Point Nepean
Flora and Fauna Survey

December 2005 to January 2007

Final Report
January 2008

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ABBREVIATIONS

CALP	Catchment and Land Protection (Act 1994)
CAMBA	China – Australia Migratory Bird Agreement
DEWR	Department of Environment and Water Resources
DSE	Department of Sustainability and Environment
EPBC	Environment Protection and Biodiversity Conservation (Act 1999)
EVC	Ecological Vegetation Class
FFG	Flora and Fauna Guarantee (Act 1988)
FIS	Flora Information System
JAMBA	Japan – Australia Migratory Bird Agreement
PNCT	Point Nepean Community Trust
VFD	Victorian Fauna Database
UXO	Unexploded Ordinance

EXECUTIVE SUMMARY

Point Nepean National Park was proclaimed in August 2005 following the transfer of 205 hectares of Commonwealth Defence Force lands to the State of Victoria. Further lands including the Quarantine Station precinct will be incorporated into the National Park in the near future. The transition from Commonwealth to State ownership and management initiated remediation works for unexploded ordinance (UXO) that remained in the dense vegetation that was the former firing range. Although highly modified the UXO contaminated areas were known to support flora and fauna values of State significance and potentially of national significance.

The complexities of UXO remediation and the conservation of significant flora and fauna lead to the development of an integrated approach that aimed to provide practical outcomes to the clearing of UXO and ecological restoration. Although this management approach is currently being implemented it has been informed by the results of this project. This flora and fauna study of Point Nepean was initiated in response to UXO remediation proposals, to adequately document a variety of biological values before works began, and to inform the management plan development process.

Aims and Objectives of the Project

The aims of this project were to identify flora and fauna values throughout the study area and provide Parks Victoria with ecological guidance on reaching a variety of management objectives. To meet this aim and in accordance with the project brief the study team conducted a staged process of background research, fieldwork and literature review.

In addition to providing a flora and fauna inventory of the study area it was also important to establish habitat preferences for significant species. This was particularly the case with a number of species of fauna.

While the main focus of much of the survey work was within the former Defence Force lands it was also an objective to consider the Point Nepean conservation estate in its entirety. This approach, allowed flora and fauna sampling to occur across the study areas land system, including old, new and proposed future sections of the National Park for the first time.

In addition to fieldwork, an extensive review of previous studies and other relevant literature was reviewed with the aim of informing discussion and recommendations on the long term management, ecological restoration and the potential impacts of burning operations associated with UXO remediation.

Methods and Results

Flora and Vegetation

Flora surveys began in June and continued through to November 2006. Flora survey methods included collecting data from over 60 quadrats, targeted searches for significant species and incidental records made while undertaking vegetation assessments. A total of 280 vascular plants were recorded during this survey of which 165 (59%) are native and 115 (41%) are introduced. Prior to this study there were only 82 species (including both indigenous and exotic) formerly recorded for the study area according to State Government databases. This is an increase of 241% on the number of vascular plants recorded for the study area. Similarly, prior to this study there were three Ecological Vegetation Classes (EVCs) mapped for the study area. This study has identified eight distinct EVC units with an additional two mosaics.

The most significant species of flora recorded during this survey was the nationally threatened Leafy Greenhood *Pterostylis cucullata.* This species occurrence within the study area is heightened by the fact that it is the only known location of a striking yellow colour variation. In addition, there is potentially another 14 species of State significance ranging in status from vulnerable to poorly known within Victoria. However, two species within this list remain unconfirmed and further work is required to clarify their taxonomy. One of these bears resemblance to the Late Helmet-orchid *Corybas* sp. aff. *diemenicus* (coastal) which is endangered within Victoria. There were an additional 65 species considered to be of regional significance. This included the Winged Spyridium *Spyridium vexilliferum* which was recorded for the first time within the Gippsland Plains bioregion and represents the most easterly occurrence known for this species.

Vegetation quality was assessed throughout the study area using 30 sampling locations combined with further field observations. The large majority of the study area is considered to be of moderate to high vegetation quality despite a suite of introduced species found in most areas.

