# The vegetation of the Nepean Peninsula, Victoria – an historical perspective

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***Abstract*:** We use historical information and extensive contemporary surveys to describe the pre-European vegetation of the Nepean Peninsula, an extensive area of calcareous sand dunes at the tip of the Mornington Peninsula, south of Melbourne, Victoria (38°19'S 144°43'E). We conclude that much of the area was once covered by open, grassy woodlands, variously dominated by *Allocasuarina verticillata* (Drooping Sheoak), *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia), *Acacia* species (Wattles), and *Melaleuca lanceolata* subsp. *lanceolata* (Moonah), along with a range of other species. Some areas supported shrublands, woodlands, forests, grasslands and wetlands. This area was markedly distinct from most other nearby areas, and has ecological affinities with areas in western Victoria. Over 200 years of 'European' land use have left this landscape remarkably different today – even in places where native vegetation persists. We review and discuss the environmental factors that have influenced the pattern and structure of the vegetation.

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## Introduction

The Nepean Peninsula is the large and distinctive expanse of calcareous (limestone) dunes at the southern end of the Mornington Peninsula. It extends from Point Nepean, the southeastern entrance to Port Phillip Bay, about 25 km east to Cape Schanck and Rosebud (38°19'S 144°43'E) (Figure 1). This area was the site of the first European settlement in Victoria, at Sorrento in 1803. Since then, the area has been subject to a wide range of land uses, and continues to change under pressure from urban development. Native vegetation persists despite this long history of use and has been the subject of controversy, largely because of its close proximity to urban expansion. Our understanding of the vegetation in terms of its typology and its processes of recovery and degradation is far from complete.

Here we use historical information and extensive contemporary surveys to describe the indigenous vegetation, as it was at the time of European settlement, discuss points of confusion or contention and provide an overview of changes. Ultimately, we hope this information will form a backdrop to better planning, management and restoration. Other reports examine the ecological response of some of this vegetation to disturbance in more detail (Moxham *et al*. 2008*a*, 2008*b*). Our work benefits from the historical descriptions of the vegetation of the Mornington Peninsula by Calder (1972, 1974, 1975), but is far more detailed and broader in its scope.

### *The Physical Environment*

The Nepean Peninsula is within a distinct geo-morphological unit, the Port Phillip Sunklands, a structural depression which began to form about 65 million years ago during the Tertiary (Bird 1975, McGregor & Johnstone 1987). It is bounded by the Selwyn fault to the east and the Rowsley and Bellarine faults to the west (Bird 1975, McGregor & Johnstone 1987). A large part of the depression is now flooded by Port Phillip Bay. About one million years ago, during the Pleistocene, a barrier system began to develop at the seaward side of the depression, the eastern extent forming the Nepean Peninsula (Bird 1975, McGregor & Johnstone 1987). It is largely composed of parabolic sand dunes, made up of calcareous sands originally derived from marine shells, sometimes consolidated into hard dune sandstones and limestones (Bird 1975, Hollinshed 1982) which form an irregular surface, conspicuously devoid of regular drainage networks. There have been multiple phases of dune activity (some unconsolidated dunes remain active) and many dunes cover previous soil surfaces. For example, the 'The cups' landscape (in the Fingal and Cape Schanck areas) was formed by

dissected cross winds relatively recently during the Holocene (10,000 years ago), whereas the more undulating dunes east of Boneo road are from an earlier period of dune formation (Hollinshed 1982). The dune fields contain varying amounts of clays (Hollinshed 1982), including 'rendzina', a dark, thin clay soil (Hollinshed 1982). Many areas have 'terra rossa' (literally red ground) soils, which are iron oxide-rich clays associated with weathered limestone worldwide. These may be exposed, or buried under more recent dunes (Hollinshed 1982, Durn *et al*. 1999). Ocean wave action is continuing to erode the southern side of the peninsula forming limestone cliffs and unusual horizontal shore platforms (Bird 1975). On the more protected Port Phillip Bay side of the peninsula sand continues to be deposited on beaches. The landscape of the Nepean Peninsula is dynamic, and continues to be shaped by changing sea levels and climatic variation, as well as intensive human land-use.

### *The Historical Context*

The Boonwurrung (or Bunurong) people, part of the Kulin nation, occupied the Nepean Peninsula just prior to European settlement (Spillane 1971, O'Neill 1988) and aboriginal archaeological sites containing stone artefacts and middens remain throughout the peninsula (Spillane 1971, O'Neill 1988). These sites attest to extensive and longstanding occupation of the area, but little is documented of this time.

The Nepean Peninsula was one of the first areas in Victoria to be explored and settled by Europeans. In 1802, John Murray on the *Lady Nelson* briefly visited the area, as did Mathew Flinders and Robert Brown on the *Investigator* (Sutherland 1888). Brown's botanical collections and descriptions were some of the earliest from Victoria (Willis 1955). Late in 1803, the first European settlement in Victoria was established in Sorrento, only to be abandoned four months later (Moorhead 1980, Shaw 2003). In 1804, John Tuckey aboard the *Calcutta* explored the Nepean Peninsula on foot (Sutherland 1888).

Between 1804 and 1835 European activity in the area was limited, but by the late 1830s a few squatters had established pastoral runs in the area (Power *et al*. 1985). This involved not only grazing, but clearing for building and firewood, and probably some cropping. By the 1840s, lime burning became one of the primary industries on the southern Mornington Peninsula (Harrington 2000) and the easily-sourced lime from the Nepean Peninsula is said to have been of superior quality to material sourced from deep quarries. The majority of the lime was utilised in Melbourne and surrounding settlements and some was exported to Sydney (Hollinshead 1982). Lime burning had a substantial impact on the vegetation. Not only was the soil disturbed, but large quantities of timber were required for the kilns. Settlers with lime licenses also had licences for timber cutting and grazing (O'Neill 1988) and it is believed that *Allocasuarina verticillata* was preferentially felled for this purpose (Calder 1972, O'Neill 1988, Harrington 2000). By the 1850s, there was also a demand for timber for the firewood market, often for Melbourne's bakeries (O'Neill 1988); bakers' apparently preferred *Leptospermum laevigatum* (Coast Tea-tree) for the ovens as it burnt fiercely (Hollinshed 1982). *Acacia uncifolia* (Coast Wirilda) was possibly the next species targeted, followed by *Allocasuarina verticillata* (Calder 1972). Timber apparently became so scarce in the early 1850s that its collection was prohibited from Arthur's Seat to Point Nepean, except that used for lime burning (O'Neill 1988, Harrington 2000). During the late 19th Century, wattle trees were intensively harvested in many parts of Victoria for their bark, which was used in tanning, *Acacia mearnsii* (Black Wattle) was the preferred species (Searle 1991). It has been suggested that the abundance of wattle thickets was a response to previous land clearance by the settlers and the cessation of aboriginal land management (Calder 1972).

In 1920 the last lime kiln was closed in Sorrento (Hollinshed 1982) and the rapid urbanisation of the Peninsula soon followed. By the early 1900s the Mornington Peninsula was a popular holiday destination. Holiday makers brought an increase in the physical damage to the vegetation, which was exacerbated by motor vehicles and bikes (Hollinshed 1982). Agricultural activity has now almost ceased on the Nepean Peninsula and the principal land uses today are urban and recreational, notably seaside tourism and golf (Mornington Peninsula Tourism 2007).

## Methods

### *Study Area*

The study area is largely defined by the distinct geo-morphological unit of the calcareous dunes on the southern Mornington Peninsula, covering some 8403 ha (Figure 1). Enclosed within the area of the calcareous sands, are several other distinct environments of minor occurrence (wetlands and siliceous beach sands), which are included in this study. The eastern boundary of the dune area is relatively sharp, abutting the Tootgarook Swamp, and the more elevated hilly country near Cape Schanck. Tootgarook Swamp, a very complex region in its own right, was excluded from this study though wetland species which occur along the swamp margins, along the boundary of the study area, were included in our records.

This area is entirely within the Gippsland Plain Bioregion (Thackway & Cresswell 1995). It has a maritime climate of hot summers (daily average 12 – 25 ºC) and mild wet winters (daily average 6.5 – 13 ºC) with a mean annual rainfall of approximately 736 mm (Mornington station 086079, Australian Bureau of Meteorology 2006). The study area is held under a wide range of tenures and management arrangements, including National Parks managed by Parks Victoria, various reserves managed by the Mornington Peninsula Shire Council and private land.

*Historical information*

We consulted a variety of primary historical sources including historical maps and surveys of the southern Mornington Peninsula (County of Mornington, parishes of Wannaeue, Kangerong and Nepean) on microfiche at the State Library of Victoria.

*Investigation of the current vegetation*

This study draws together unpublished data from several independent projects carried out by the authors over several years. Vegetation mapping of the bulk of the study area was carried out between 2004 and 2006, as part of a larger project to map native vegetation (type and condition) across the entire Mornington Peninsula. These maps were created for accurate representation at 1:10 000 scale. This investigation did not include areas of National Park, but was otherwise 'tenure blind', and included private land wherever access could be arranged. As described elsewhere (Sinclair *et al*. 2006), we assigned the landscape to three broad classes:

- **native vegetation** where native species represented > 25% of the total vegetation cover (with the exception of areas which were severely structurally degraded, where the only native vegetation was *Leptospermum laevigatum* which was clearly recolonising cleared sites, and/or areas with soils substantially disturbed by intensive horticulture).
- '**urban and paddock trees**' where some woody native vegetation existed, but the criteria above were not met.
- **no native vegetation.**

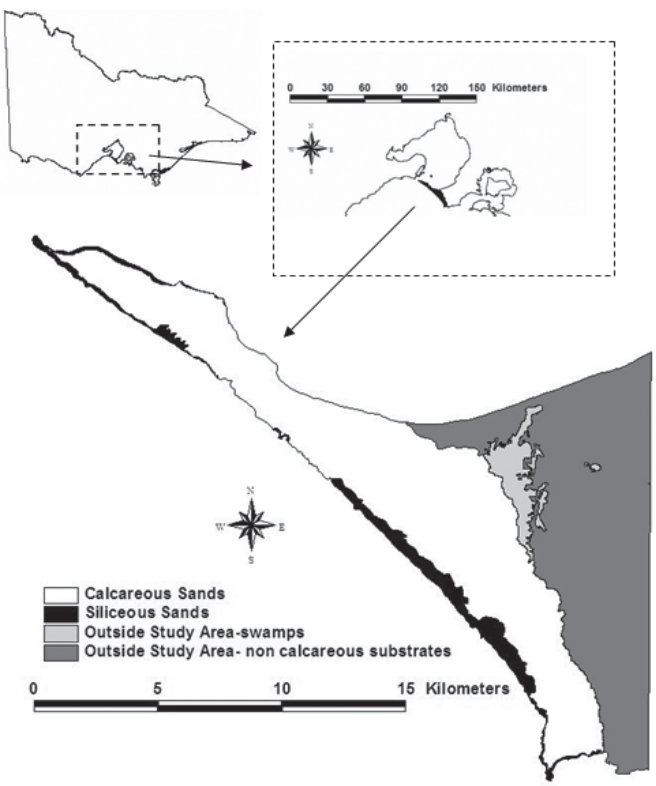


**Fig. 1.** The Nepean Peninsula in southern Victoria showing the study area (including calcareous sands, white and minor siliceous sands, black) and the adjacent areas outside the study area (swamps, light grey and the non calcareous substrates, dark grey).

