1975). The increasing use of recreational vehicles on salt marshes is also a cause for concern.

The use of the coastal zone as a recreational resource has resulted in the modification of many coastal plant communities. In urban areas, for instance, as along the shores of Port Phillip, coastal land has been cleared to provide sites for sporting grounds and club houses (some of which serve activities that are not dependent on coastal loca-

tions), access roads, car parks, camping sites and other visitor facilities. In areas receiving the most intensive use, uncontrolled access has resulted in damage to the vegetation and often in subsequent erosion.

In spite of such pressures many valuable tracts of coastal vegetation persist in natural or semi-natural conditions. The provision of fencing and well-defined access tracks has helped to reduce the impact of visitors on vegetation at some sites along the coast, but many areas will require more intensive management along the lines of the Seaford Foreshore Reserve Program (Bird 1975, Thatcher & McAlpine 1975), to conserve and maintain the present diversity of coastal communities.

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