The primary short to medium-term threat to significant flora and vegetation communities is that posed by introduced species. A prioritised list of 23 weeds has been identified as the species most likely to alter the structure and function of habitats and communities.

Fauna

A total of 39 individual fauna survey sites were established throughout the study area. A range of survey techniques including cage, Elliot and pitfall trapping, hair tubing, bird counts and active searches were employed over a one year period (February 2006 – March 2007).

Surveys revealed the presence of 121 vertebrate species (85 birds, 23 mammals, 12 reptiles and one amphibian). While a number of species recorded were vagrants to the

site, surveys revealed the presence of at least 15 resident State significant species (14 birds and 1 mammal) and 20 resident species of regional significance (4 reptiles, 3 mammals and 13 birds). A number of introduced species were also observed, of which the Black Rat, House Mouse, Red Fox, Feral Cat and Common Blackbird were the most common.

A number of species including the Long-nosed Bandicoot, White-footed Dunnart and Spotted Quail-thrush are particularly rare on the Nepean Peninsula and in some cases in the broader Gippsland Plains bioregion, and are highly significant in a regional context. Despite finding a number of significant species within the study area, there are questions regarding the capacity of the site, in its current condition, to maintain these populations. When compared with previous studies, there is direct evidence that the populations of some native species have declined substantially in recent times within the study area (e.g. White-footed Dunnart).

In addition to identifying the presence and absence of terrestrial vertebrate fauna, surveys investigated the faunal composition and conservation value of different habitat types, based on structural and floristic attributes within the study area. Results validated the *apriori* definition of habitat types with differences in overall species richness and avifaunal composition between the major habitat types evident. Grassy Woodland habitats had a significantly higher richness of vertebrate species than all other habitat types at the site, and were compositionally distinct providing habitat for more ground-dwelling birds, terrestrial mammals and reptile species than other habitat types. The richness of species of conservation significance was also highest in Grassy Woodlands. There was a clear distinction in the composition of avifaunal communities of Coastal Heath and Coastal Headland Scrub compared to woodland complexes. Few vertebrate species were found in habitats dominated by Coastal Tea-tree and the invasive weed Myrtle-leaf Milkwort.

Habitat preferences of significant fauna were revealed with terrestrial mammals, reptiles and ground-foraging and ground-dwelling birds showing a preference for Grassy Woodland habitats and to a lesser, albeit significant extent Coastal Heath communities. Moonah Woodlands were also used by significant fauna, although only when they were mature with relatively an open canopy and grassy understorey.

Coastal habitats at Point Nepean were also found to constitute particularly significant faunal habitat, providing important foraging, roosting and breeding habitat for a number of resident shorebirds (e.g. Hooded Plover and Sooty Oystercatcher) and coastal birds (e.g. Cormorants, Gulls and Terns). Although not investigated in this study, it is also known from other research that coastal and marine habitats are also support some of the more highly diverse inter and sub-tidal macroalgal and macroinvertebrate marine communities in the region.

A number of threats are apparent at the site, the most serious of which include predation by feral species, habitat degradation, inappropriate disturbance regimes (including fire), weed invasion and disturbance to breeding sites by humans. The site history of multiple intensive uses and subsequent degradation of habitat values presents significant challenges for the conservation of flora and fauna within the study area. This research has

however provided baseline information which can inform sustainable future management of the site.

Conclusions and Recommendations

Flora and fauna values of national, State and regional significance have been identified throughout Point Nepean National Park and Quarantine Station area. Despite significant disturbance and modification, military training and the prevalence of pest plants and animals, there remains important populations of a number of species and extensive areas of intact native vegetation. However, the viability of some populations remains in doubt and their future within the study area remains uncertain.

Consolidation of land units into consistent management under the National Parks Act will enable more strategic management across the study area. The study area is unique in that the eastern boundary is the only terrestrial edge while the remaining boundaries are marine. Sampling of the former Range Area and the former Quarantine Station precinct together with the areas that were already under National Park management has provided the most comprehensive biological assessment of Point Nepean to date.