A separate project (Moxham & Turner 2008*b*, unpublished) investigated much of the land within the Point Nepean section of the Mornington Peninsula National Park, as well as other remnants, using similar criteria. This three-year project undertook research into various aspects of plant community dynamics of the calcareous dune vegetation of the Peninsula. Some of the National Park remains un-mapped by us, and in these areas any mapped information has come from the previously available 1:25 000 scale vegetation mapping held by the Victorian State Government (www.dse.vic.gov.au).

A complete species list for the study area was generated using unpublished data from the above studies, together with species lists created by the authors over many years of casual investigation of sites across the study area, and from records held within the Flora Information System (VFSD 2007). We also took quadrats representative of the vegetation at particular sites, where these exemplified patterns discussed in this report. These are deposited on the VFSD.

All Maps were created using Arcview 3.2 (ESRI). Vegetation polygons were drawn 'by hand', using digital aerial photographs (Melbourne Aerial Survey mosaic 2000, AGD66/AMG Zone55) and the cadastral/property data for the Mornington Shire as templates. Soil maps were consulted where available and GPS reference points were generated in the field where necessary.

## Results

*Historical accounts of the vegetation*

The earliest accounts of the vegetation of the Nepean Peninsula are from John Murray's logbooks in the *Lady Nelson* (transcribed by Lee 1915). His accompanying charts allow us to be confident that much of his time ashore in Port Phillip was spent on the Nepean Peninsula. On the 15th February 1802, Murray began his explorations near Portsea. He writes: *"The southern shore of this noble harbour is bold high land in general and not clothed as all the land at Western Point is with thick brush but with stout trees of various kinds and in some places falls nothing short, in beauty and appearance, of Greenwich Park… I went on shore and walked through the woods a couple of miles. The ground was hard and pleasant to walk on. The trees are at a good distance from each other and no brush intercepts you. The soil is good as far as we may be judges. I saw several native huts and very likely they have burnt off several*

*hundred acres of ground. Young grass we found springing up over all the ground we walked; the only birds we saw were a few parrots… After dinner I took a walk through the woods of this part of the country, attended by one soldier and our carpenter to examine the wood. To describe this part I walked through is simply to say that it nearly resembles a walk on Blackheath and the Park if we set out of question the houses and gardens of the latter. The hills and valleys rise and fall with inexpressible elegance. We discovered no water nor any new wood of consequence, but it is impossible that a great want of water can be here from the number of native huts and fires we fell in with in our march."*

Two days later, Murray's party encountered a group of aboriginal people "*all of whom were seated in a circle on a beautiful spot of grass*" (Lee 1915). While relations were friendly at first, fighting soon broke out and Murray's party fired shots. Murray recalls seeing a man fleeing "*through the wood which was by no means thick…*" past the "*roots of black trees*." Murray, more cautious after this fight, later "*Sent an armed party and our carpenter a long range through the woods to try the different kinds of wood, none however was found of use, the trees being almost invariably oak and other wood quite common at Sydney*." Calder (1972) quotes Sutton (actually Sutherland 1888), who describes Murray taking a "*pleasant walk… with handsome honeysuckle trees overhead*." But we could find no reference to 'Honeysuckle' in Murray's own account (Lee 1915), and (while not necessarily incorrect) this reference is presumably a description based on supposition.

In May 1802, Matthew Flinders explored Port Phillip. He singled out the Nepean Peninsula as different from the rest of the land surrounding the Port, stating "*…the surface there being mostly sandy, and the vegetation in many places, little better than brush-wood*" (Flinders 1814). On the same day, 2nd May, the naturalist Robert Brown, who accompanied Mathew Flinders, explored the Portsea area. His notes were transcribed by Willis (1955): "*After breakfast I landed on the south shore opposite to the ship and about a mile or mile and a half from the entrance of the port. The country here consisted of gentle swells and hollows, pretty uniformly covered with grass and in many places rather thinly furnished with trees which grow, either the Banksia formally observed or* Casuarina equisetifolia *and* Mimosa odoratissima*, forming small trees. Besides the grass which forms the greater part of the verdure, some of the herbaceous plants examined in the meadow land as* Geranium ple*{…},* Convolvulus, Scaevola, Picris, Glycine lacin*{…}, etc. Towards the opposite shore, within a direct line…and half a mile distant the hills were more sandy and covered with low shrubs as* Fabricia*,* Correa alba*,* Croton aff. viscida *and a few dwarf* Styphelias *and* Styphelia lanceolata*…here but a shrub, but in less…and more fertile situations forming a small tree. The soil on the slopes of the hills was rather light and sandy but a tolerable depth. In the hollows it was deeper richer and black, in some places approaching to Bog."*

Brown's description is rich in detail, and requires careful interpretation. His description at first applies to the Bay-side portion of the Peninsula near Portsea. The tree species he notes here are probably *Banksia integrifolia* subsp. *integrifolia*, *Allocasuarina verticillata* (Calder 1972, Vallance *et. al*. 2001) and *Acacia mearnsii*. Calder (1972) suggests the latter was *Acacia uncifolia*, however in 1802 the name *Mimosa odoratissima* correctly referred to Tea Shade-tree (*Albizia odoratissima*), a species with feathery leaves, already known from the 'old world' tropics (Hooker 1844). *Acacia mearnsii* is the only feathery-leaved wattle known on the Nepean Peninsula (Table 1). Brown then singles out the area towards the opposite shore, where the vegetation is lower, and the ground more sandy. Here, he undoubtedly refers to the dunes near the ocean 'back' beach at Portsea. Here he sees several species to which he applies problematic names. *Fabricia* is a shrub genus of the Myrtaceae, and presumably refers to *Leptospermum laevigatum*, which was originally described, in 1788, as *Fabricia laevigatum* and was subsequently placed in the new genus by von Mueller in 1858 (Wagner *et. al*. 1999), and remains the only *Leptospermum* now occurring in the dune area. *Croton* is a genus of low, broad-leaved shrubs of the Euphorbiaceae. This is a reference to *Adriana quadripartita* (Coast Bitter-bush), but may also be *Beyeria lechenaultii* (Pale Turpentine-bush) (Vallance *et. al*. 2001). *Styphelia lanceolata* presumably refers to the locally abundant *Leucopogon parviflorus* (Coast Beard-heath) (*Leucopogon lanceolata*, an equally obvious choice given the name, is an unlikely possibility, being unknown locally). The other dwarf '*Styphelias*' (Epacridaceae) may include *Acrotriche* species (Groundberrys).

We find few references to the vegetation at the time of the Sorrento settlement, 1803–04, (Shillinglaw 1879, Hollinshead 1982). John Pascoe Fawlkner, who stayed at the settlement as a boy, merely recalled in later years that "*the timber was light, chiefly the native she-oak and the honeysuckle. The land a light sandy soil, from brown to black."* (Hollinshead 1982). In October 1804, after the abandonment of the settlement, John Tuckey described the Nepean Peninsula and nearby areas (Tuckey 1805): "*The face of the country bordering on the port is…dotted with trees, as if planted by the hand of taste, whilst the ground is covered with a profusion of flowers of every colour; in short the external appearance of the country flattered us into most delusive dreams of fruitfulness and plenty. The soil (except in a few places where marle is found mixed with vegetable mould), is invariable sandy, and its blackness proceeds from the ashes of the burnt grass, which has every where been set on fire by the natives. The Timber, within five miles of the beach is chiefly the Sheoak, which is only fit for cabinet work. The trees are open and the country is entirely free from underwood, except in the swamps, which are always covered with impenetrable bush. The other kinds of timber trees are very thinly scattered within the above limits; they are the blue gum, Stringybark, honeysuckle, box, and a kind of pine."*

Calder correctly points out that this quotation is ambiguous in terms of its location, and seems to refer to an area including the Nepean Peninsula, but extending further westwards; given its reference to swamps (there are very few within our study area) and the fact that the Nepean Peninsula is mostly narrower than five miles. Tuckey's reference to the 'other' trees must be treated cautiously (Calder 1972). The species he notes are virtually impossible to identify with confidence, although some are clearly Eucalypts. Calder (1972) suggests that Blue Gum refers to *Eucalyptus pauciflora* (Snow Gum) (although forms of *Eucalyptus viminalis* are surely as likely), and Stringybark refers to *Eucalyptus viminalis* (Manna Gum). The 'kind of pine' is perhaps *Exocarpos cupressiformis* (Cherry Ballart) (although not a pine), and the 'box' may plausibly be any number of species (e.g. *Bursaria spinosa* Sweet Bursaria, *Melaleuca lanceolata*, *Eucalyptus radiata* Narrow-leaf Peppermint).

The next reports are those of the early squatters, which are short on detail and usually written many years later. Robert Jamieson (who settled near Arthur's seat in 1839) recalled that he was "*the only settler on the coast side of Arthur's Seat, and all the country from Point Nepean to Cape Schanck, now comparatively so thickly populated, was then in undisputed possession of the kangaroo, emu and native dog, the first of these running literally in large herds*" (McBride 1898). Georgina McCrae, who settled at McCrae on the side of Arthur's seat in 1844, recalled the dunes of the Nepean Peninsula in her recollections: We…"*walked up to one of the 'cups', or sand dunes, whence we took in a majestic view of Point Nepean across a finely wooded middle-distance and foreground*." (McCrae 1934).

Several published maps from the mid-19th Century (Figure 2) generally support the written descriptions above, and portray a well-grassed, open woodland of sheoaks and wattles.

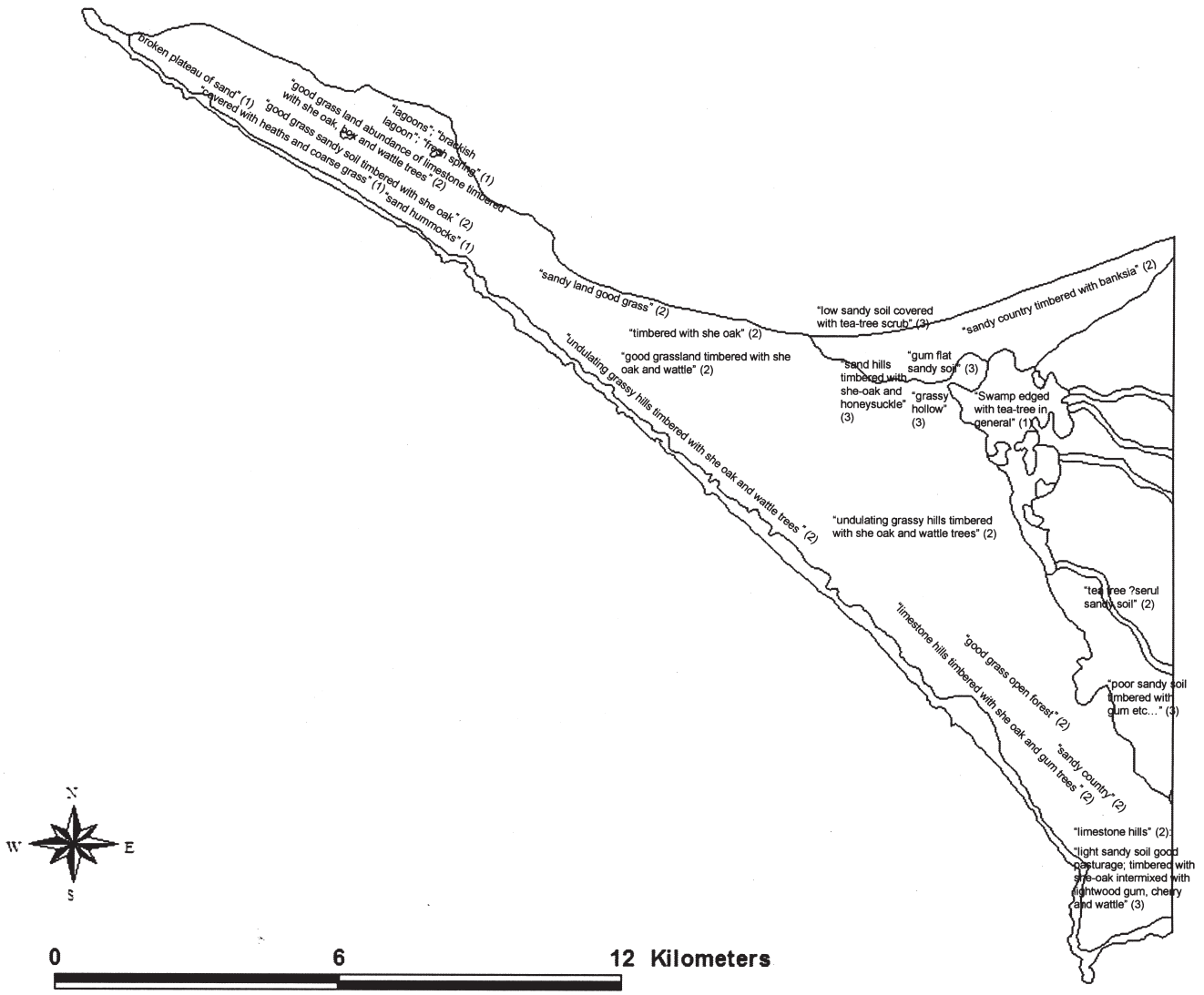


**Fig. 2.** The Nepean Peninsula showing all the vegetation notations from historical maps and surveys. Sources (1) – Anon 1857, (2) – Smythes 1841, (3) – Anon 1853.

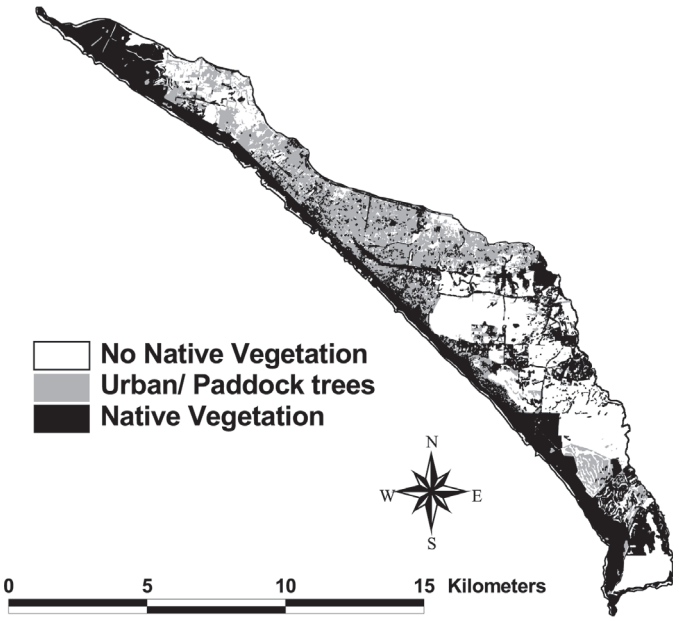


**Fig. 3.** The vegetation of the Nepean Peninsula today showing remnant native vegetation (black), urban and paddock trees (grey) and areas with no native vegetation (white).

Published recollections of the late 19th or early 20th Centuries stress the fact that the Nepean Peninsula was once thinly wooded, but had since become overgrown with *Leptospermum laevigatum* (this phenomenon is discussed in more detail below). Mrs. McKernan, granddaughter of an original settler of the southern peninsula believed "*that the Nepean peninsula was originally open and well-grasses, with very little tea-tree*." (Cox 1931). Byrne (1931) adds that: "*it could be described as a beautiful, park-like place abounding in she-oaks. At the time, the beach tea-tree was confined to a narrow fringe in the sand just above the high water mark."* Turkey Flat, now St Andrews Beach, was owned in 1860 by James Purves. He describes this area as "*beautifully wooded then and park like, studded with Banksia*" later the area became overgrown with tea tree (Hollinshed 1982). William Rowley, interviewed in 1950, talked about the Rye area in the 19th Century: "*there was a great deal of she-oak and some enormous honeysuckle (banksia). There was only a narrow belt of tea-tree along the coast which developed into a large extent later on*." (Hollinshed 1982). Hall (1901) describes the "*dense scrub-land of the Nepean Peninsula*."

*The vegetation today*

Our vegetation survey for 2004–07 (Figure 3) shows, native vegetation covers approximately 34% of the study area (although area calculations based on GIS datasets must be interpreted cautiously; Turner *et al*. 1989). This level of coverage is relatively high for a near-urban area and is certainly higher than comparable areas elsewhere on Melbourne's urban fringe (www.dse.vic.gov.au; Biodiversity Interactive Maps).

We classified the vegetation according to Ecological Vegetation Classes (EVCs), the descriptive mapping unit widely employed by management agencies and naturalists across Victoria (Parkes *et. al*. 2003). The EVCs we used to map the present vegetation are (www.dse.vic.gov.au; Ecological Vegetation Classes):

**Fig. 4.** Coastal Moonah Woodland (left) at Nelson in south western Victoria and (right) on the Nepean Peninsula.

- **Coastal Alkaline Scrub** (EVC 858) The vast majority of the vegetation (2131 ha) consists of more-or-less dense stands of *Leptospermum laevigatum*, along with patches of *Melaleuca lanceolata* subsp. *lanceolata* (Figure 4). This vegetation is broadly classifiable as **Coastal Alkaline Scrub** (EVC 858) (portions of it are referable to Coast Moonah Woodland, which is listed as a threatened community under the Flora and Fauna Guarantee Act (FFG Act 1988, DSE 2002, Moxham *et al*. 2008*b* in review). The Coastal Moonah Woodland community is described below. While it is extensive, this vegetation has been massively modified since colonisation.
- **Coast Banksia Woodland** (EVC 2) (~ 0.05 ha) occurs on the sheltered bay beaches, along the northern side of the peninsula. It is characterised by the structural dominance of *Banksia integrifolia* subsp. *integrifolia* and the presence of species requiring shade and shelter from fire in the understorey.
- **Coastal Dune Scrub** (EVC 160) (~ 13 ha) forms a shrubland on the exposed upper slopes and crests of secondary dunes and along the southern coastline of the Nepean Peninsula; it occurs on siliceous and calcareous sands. It is dominated by *Acacia longifolia* var. *sophorae* (Coast Wattle), *Leptospermum laevigatum* and in places, by stunted *Melaleuca lanceolata* subsp. *lanceolata*.
- **Coastal Headland Scrub** (EVC 161) (432 ha) and **Spray-zone Coastal Shrubland** (EVC 876) (~ 22 ha) form wind-pruned shrublands on the most exposed parts of the coast. Prominent species include *Correa alba* (Coast Correa) and *Leucophyta brownii* (Cushion Bush).
- **Coastal Tussock Grassland** (EVC 163) (~ 0.15 ha) also occurs on the exposed cliffs with the grass *Austrostipa stipoides* (Prickly Spear-grass) prominent.
- **Coastal Dune Grassland** (EVC 879) (~ 1 ha) is found on the siliceous sandy beaches of the more protected Bay side. It is dominated by *Spinifex sericeus* (Hairy Spinifex).
- **Berm Grassy Shrubland** (EVC 311) (~ 0.3 ha) occurs on sand deposits formed by low wave action on the sheltered bay beaches. It is composed of low succulent shrubs such as *Atriplex cinerea* (Coast Saltbush), over a ground layer of grasses and herbs.
- An un-resolved unit (referred to **Calcareous Swale Grassland** (EVC 309), see below) occurs in the swales and flats of the calcareous hind dunes. The grassy ground layer is dominated by *Poa labillardieri* (Common Tussock-grass) and the canopy, when present, is composed of *Banksia integrifolia* subsp. *integrifolia*. This unit is of very minor occurrence, but there are indications it was once widespread (discussed below) (~ 1.15 ha).
- Several wetlands also occur, of various types, which are of minor extent (~ 1 ha).

Table 1 lists all the species we know that occur (or occurred) naturally within the study area with each assigned to a 'vegetation group' (combinations of EVCs) based on field observations (occasionally from observations elsewhere). We have assigned the check marks conservatively, and the lack of a mark under a particular vegetation group does not indicate a definite absence. Introduced species are not included, though there are, numerous weeds on the Nepean Peninsula, some of which pose a major threat to the surviving vegetation. The most prominent of these include *Polygala myrtifolia* (Myrtle-leaf Milkwort), *Asparagus asparagoides* (Bridal Creeper), *Dipogon lignosus* (Common Dipogon) and *Ehrharta erecta* (Panic Veldt-grass).

The most prominent features of the early accounts – the woodlands of sheoaks, the well-grassed 'meadow lands', the 'profusion of flowers', and the Banksias are barely to be found today, and the structure and composition of the remaining vegetation is markedly different from that described in the early 19th Century. Despite the extent of the remaining stands, this presents a challenge for historical interpretation.

**Table 1. Native plant species recorded on the Nepean Peninsula with occurrence in vegetation groups and Ecological Vegetation Classes (EVC)**

Data from this study and Victorian Flora Site Database (VFSD 2007). Species nomenclature follows Walsh & Stajsic (2007).

Conservation status for some species is displayed; capital letters for nationally listed, non-capitalised for Victorian listing; 'r' = rare, 'v' = vulnerable, 'e' = endangered, 'k' = poorly known, 'f' = species listed under *Victorian Flora and Fauna Guarantee Act* 1988.
# = native species that may become invasive out of their range.

Vegetation groups include the following ecological vegetation classes (EVC): Coastal Dune Scrub (EVC160), Coastal Headland Scrub (EVC 161), Coastal Tussock Grassland (EVC 163), Calcareous Swale Grassland (EVC 309), Berm Grassy Shrubland (EVC 311), Coastal Alkaline Scrub (EVC 858), Spray-zone Coastal Shrubland (EVC 876) and Coastal Dune Grassland (EVC 879).

| | **Cons. status** | **Alkaline dunes** | **Damp sands/ acid soils** | **Swales** | **Cliffs** | **Sandy Beaches** | **Wetlands/ swamps** |
|---|---|---|---|---|---|---|---|
| **Scientific name (Common name)** | | **EVC 160, 858** | **EVC 3** | **EVC 309** | **EVC 161, 163, 876** | **EVC 879, 311** | **various EVCs** |
| **FERNS AND ALLIES** | | | | | | | |
| **Dennstaedtiaceae** | | | | | | | |
| *Pteridium esculentum* (Austral Bracken) | | | Ds | S | | | |
| **MONOCOTYLEDONS** | | | | | | | |
| **Anthericaceae** | | | | | | | |
| *Thysanotus patersonii* (Twining Fringe-lily) | | Ad | | S | | | |
| **Colchicaceae** | | | | | | | |
| *Wurmbea latifolia subsp. vanessae* (Broad-leaf Early Nancy) | | Ad | | | | | |
| *Wurmbea spp.* (Early Nancy) | | Ad | | | | | |
| **Cymodoceaceae** | | | | | | | |
| *Amphibolis antarctica* (Sea Nymph) | k | | | | | | |
| **Cyperaceae** | | | | | | | |
| *Baumea juncea* (Bare Twig-sedge) | | | | | | | WS |
| *Bolboschoenus caldwellii* (Salt Club-sedge) | | | | | | | WS |
| *Carex appressa* (Tall Sedge) | | | | | | | WS |
| *Carex breviculmis* (Common Grass-sedge) | | Ad | Ds | S | | | |
| *Carex fascicularis* (Tassel Sedge) | | | | | | | WS |
| *Carex gunniana* (Swamp Sedge) | | | | | | | WS |
| *Carex pumila* (Strand Sedge) | | | | | | Sb | |
| *Cladium procerum* (Leafy Twig-sedge) | r | | | | | | WS |
| *Eleocharis acuta* (Common Spike-sedge) | | | | | | | WS |
| *Ficinia nodosa* (Knobby Club-sedge) | | Ad | | S | C | Sb | WS |
| *Gahnia trifida* (Coast Saw-sedge) | | | | | | | WS |
| *Isolepis cernua var. cernua* (Nodding Club-sedge) | | | | | | | WS |
| *Isolepis cernua var. platycarpa* (Broad-fruit Club-sedge) | | | | | | | WS |
| *Isolepis inundata* (Swamp Club-sedge) | | | | | | | WS |
| *Isolepis marginata* (Little Club-sedge) | | | | | | | WS |
| *Isolepis subtilissima* (Mountain Club-sedge) | | | | | | | WS |
| *Lepidosperma gladiatum* (Coast Sword-sedge) | | Ad | Ds | S | | Sb | |
| *Schoenus apogon* (Common Bog-sedge) | | | | | | | WS |
| *Schoenus nitens* (Shiny Bog-sedge) | | Ad | Ds | | | | |
| *Tetraria capillaries* (Hair Sedge) | | | | S | | | |
| **Hemerocallidaceae** | | | | | | | |
| *Dianella brevicaulis* (Small-flower Flax-lily) | | Ad | | | C | Sb | |
| *Dianella longifolia var. longifolia s.l.* (Pale Flax-lily) | | Ad | Ds | | | | |
| *Dianella revoluta s.l.* (Black-anther Flax-lily) | | | Ds | | | | |
| *Dianella sp. aff. revoluta (Coastal)* (Coast Flax-lily) | | Ad | | | C | | |
| **Hypoxidaceae** | | | | | | | |
| *Hypoxis glabella var. glabella* (Tiny Star) | | Ad | | S | | | |
| **Juncaceae** | | | | | | | |
| *Juncus pallidus* (Pale Rush) | | | | | | | WS |

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|---|---|---|---|---|---|---|---|
| *Luzula meridionalis var. flaccida* (Common Woodrush) | | Ad | Ds | S | | | |
| *Luzula meridionalis var. densiflora* (Common Woodrush) | | Ad | Ds | S | | | |
| **Orchidaceae** | | | | | | | |
| *Caladenia carnea sensu Willis (1970)* (Pink Fingers) | | Ad | | | | | |
| *Caladenia latifolia* (Pink Fairies) | | Ad | | | | | |
| *Corybas despectans* (Coast Helmet-orchid) | f, v | Ad | | | | | |
| *Corybas diemenicus s.l.* (Veined Helmet-orchid) | | Ad | | | | | |
| *Corybas sp.aff. diemenicus (coastal)* (Late Helmet-orchid) | f, e | Ad | | | | | |
| *Corybas incurvus* (Slaty Helmet-orchid) | | Ad | | | | | |
| *Cyrtostylis reniformis* (Small Gnat-orchid) | | Ad | | | | | |
| *Cyrtostylis robusta* (Large Gnat-orchid) | | Ad | | | | | |
| *Microtis unifolia* (Common Onion-orchid) | | Ad | | | | | |
| *Pterostylis cucullata* (Leafy Greenhood) | V, f, v | Ad | | | | | |
| *Pterostylis cucullata subsp. cucullata (coastal)* (Leafy Greenhood) | e | Ad | | | | | |
| *Pterostylis nutans* (Nodding Greenhood) | | Ad | | | | | |
| *Pterostylis pedunculata* (Maroonhood) | | Ad | | | | | |
| **Poaceae** | | | | | | | |
| *Austrofestuca littoralis* (Coast Fescue) | r | | | | C | Sb | |
| *Austrodanthonia caespitosa* (Common Wallaby-grass) | | Ad | | | | | |
| *Austrodanthonia geniculata* (Kneed Wallaby-grass) | | Ad | Ds | | | | |
| *Austrodanthonia racemosa var. racemosa* (Slender Wallaby-grass) | | Ad | Ds | | | | |
| *Austrodanthonia setacea* (Bristly Wallaby-grass) | | Ad | Ds | | | | |
| *Austrostipa flavescens* (Coast Spear-grass) | | Ad | | S | | | |
| *Austrostipa stipoides* (Prickly Spear-grass) | | Ad | | | | | |
| *Dichelachne crinita* (Long-hair Plume-grass) | | Ad | | | | | |
| *Distichlis distichophylla (*Australian Salt-grass) | | | | | C | Sb | |
| *Elymus scaber var. scaber* (Common Wheat-grass) | | Ad | | | | | |
| *Eragrostis brownii* (Common Love-grass) | | | | | | | WS |
| *Glyceria australis* (Australian Sweet-grass) | | | | | | | WS |
| *Hemarthria uncinata var. uncinata* (Mat Grass) | | | | S | | | WS |
| *Imperata cylindrica* (Blady Grass) | | | | S | | | |
| *Lachnagrostis billardierei subsp. billardierei* (Coast Blown-grass) | | Ad | | S | | | |
| *Lachnagrostis filiformis* (Common Blown-grass) | | | | | | | WS |
| *Microlaena stipoides var. stipoides* (Weeping Grass) | | | Ds | | | | |
| *Phragmites australis* (Common Reed) | | | | | | | WS |
| *Poa labillardierei* (Common Tussock-grass) | | Ad | Ds | S | | Sb | |
| *Poa poiformis var. ramifer* (Dune Poa) | r | Ad | | | C | Sb | |
| *Poa rodwayi* (Velvet Tussock-grass) | | Ad | | S | | | |
| *Spinifex sericeus* (Hairy Spinifex) | | | | | | Sb | |
| *Themeda triandra* (Kangaroo Grass) | | Ad | | S | | | |
| **Xanthorrhoeaceae** | | | | | | | |
| *Lomandra filiformis* (Wattle Mat-rush) | | | Ds | | | | |
| *Lomandra longifolia* (Spiny-headed Mat-rush) | | | Ds | S | | | |
| **Pontamogetonaceae** | | | | | | | |
| *Potamogeton pectinatus* (Fennel Pondweed) | | | | | | | WS |
| **DICOTYLEDONS** | | | | | | | |
| **Aizoaceae** | | | | | | | |
| *Carpobrotus rossii* (Karkalla) | | Ad | | | | Sb | |
| *Disphyma crassifolium subsp. clavellatum* (Rounded Noon-flower) | | | | | C | Sb | WS |
| *Tetragonia implexicoma* (Bower Spinach) | | Ad | Ds | | C | Sb | |

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|---|---|---|---|---|---|---|---|
| *Tetragonia tetragonioides* (New Zealand Spinach) | | | | | | Sb | |
| **Amaranthaceae** | | | | | | | |
| *Hemichroa pentandra* (Trailing Hemichroa) | | | | | | | WS |
| **Apiaceae** | | | | | | | |
| *Apium annuum* (Annual Celery) | | | | | | Sb | WS |
| *Apium prostratum subsp. prostratum* (Sea Celery) | | | | | C | Sb | |
| *Apium prostratum subsp. prostratum var. filiforme* (Sea Celery) | | | | | | | WS |
| *Berula erecta* (Water Parsnip) | k | | | | | | WS |
| *Centella cordifolia* (Centella) | | | | | | | WS |
| *Daucus glochidiatus* (Australian Carrot) | | Ad | Ds | | | | |
| *Hydrocotyle laxiflora* (Stinking Pennywort) ) | | Ad | Ds | S | | | |
| *Hydrocotyle sibthorpioides* (Shining Pennywort) | | | | | | | WS |
| *Hydrocotyle verticillata* (Shield Pennywort) | | | | | | | WS |
| *Lilaeopsis polyantha* (Australian Lilaeopsis) | | | | | | | WS |
| **Apocynaceae** | | | | | | | |
| *Alyxia buxifolia* (Sea Box) | | Ad | | | C | Sb | |
| **Asteraceae** | | | | | | | |
| *Actites megalocarpa* (Dune Thistle) | | | | | C | Sb | |
| *Apalochlamys spectabilis* (Showy Cassinia) | | Ad | | | | | |
| *Cotula australi* (Common Cotula) | | Ad | | | | | |
| *Cymbonotus* sp.(Bear's Ear) | | Ad | | | | | |
| *Helichrysum leucopsideum* (Satin Everlasting) | | Ad | | | C | | |
| *Lagenophora stipitata* (Common Bottle-daisy) | | Ad | Ds | S | | | |
| *Leucophyta brownii* (Cushion Bush) | | | | | C | Sb | |
| *Olearia axillaris* (Coast Daisy-bush) | | Ad | | | C | | |
| *Olearia glutinosa* (Sticky Daisy-bush) | | | | | C | | |
| *Olearia sp. 2* (Peninsula Daisy-bush) | r | | | | C | | |
| *Ozothamnus ferrugineus* (Tree Everlasting) | | | | S | | | WS |
| *Ozothamnus turbinatus* (Coast Everlasting) | | | | | C | | |
| *Pseudognaphalium leuteoalbum* (Jersey Cudweed) | | Ad | | | | Sb | |
| *Picris angustifolia subsp. angustifolia* (Coast Picris) | | | | | C | | |
| *Senecio biserratus* (Jagged Fireweed) | | Ad | | | | | |
| *Senecio glomeratus* (Annual Fireweed) | | Ad | Ds | S | | Sb | WS |
| *Senecio hispidulus s.l.* (Rough Fireweed) | | Ad | Ds | S | | Sb | |
| *Senecio minimus* (Shrubby Fireweed) | | | | S | | | WS |
| *Senecio odoratus* (Scented Groundsel) | | | | S | | | |
| *Senecio pinnatifolius var. maritimus* (Coast Groundsel) | | | | | C | | |
| *Senecio quadridentatus* (Cotton Fireweed) | | Ad | Ds | S | | | |
| *Senecio spathulatus s.l.* (Dune Groundsel) | | | | | C | Sb | |
| *Senecio tenuiflorus spp. agg.* (Slender Fireweed) | | Ad | | | | | |
| *Sonchus oleraceus* (Common Sow-thistle) | | Ad | Ds | S | | Sb | |
| **Boraginaceae** | | | | | | | |
| *Austrocynoglossum latifolium* (Forest Hounds-tongue) | | | | | | | |
| *Cynoglossum australe* (Australian Hound's-tongue) | | Ad | | S | | | |
| *Heliotropium europaeum* (Common Heliotrope) | | Ad | | S | | | |
| *Myosotis australis* (Austral Forget-me-not) | | Ad | | | | | |
| **Brunoniaceae** | | | | | | | |
| *Brunonia australis* (Blue Pincushion) | | Ad | | | | | |
| **Caprifoliaceae** | | | | | | | |
| *Sambucus gaudichaudiana* (White Elderberry) | | Ad | | S | | | |
| **Caryophyllaceae** | | | | | | | |
| *Colobanthus apetalus* (Coast Colobanth) | r | Ad | | | | | |
| *Stellaria angustifolia* (Swamp Starwort) | | | | | | | WS |
| *Stellaria pungens* (Prickly Starwort) | | | Ds | | | | |

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|---|---|---|---|---|---|---|---|
| **Casuarinaceae** | | | | | | | |
| *Allocasuarina verticillata* (Drooping Sheoak) | | Ad | | S | C | | |
| **Chenopodiaceae** | | | | | | | |
| *Atriplex cinerea* (Coast Saltbush) | | | | | | Sb | |
| *Chenopodium glaucum* (Glaucous Goosefoot) | | | | | | Sb | WS |
| *Chenopodium pumilio* (Clammy Goosefoot) | | Ad | | | | Sb | WS |
| *Enchylaena tomentosa var. tomentosa* (Ruby Saltbush) | | | | | C | | |
| *Rhagodia candolleana subsp. candolleana* (Seaberry Saltbush) | | Ad | Ds | S | | Sb | |
| *Sarcocornia quinqueflora subsp. quinqueflora* (Beaded Glasswort) | | | | | C | | |
| *Sarcocornia quinqueflora subsp. tasmanica* (Beaded Glasswort) | k | | | | C | | |
| *Suaeda australis* (Austral Seablite) | | | | | C | | |
| *Threlkeldia diffusa* (Coast Bonefruit) | | Ad | | | C | Sb | |
| **Convolvulaceae** | | | | | | | |
| *Calystegia sepium subsp. roseata* (Large Bindweed) | | | | | | | WS |
| *Convolvulus erubescens spp. agg.* (Pink Bindweed) | | | | S | | | |
| *Dichondra repens* (Kidney-weed) | | Ad | Ds | S | C | Sb | WS |
| **Crassulaceae** | | | | | | | |
| *Crassula helmsii* (Swamp Crassula) | | | | | | | WS |
| *Crassula peduncularis* (Purple Crassula) | | | | | C | | |
| *Crassula sieberiana s.l.* (Sieber Crassula) | | Ad | | S | C | Sb | |
| **Dilleniaceae** | | | | | | | |
| *Hibbertia sericea s.l* (Silky Guinea-flower) | | Ad | | S | | | |
| **Epacridaceae** | | | | | | | |
| *Acrotriche affinis* (Ridged Ground-berry) | | Ad | | | | | |
| *Leucopogon parviflorus* (Coast Beard-heath) | | Ad | | S | C | Sb | |
| *Leucopogon australis* (Spike Beard-heath) | | | | | | | WS |
| **Euphorbiaceae** | | | | | | | |
| *Adriana quadripartita (pubescent form)* (Coast Bitter-bush) | v | Ad | | S | C | | |
| *Adriana quadripartita s.s. (glabrous form)* (Rare Bitter-bush) | f, e | Ad | | S | | | |
| *Beyeria lechenaultii* (Pale Turpentine-bush) | | Ad | | | C | | |
| *Poranthera microphylla s.l.* (Small Poranthera) | | Ad | Ds | | | | |
| **Fabaceae** | | | | | | | |
| *Glycine clandestina* (Twining Glycine) | | | Ds | | | | |
| *Kennedia prostrata* (Running Postman) | | Ad | | S | C | Sb | |
| *Lotus australis var. australis* (Austral Trefoil) | k | | | | C | Sb | |
| *Pultenaea canaliculata* (Coast Bush-pea) | r | Ad | | | C | | |
| *Pultenaea tenuifolia* (Slender Bush-pea) | | Ad | | | C | | |
| *Swainsona lessertiifolia* (Coast Swainson-pea) | | Ad | | S | C | Sb | |
| *Frankenia pauciflora var. gunnii* (Southern Sea-heath) | | | | | | | |
| **Geraniaceae** | | | | | | | |
| *Geranium retrorsum s.l.* (Grassland Crane's-bill) | | | | S | | | |
| *Geranium solanderi s.l.* (Austral Crane's-bill) | | | | | | | |
| *Geranium spp.* (Crane's Bill) | | Ad | Ds | S | | | |
| *Pelargonium australe* (Austral Stork's-bill) | | Ad | | | C | Sb | |
| **Goodeniaceae** | | | | | | | |
| *Scaevola albida* (Small-fruit Fan-flower) | | Ad | | S | C | Sb | |
| *Selliera radicans* (Shiny Swamp-mat) | | | | | | | WS |
| **Haloragaceae** | | | | | | | |
| *Haloragis brownii* (Swamp Raspwort) | | | | | | | WS |
| *Myriophyllum amphibium* (Broad Water-milfoil) | | | | | | | WS |
| *Myriophyllum crispatum* (Upright Water-milfoil) | | | | | | | WS |
| **Lamiaceae** | | | | | | | |
| *Ajuga australis* (Austral Bugle) | | Ad | | S | | | |

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|---|---|---|---|---|---|---|---|
| *Scutellaria humilis* (Dwarf Skullcap) | | Ad | | | | | |
| **Lauraceae** | | | | | | | |
| *Cassytha pubescens s.s.* (Downy Dodder-laurel) | | Ad | Ds | | C | | |
| **Loranthaceae** | | | | | | | |
| *Amyema miquelii* (Box Mistletoe) | | Ad | | | | | |
| *Amyema pendula* (Drooping Mistletoe) | | Ad | Ds | | | | |
| *Amyema preissii* (Wire-leaf Mistletoe) | | Ad | | | | | |
| **Mimosaceae** | | | | | | | |
| *Acacia longifolia subsp. longifolia #* (Sallow Wattle) | | Ad | | | C | Sb | |
| *Acacia longifolia subsp. sophorae* (Coast Wattle | # | Ad | Ds | S | C | Sb | |
| *Acacia mearnsii* (Black Wattle) | | | Ds | S | | | |
| *Acacia melanoxylon* (Blackwood) | | | Ds | | | | |
| *Acacia paradoxa* (Hedge Wattle) | | Ad | | S | | | |
| *Acacia pycnantha* (Golden Wattle) | | Ad | | | | | |
| *Acacia uncifolia* (Coast Wirilda) | r | Ad | | | | | |
| **Myoporaceae** | | | | | | | |
| *Myoporum insulare* (Common Boobialla) | # | Ad | | S | | Sb | |
| **Myrtaceae** | | | | | | | |
| *Eucalyptus viminalis* (Manna Gum) | | | Ds | | | | |
| *Eucalyptus viminalis subsp. pryoriana* (Coast Manna-gum) | | | Ds | | | | |
| *Leptospermum laevigatum* (Coast Tea-tree) | # | Ad | | S | C | Sb | |
| *Leptospermum lanigerum* (Woolly Tea-tree) | # | | | | | | WS |
| *Melaleuca armillaris subsp. armillaris* (Giant Honey-myrtle) | # | Ad | | | | | |
| *Melaleuca ericifolia* (Swamp Paperbark) | | | | | | | WS |
| *Melaleuca lanceolata subsp. lanceolata* (Moonah) | | Ad | | | C | | |
| **Onagraceae** | | | | | | | |
| *Epilobium billardierianum* (Variable Willow-herb) | | | | | | | WS |
| *Epilobium hirtigerum* (Hairy Willow-herb) | | | | | | | WS |
| **Oxalidaceae** | | | | | | | |
| *Oxalis perennans s.l.* (Grassland Wood-sorrel) | | | | S | | | |
| *Oxalis rubens* (Dune Wood-sorrel) | r | Ad | | S | | | |
| *Oxalis thompsoniae* (Fluffy-fruit Wood-sorrel) | k | Ad | | S | | | |
| **Phrymaceae** | | | | | | | |
| *Mimulus repens* (Creeping Monkey-flower) | | | | | | | WS |
| **Pittosporaceae** | | | | | | | |
| *Bursaria spinosa subsp. spinosa* (Sweet Bursaria) | | Ad | Ds | | | | |
| *Pittosporum undulatum* (Sweet Pittosporum | # | Ad | Ds | | | | |
| **Polygalaceae** | | | | | | | |
| *Comesperma volubile* (Love Creeper) ) | | Ad | | | | | |
| **Polygonaceae** | | | | | | | |
| *Muehlenbeckia adpressa* (Climbing Lignum) | | Ad | Ds | S | C | | |
| *Persicaria decipiens* (Slender Knotweed) | | | | | | | WS |
| *Rumex brownii* (Slender Dock) | | Ad | Ds | S | | Sb | |
| **Portulacaceae** | | | | | | | |
| *Portulaca oleracea* (Common Purslane) | | Ad | | | | | |
| **Primulaceae** | | | | | | | |
| *Samolus repens* (Creeping Brookweed) | | | | | C | | |
| **Proteaceae** | | | | | | | |
| *Banksia integrifolia subsp. integrifolia* (Coast Banksia) | | Ad | | S | C | | |
| **Ranunculaceae** | | | | | | | |
| *Clematis microphylla s.s.* (Small-leaved Clematis) | | Ad | | S | C | | |
| *Ranunculus sessiliflorus var. sessiliflorus* (Annual Buttercup) | | Ad | | | | | |
| *Ranunculus spp.* (Buttercup) | | | | | | | WS |

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| **Rhamnaceae** | | | | | | | |
| *Pomaderris paniculosa subsp. paralia* (Coast Pomaderris) | | Ad | | | | | |
| *Spyridium vexilliferum var. vexilliferum* (Winged Spyridium) | | | | | C | | |
| **Rosaceae** | | | | | | | |
| *Acaena novae-zelandiae* (Bidgee-widgee) | | Ad | Ds | S | | | |
| *Rubus parvifolius* (Small-leaf Bramble) | | Ad | Ds | S | | | |
| **Rubiaceae** | | | | | | | |
| *Asperula scoparia* (Prickly Woodruff) | | | Ds | | | | |
| *Galium australe* (Tangled Bedstraw) | | Ad | | | | | |
| **Rutaceae** | | | | | | | |
| *Correa alba* (White Correa) | | Ad | | | C | Sb | |
| *Correa reflexa* (Common Correa) | | Ad | | | | | |
| **Santalaceae** | | | | | | | |
| *Exocarpos cupressiformis* (Cherry Ballart) | | Ad | Ds | | | | |
| **Sapindaceae** | | | | | | | |
| *Dodonaea viscosa subsp. spatulata* (Sticky Hop-bush) | | | Ds | | | | |
| **Solanaceae** | | | | | | | |
| *Nicotiana maritima* (Coast Tobacco) | e | | | | C | | |
| *Solanum laciniatum* (Large Kangaroo Apple) | | Ad | | S | | | |
| **Stackhousiaceae** | | | | | | | |
| *Stackhousia monogyna* (Creamy Stackhousia) | | Ad | | S | | | |
| *Stackhousia spathulata* (Coast Stackhousia) | k | | | | C | Sb | |
| *Stackhousia viminea* (Slender Stackhousia) | | Ad | | | | | |
| **Thymelaeaceae** | | | | | | | |
| *Pimelea serpyllifolia subsp. serpyllifolia* (Thyme Rice-flower) | | Ad | | S | C | | |
| **Urticaceae** | | | | | | | |
| *Parietaria debilis s.s.* (Shade Pellitory) | | Ad | | | | | |
| **Veronicaceae** | | | | | | | |
| *Plantago hispida* (Hairy Plantain) | | Ad | Ds | S | | | |
| *Veronica calycina* (Hairy Speedwell) | | Ad | Ds | S | | | |
| *Veronica gracilis* (Slender Speedwell) | | | | | | | WS |
| **Violaceae** | | | | | | | |
| *Viola hederacea* (Ivy-leaf Violet) | | | Ds | | | | |
| **Zygophyllaceae** | | | | | | | |
| *Zygophyllum billardierei* (Coast Twin-leaf) | r | Ad | | S | C | Sb | |

## Discussion

### *A biogeographic perspective*

The predominance of calcareous sandy soils distinguishes the Nepean Peninsula from the remainder of the Mornington Peninsula. This distinction is clearly reflected in the vegetation, which differs noticeably from that on the remainder of the Peninsula (e.g. *Eucalyptus* species are apparently absent, while other species have isolated populations on the Nepean Peninsula, but are absent from the remaining Mornington Peninsula). The strong correlation between certain plant distributions and the levels of calcium carbonate has long been recognised worldwide, with many species strongly correlated with high calcium carbonate levels ('calcicoles', cf 'calcifuges'). The physiological mechanisms driving this strong preference are complex and poorly understood, but involve differences in nutrient availability (Clymo 1962, Strom 1997, Paertel 2002).

The floristic affinities of the Nepean Peninsula lie not with the nearby Melbourne region, but with other calcareous coasts in Victoria, and more distantly to the calcareous inland areas such as in the Mallee. Many plant taxa have disjunct occurrences on calcareous soils scattered across Victoria. These include *Beyeria lechenaultii* (Turpentine Bush), *Melaleuca lanceolata*, *Amyema preissii* (Pencil Mistletoe), *Acrotriche affinis*, *Pimelea serpyllifolia* (Thyme Rice-flower), the genus *Zygophyllum*, and the genus *Adriana*.

The calcareous dunes of the inland (e.g. the Woorinen sands) and those of the coast are derived from a complex mixture of sources (Bird 1975, Pell *et al*. 2001, Bolwer *et al*. 2006), but share some basic physiochemical characteristics, notably high levels of calcium carbonate. The Mallee regions have also experienced substantial marine incursions, providing some direct biogeographic links to the coast. In South Australia, the calcareous sandy regions of the Coast and the Mallee are in much closer proximity. The primary difference between the inland and the coastal dune systems of the Nepean Peninsula is rainfall: the Woorinen sands of the Victorian Mallee experience a mean annual rainfall of 250 – 400 mm (White *et al*. 2003), while the Mornington Peninsula receives over 730 mm (Mornington Station 086079, Australian Bureau of Meteorology 2006). Thus, while these regions can be argued to constitute an 'archipelego' of roughly similar habitats, they are spread across a marked rainfall gradient. These statewide bio-geographic links call into question the placement of the Nepean Peninsula in the Gippsland Plain Bioregion (Thackway & Cresswell 1995); affinities with the Otway Plain, the Warrnambool Plain or the Bridgewater Bioregions seem far stronger to us. This link to the south-western Victorian coast is exploited in our study, since analogous vegetation to that considered here can be found in a far less modified state in the west.

The links to other calcareous areas (particularly the Mallee) must not be overstated at the expense of other bio-geographic patterns. Clearly, the flora of the Nepean Peninsula has floristic affinities with other (non-calcareous) coasts (e.g. *Banksia integrifolia* occurs in near-coastal areas of eastern Victoria, on siliceous and calcareous soils, but is absent from most of Western Victoria).

### *Changing structure: from woodland/forest to scrub*

That the vegetation of the Nepean Peninsula was once more open than most of the remaining stands today (the view of Calder 1972, 1974, 1975) is well supported by our comparison between the historical accounts and the current vegetation. The most striking change has been the disappearance of the once-prominent woodlands of *Allocasuarina verticillata* and the appearance of large expanses of scrub dominated by *Leptospermum laevigatum*. This change in vegetation structure has been brought about by European land use (e.g. land clearing) and changes to disturbance regimes that regulate vegetation dynamics, such as fire and grazing.

While the exact historical distribution of *Leptospermum laevigatum* will always be a matter of conjecture (and controversy, given its location alongside areas of development), we believe that it has increased substantially in extent since colonisation. While the historical accounts barely mention it (with the exception of Robert Brown, who notes it only on the ocean-beach dunes; Willis, 1955), it is now the dominant species over large areas of dense scrub. The historical accounts rarely refer to scrubs; Flinders (1814) is an exception. The most obvious reason for this change is that most of the former canopy species have been preferentially removed for fuel (discussed above), leaving open, exposed soil. *Leptospermum laevigatum* is a rapid, strong coloniser, and is well known to form scrubs, which are stable for many decades in areas where other vegetation has been removed or disturbed (e.g. Burrell 1981, Bennett 1994). All the other candidate canopy species (*Melaleuca lanceolata* subsp. *lanceolata*, *Banksia integrifolia* subsp. *integrifolia*, *Allocasuarina verticillata*) are apparently far less aggressive colonisers.

Fire is also likely to have played a role in changing the landscape, but it is difficult to be precise. Early accounts provide direct evidence that aboriginal people occupied and burnt the area, but how frequently, intensely and extensively burning took place is unknown, although we can presume that fire was at least sometimes used deliberately in response to seasonal cues (Gott 2005). The effects of fire on some relevant coastal woodlands and forests have been studied (e.g. Gent & Morgan 2007, Moxham & Turner 2008*a* in review). For woodlands of *Banksia integrifolia* subsp. *integrifolia* (on the Mornington Peninsula, nearby at Somers), Gent and Morgan (2007) found that the long-term absence of fire may result in a transition to a more open, grassy community. In coastal woodland and forest communities dominated by *Allocasuarina verticillata*, this species is favoured by low intensity fires, (Kirkpatrick 1986) and its predominance may indicate a long-term lack of fire (Withers 1979). In some

other systems, low intensity fires may maintain an open woodland structure, with a canopy of species intolerant of intense fires (Chesterfield 1986, Lunt 1998). Given the Nepean Peninsula was burnt to some degree, we suggest that the presence of extensive *Allocasuarina* woodlands suggest that the fires were of low intensity. This view is consistent with the presence of some fire-sensitive elements in the flora (See Table 1; including species such as *Beyeria lechenaultii*). This is supported by Benson and Redpath (1997), who examined the available historical and current literature and rejected the notion that in south-eastern Australia aboriginal people regularly burnt the landscape more than every few years. Fire was perhaps used more extensively by the early pastoralists both to clear land and promote green pick (Gill 1981). Massive burning-off following land-clearing and soil disturbance may have contributed to *Leptospermum laevigatum* proliferation, as suggested by others (Head 1988, Mooney *et al*. 2001).

More subtle changes in disturbance regimes probably also played a role; biomass removal and soil disturbance not only occur with fire but herbivore grazing as well. Native ground-dwelling mammals and emus were once plentiful on the Nepean Peninsula (likely including Eastern Grey Kangaroo, Long-nosed Bandicoot, Black Wallaby, Short-beaked Echidna, White-footed Dunnart (McBride 1898, Menkhorst 1995). Their activities would inevitably have disturbed the soil and influenced seedling and shrub survival.

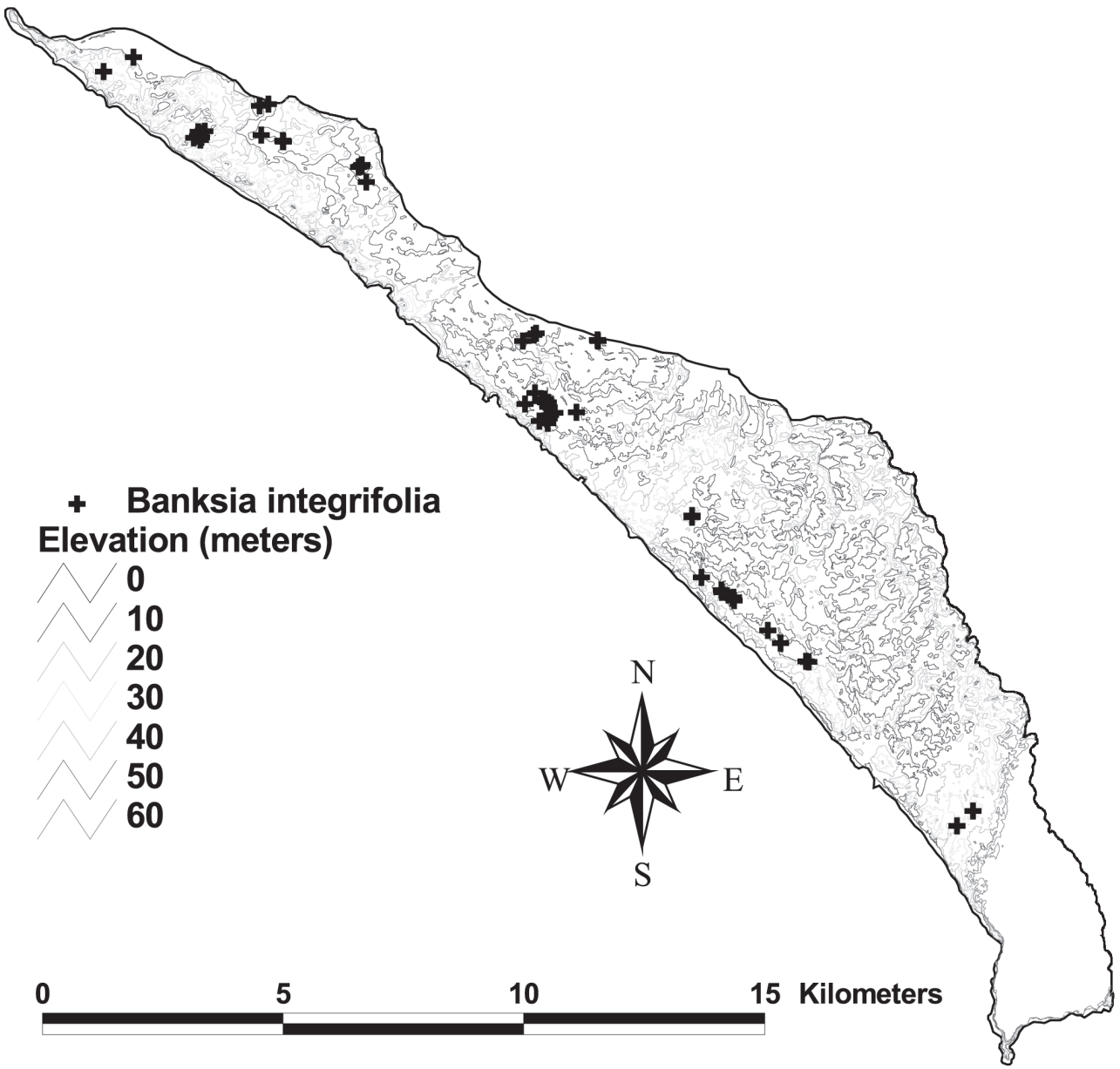


**Fig. 5.** Known locations of *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia) in the study area on the Nepean Peninsula, showing elevation (metres).

**Fig. 6.** Calcareous swale community showing *Banksia integrifolia* subsp. *integrifolia* (Coast Banksia, on the left), and *Poa labillardierei* (Common Tussock-grass) (Calcareous Swale Grassland EVC 309).

Native herbivores have long been rare in the area and have been replaced by rabbits (Menkhorst 1995). We cannot determine the precise effects of the changing mammal fauna on vegetation composition, but it is probably significant.

*Where does Banksia integrifolia subsp. integrifolia belong?*

Most of the low flats on the Nepean Peninsula are now cleared (Figures 3 and 5) but we believe that a grassy woodland or forest of *Banksia integrifolia* subsp. *integrifolia* was once extensive in these areas, and may partly explain the emphasis in early descriptions of grassy 'meadow lands'. Although *Banksia integrifolia* is often cultivated, relict populations on the Nepean Peninsula can be distinguished with a fair degree of confidence (i.e. occurring in mature stands across properties or in reserves, or accompanying un-cultivated species such as *Pteridium esculentum* (Austral Bracken)). On the Nepean Peninsula naturally-occurring *Banksia integrifolia* trees occur almost exclusively in dune swales and flats, in low elevation areas (below 10 m a.s.l.) (Figure 5). These sites often have 'terra rossa' soils, and are less well-drained than the surrounding dunes.

We located several areas where *Banksia integrifolia* subsp. *integrifolia* still remained with native understorey species. These areas are quite distinct from the other relict vegetation. They support few shrubs and a dense sward of grasses, including species, which hardly occur outside these low-lying areas, such as *Poa labillardierei*, *Themeda triandra* (Kangaroo Grass), *Imperata cylindrica* (Blady Grass) and *Hemarthria uncinata* (Mat Grass) (all included in 'swales' column, Table 1; quadrat data stored in the Flora Information System, VFSD 2007). Other species that are apparently more abundant in these situations include *Convolvulus erubescens* (Pink Bindweed), *Pteridium esculentum* and *Acacia mearnsii*. In some cases, *Banksia integrifolia* is sparse or absent, leaving grassy flats and hollows (Figure 6). We have tentatively labelled these areas Calcareous Swale Grassland (EVC 309) (see above), a name which has formerly been applied to grassy and shrubby flats on Wilsons Promontory, but which is very poorly delineated (Commonwealth & Victorian RFA Steering Committee 1999). On the Nepean Peninsula, the predominance of grasses at the expense of woody species may be due to periodic impeded drainage. Robert Brown (in Willis 1955) corroborates this idea, in describing the soils in the 'hollows' as "*deeper richer and black, in some places approaching to Bog*", although other plausible explanations cannot be discounted (e.g. cold air drainage may also play a role, in an environment which is so deeply and broadly divided by hollows) and it is not certain that Brown's 'hollows' refer to the *Banksia*-dominated flats we describe.

*What was the place of Melaleuca lanceolata subsp. lanceolata?*

Today, much of the most diverse, weed-free and apparently oldest vegetation (e.g. Point Nepean restricted area, Tyrone Bushland Reserve, stands in 'The Course' and 'The National' golf clubs) are dominated by a relatively dense canopy of large *Melaleuca lanceolata* subsp. *lanceolata* trees, with *Acacia uncifolia*, *Leptospermum laevigatum* and *Leucopogon parviflorus*. This vegetation corresponds to the FFG listed community Coastal Moonah Woodland (DSE 2002). Given the emphasis placed on open sheoak woodlands and forests in the early accounts, it is worth questioning the place of this community.

Some of the best quality stands of Coastal Moonah Woodland in Victoria are between Portland and Nelson in south western Victoria. Some of these are relatively undisturbed, particularly those which occur on islands or 'headlands' hidden among the extensive wetlands (Figure 4). Here, *Melaleuca lanceolata* subsp. *lanceolata* trees strongly dominate the canopy. Beneath them, the vegetation is sheltered, and many shade loving plants thrive among a sparse cover of grasses, including an abundance of moss (*Thuidiopsis* sp. is prominent) and many small herbs (e.g. *Dichondra repens* Kidney-weed, *Hydrocotyle laxiflora* Stinking Pennywort). The shrub layer is thin. In places, scrambling semi-succulent shrubs form great drifts, particularly in areas which seem to have been recently disturbed (e.g. *Rhagodia candolleana* subsp. *candolleana* Seaberry Saltbush, *Tetragonia implexicoma* Bower Spinach). In a few places in the Long Swamp, *Melaleuca lanceolata* subsp. *lanceolata* stands have clearly enveloped and suppressed the growth of other vegetation. For example, in Nelson, *Eucalyptus leucoxylon* subsp. *megalocarpa* (Large-fruited Yellow Gum) individuals have failed to survive among stands of relatively young *Melaleuca lanceolata* subsp. *lanceolata*. Such evidence suggests a dynamic system, where *Melaleuca lanceolata* subsp. *lanceolata* is able to out-compete more open-canopied species, forming tall shrublands and forests. The resulting vegetation is presumably fire-resistant and impermeable to sun-loving species. Whether this *Melaleuca lanceolata* subsp. *lanceolata* vegetation is a 'climax' in the Clementsian sense (Clements 1916) is debatable. Transition from a dense stand (e.g. tall shrubland or forest) of *Melaleuca lanceolata* subsp. *lanceolata* to a more open formation (e.g. open forest or woodland) may perhaps occur because of disturbances such as grazing and fire regimes (*Melaleuca lanceolata* subsp. *lanceolata* is relatively fire sensitive, although it will germinate after fire), or following senescence, gap formation and associated successional processes

While *Melaleuca lanceolata* subsp. *lanceolata* is capable of forming closed stands elsewhere in southwestern Victoria, the historical records indicate that it did not achieve this across much of the Nepean Peninsula. Instead, an open woodland of sheoak is described. We will never know precisely to what extent the Nepean Peninsula was covered by *Melaleuca lanceolata* forests and woodlands or open grassy woodlands and forests of *Allocasuarina verticillata*, *Banksia integrifolia* and other species. Open grassy woodlands and forests were commonly highlighted in early reports, as they needed little clearing before stock could be introduced and their frequent mention may be due to this bias, as much as by any significant dominance in the landscape.

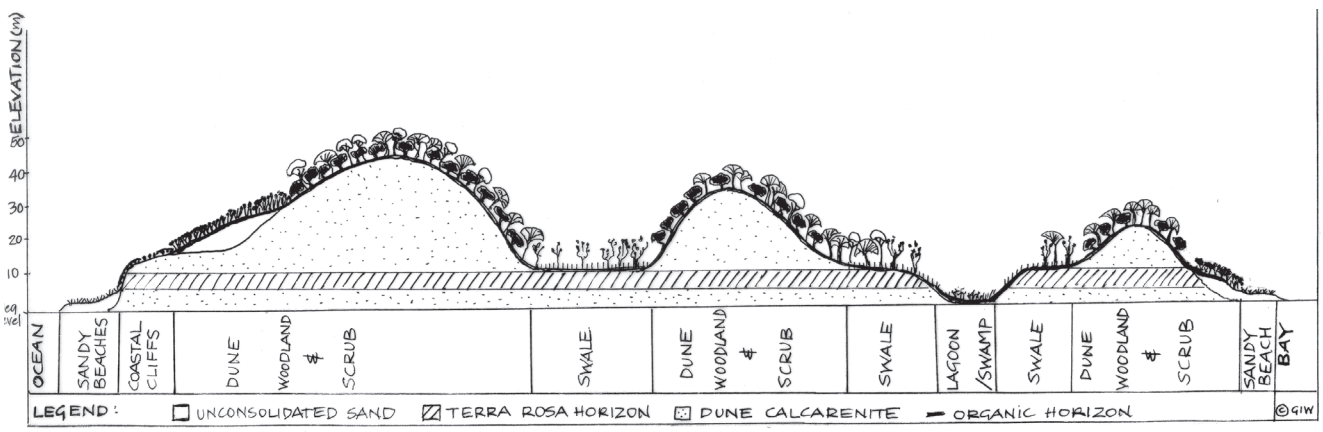


**Fig. 7.** Profile diagram of the calcareous dune system on the Nepean Peninsula displaying the different vegetation groups in relation to landform (sand beaches, coastal cliffs, dune woodland and scrub, swales, lagoons and swamps) and variation in soil properties (unconsolidated sand, terra rossa horizon, dune calcarenite, organic horizon). Where sandy beaches are the strandline, grasslands dominated by *Spinifex sericeus* and shrublands of *Atriplex cinerea* grade to the hinterland dune woodlands and scrub composed of *Allocasuarina verticillata*, *Melaleuca lanceolata* subsp. *lanceolata*, *Acacia uncifolia*, *Bursaria spinosa*, *Exocarpos cupressiformis*, *Leucopogon parviflorus* and maybe *Leptospermum laevigatum* in the canopy. Interspersed in the low-lying sections of the hind-dune system are grassy dune swales covered with a rich growth of tussock grasses and woodland with Banksia, and lagoon/ swamps composed of various forms of wetlands and 'bogs'. On the ocean side are coastal cliffs and headland shrublands intermixed with small areas of tussock grasslands.

Nonetheless, there is no reason to doubt that both types of vegetation could co-exist. In south-western Victoria, we noted a patchwork of woodlands and forests formed by *Melaleuca lanceolata* subsp. *lanceolata*, *Eucalyptus leucoxylon*, *Eucalyptus viminalis*, *Bursaria spinosa*, *Banksia marginata* (Silver Banksia) and *Allocasuarina verticillata*. Some are dense, some are open. The explanation for their distribution seems sometimes to be related to land management, in other cases to topography and exposure to coastal influences and is sometimes obscure. This co-existence is also evident on the Nepean Peninsula where stands of *Melaleuca lanceolata* subsp. *lanceolata* with the occasional individual of *Allocasuarina verticillata, Bursaria spinosa* and *Banksia integrifolia* in the canopy can be found.

Because so few pre-European *Allocasuarina verticillata* individuals remain on the peninsula today it is difficult to establish the pre-European distribution and abundance of this species. To understand these patterns further, we need to know more about the disturbance regimes regulating community dynamics including the impacts of grazing and the fire responses of *Allocasuarina verticillata* and *Melaleuca lanceolata*.

*A question of Eucalypts*

It has never been settled whether any eucalypt species occurred naturally on the Nepean Peninsula. This is astonishing, particularly for an area that retains 34% cover of native vegetation, in south-eastern Australia where *Eucalyptus* are almost ubiquitous. Calder could find no evidence of natural eucalypts in the area during the 1960s and 1970s (Calder 1972, 1974, 1975). If they did not occur naturally, then the Nepean Peninsula is a marked exception to almost all other nearby regions in Victoria, where Eucalypts are present to some degree, and frequently dominate the overstorey.

On the survey plan of Smythes (1841), however, the area between Gunnamatta and Cape Schanck is described as "*Lime stone hills timbered with she-oak and gum trees*". The area around Cape Schanck Road is again shown in a later map (Anonymous and undated, but showing early subdivisions) as "*light sandy soil and good pasturage timbered with shea-oak* [sic] *intermixed with lightwood, gum, cherry and wattle*". We view these accounts as strong evidence that Eucalypts did occur on the Nepean Peninsula, at least at the western end, where the calcareous dunes begin to diminish, not far from the adjacent basaltic soils.

There are a number of candidate species, the most likely of which is *Eucalyptus viminalis*, which grows on sand dunes immediately adjacent to the Nepean Peninsula. There is a single *Eucalyptus viminalis* of considerable age, at Police Point, near the Quarantine Station; we suspect that this is an original specimen; perhaps the only relict Eucalypt remaining in the study area. Genotypes of *Eucalyptus viminalis* occur on calcareous dunes near the coast in western Victoria (for example near Tyrendarra) and at Wilsons Promontory.

*Eucalyptus ovata* (Swamp Gum) occurs among the calcareous dunes, in low-lying areas on the Isthmus at Wilsons Promontory, such as 'Gum Flat' on the road to Tidal River. This species occurs immediately adjacent to our study area and we suggest it is quite likely to have once occurred within it.

*Eucalyptus leucoxylon* subsp. *megalocarpa* occurs on calcareous dunes, in far south-western Victoria, near the coast, along the margin of Long Swamp. The closely related *Eucalyptus leucoxylon* subsp. *bellarinensis* (Bellarine Yellow Gum) occurs on the Bellarine Peninsula, sometimes among *Melaleuca lanceolata* subsp. *lanceolata*. The Nepean Peninsula was once connected (during the Pleistocene) with the Bellarine via the Nepean Bay Bar (Bird 1975) and it is conceivable that the *Eucalyptus leucoxylon* subsp. *bellarinensis* once occurred within our study area.

Several other Eucalypt species (*Eucalyptus radiata*, *Eucalyptus pauciflora*, *Eucalyptus cephalocarpa*) occur adjacent to the calcareous dunes in Rosebud and at Cape Schanck; it is possible that these species may have occurred sporadically on the Nepean Peninsula

## Conclusion: A description of the pre-European vegetation

A picture of the vegetation of the Nepean Peninsula as it was in the early 19th Century, when the area was the site of Victoria's first colonial settlement is shown diagrammatically in Figure 7. The following description is necessarily speculative, but based on the evidence discussed above and includes references to the current Victorian EVC typology where relevant.

*The southern ocean coast*.

Along this coastline, eroding limestone cliffs and high calcareous sand dunes bordered the ocean. Some of these dunes were probably active and bare, and are described as "*sand hummocks*" and "*broken plateau of sand*" (see Figure 2). In other places, as described by Robert Brown in 1802, the dunes were vegetated with low shrubs, including *Correa alba*, *Leucophyta brownii*, stunted plants of *Leucopogon parviflorus, Leptospermum laevigatum* and *Melaleuca lanceolata* subsp. *lanceolata*. This description aligns with the EVCs Coastal Headland Scrub (EVC 161) and Spray-zone Coastal Shrubland (EVC 876). Judging by the current vegetation, these coastal areas included small areas of *Austrostipa stipoides* aligning with Coastal Tussock Grassland (EVC 163). On the low strands of sand on the ocean beaches, a band of low, grey *Spinifex sericeus* grassland would have occurred, as it does today (Coastal Dune Grassland EVC 879). On the more sheltered hind dunes, a slightly taller scrub grew, probably composed of less-stunted plants of *Leucopogon parviflorus, Leptospermum laevigatum* and *Melaleuca lanceolata* subsp. *lanceolata* with an understorey of grasses, herbs and creepers such as *Clematis microphylla* (Small-leaved Clematis) (Coastal Dune Scrub EVC 160).

*The Port Phillip Bay Coast*

The coastline within Port Phillip Bay differs greatly from the southern ocean coast as it is sheltered, and its dunes and cliffs are lower and more subdued. On the beach, the sandy strand was covered with patches of *Spinifex sericeus* (Coastal Dune Grassland EVC 879), sometimes with shrublands of *Atriplex cinerea* (Berm Grassy Shrubland EVC 311). Behind the beach grew a narrow band of tall woodlands of *Banksia integrifolia* subsp. *integrifolia*, and probably *Leptospermum laevigatum* (Coast Banksia Woodland EVC 2) (Cox 1931, Hollinshead 1982). These still occur, largely on recent sand deposits (unconsolidated calcareous or often siliceous sands), and extend far beyond the study area towards Melbourne. These woodlands had an undergrowth of grasses, sprawling creepers (e.g. *Rhagodia candolleana* subsp. *candolleana*, *Tetragonia implexicoma*), patches of *Pteridium esculentum*, clumps of *Lepidosperma gladiatum* (Coast Sword-sedge) and many herbs. Immediately behind them was the vegetation of the hinterland dunes, and many grassy flats.

*The flats and hollows*

Between the dunes, plains and small depressions occurred, sometimes on 'terra rossa' soils. These were covered with a rich growth of tussock grasses, and wooded with *Banksia integrifolia* subsp. *integrifolia* and possibly *Acacia melanoxylon* (Blackwood) and *Acacia mearnsii*. In places, these areas would have been mottled with the dense reddish growth of *Imperata cylindrica* and *Themedia triandra*, patches of *Pteridium esculentum*, bright green tussocks of *Lomandra longifolia* (Spiny-headed Mat-rush) and in springtime coloured with numerous small wildflowers.

*The wetlands and 'bogs'*

A few low-lying areas were covered by wetlands. These may have had various forms, but there is contemporary evidence of stands of *Phragmites australis* (Common Reed) (Tall Marsh EVC 821). Near Portsea, a few salty lagoons occur, fringed with dense stands of *Gahnia ?trifida* (Saw-sedge) and salt-tolerant herbs such as *Mimulus repens* (Creeping Monkey-flower) and *Selliera radicans* (Shiny Swamp-mat) (possibly once Gahnia Sedgeland EVC 968 or Brackish Sedgeland EVC 13). In the brackish water, *Potamogeton pectinatus* (Fennel Pondweed) probably occurred. At their westward edge, the calcareous dunes of the Nepean Peninsula ended abruptly in one great wetland: The Tootgarook Swamp. This swamp remains impressive, with scrubs of *Leptospermum lanigerum* and areas of sedgeland, reeds and open water.

*The hinterland dunes*

The rolling calcareous dunes were covered with woodlands and forests of *Allocasuarina verticillata*, *Melaleuca lanceolata* subsp. *lanceolata*, *Acacia uncifolia*, *Bursaria spinosa*, *Exocarpos cupressiformis*, *Leucopogon parviflorus* and maybe *Leptospermum laevigatum* (Coastal Alkaline Scrub EVC 858). These trees grew above a grassy understorey rich in small shrubs and herbs (including *Pimelea serpyllifolia* subsp. *serpyllifolia* (Thyme Rice-flower), *Astrostipa flavescens*, *Swainsona lessertifolia* (Coast Swainson-pea), *Scaevola albida* (Coast Scaevola) and *Hibbertia sericea* (Silky Guinea-flower)). In some places (perhaps largely towards the eastern end of the Nepean Peninsula, according to some survey plans; Figure 2) Eucalypts took a place in these woodlands. The exact structure of these woodlands/forests and the distribution of the tree species remain difficult to determine. They probably ranged form dense, shady forests of *Melaleuca lanceolata* subsp. *lanceolata*, through to open grassy woodlands of *Allocasuarina verticillata*. Perhaps the *Melaleuca lanceolata* subsp. *lanceolata* stands were in sheltered sites, the *Allocasuarina verticillata* on the exposed slopes and crests. On the steepest, most exposed and well-drained slopes, the structure may have been a tall shrubland.

Today the urgent task for land managers and planners is to secure the remaining vegetation from clearing and weeds, but there remains an important management question: What type of vegetation are we managing? Almost all of the remaining patches of vegetation on the Nepean Peninsula today are derived from the hinterland woodlands and forests and although often altered very far from their pre-colonial structure, they retain considerable value as habitat for a large range of native species. Different management actions will significantly determine the resultant appearance of the vegetation and these considerations are determined by practicality and human preference, as well as by a desire to acknowledge historic patterns. The recently expanded Point Nepean National Park is already being managed with these ideas in mind (Moxham *et al*. 2008*a* in review, Moxham & Turner 2008*b* in review) and we hope that some small portion of this lost landscape will become visible again at this historic site.

## Acknowledgements

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