There still remains some ambiguities surrounding the structure and composition of pre-European vegetation and the plant and animal communities it originally supported. However, it is generally a consensus view that Coast Tea-tree is more abundant now than in pre-European times. The level of disturbance experienced across the study area over the last 180 years has undoubtedly had a major influence on the composition and quality of native vegetation and the faunal assemblages present today. What remains unclear are the successional pathways currently operating within the vegetated landscape and the ecological processes that facilitate compositional change in disturbed vegetation.

Restoration objectives for the study area are not only centred around pest plant and animal control but also include manipulation of the existing condition of native vegetation. Fauna of State and high regional significance were found to be associated with open grassy habitats of either grassland or woodland structure. Although further research is necessary, it seems that the natural succession of long unburnt coastal scrubs is towards a community with closer affinities with woodland. However, the combined management objectives of UXO remediation and habitat restoration present an immediate opportunity to address perceived habitat deficiencies for certain fauna.

While the successional dynamics of the most abundant EVC, Coastal Alkaline Scrub, are slowly becoming understood through ongoing research, it is recommended here to actively improve the habitat grassy ecosystem dependent species in targeted areas such as Harrisons Bowl. In addition, it is also recommended that access remains restricted in key areas to protect the habitat significant species and minimise the risk of human disturbance. This is particularly important for a number of birds. Other recommendations have been made to the general maintenance of flora and fauna values addressing specific and potential threats. There is also a demonstrable need for ongoing research at both the species and community levels.

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1. INTRODUCTION

This report provides detailed results of flora and fauna surveys undertaken at Point Nepean throughout 2006 and early 2007. In addition, further research on the management, ecological restoration and the ecology of selected significant species is presented in this report.

After the following introductory sections, the study area is discussed with information on the climate, geology and an overview of land use history. The latter, land use history, provides a comprehensive summary of what is known about Aboriginal to present uses of the study area including early grazing, lime burning and the establishment of the Quarantine Station and military uses to the present nature and heritage conservation regimes.

Following discussion on the study area an overview of existing management is provided. This section discusses the current application of fire, UXO remediation, active habitat maintenance for fauna such as the Hooded Plover, pest plant and animal control and public access.

As there is a considerable amount of literature on the study area, and flora and fauna values occurring within the National Park, the sections on vegetation, flora and fauna contain existing information and the results from this survey. Each section has its own literature review, methods, results and discussion. Detailed consideration is given to vegetation including type, condition and prospects for restoration. In addition, discussion on all State and nationally significant flora and fauna including their ecology and their management in the context of the study area is also provided.

This is followed by a review of relevant policy and legislation that require consideration when planning works and developing management objectives.

A discussion on the complexities of vegetation management and habitat restoration has been provided to address the complexities of Coast Tea-tree and its ecological implications. While research is still ongoing into the successional behaviour of the predominant vegetation type; Coastal Alkaline Scrub important management decisions need to be made. This section remains separate from both the flora and fauna components as it attempts to address management issues.

Recommendations concerning many facets of the flora and fauna attributes of the study area conclude the report.

1.1 Project Background

Practical Ecology Pty Ltd together with Mal's Environmental and Ecological Services and Claire Moxham from the Arthur Rylah Institute (an environmental research unit from the

Department of Sustainability and Environment) were commissioned by Parks Victoria in partnership with the Point Nepean Community Trust (PNCT) to provide a detailed flora and fauna assessment of the proposed Point Nepean National Park. Practical Ecology received written confirmation from Parks Victoria to proceed with this contract on 18 November 2005 and fieldwork commenced in January 2006.

This project has been made possible through the agreed transfer of Commonwealth Defence Lands currently abutting the existing Point Nepean National Park at Portsea on the Mornington Peninsula.

While flora and fauna surveys are a key component of this project, Parks Victoria also required detailed discussion on the management of native vegetation and the habitat of significant species. This component of the project is vital for the successful transition of land formerly used for Defence Force training for management under the *National Parks Act 1975*.

1.1.1 Aims and Objectives

The project brief prepared by Parks Victoria and contained within the tender documents is as follows:

- *To identify the presence or absence of threatened and significant species and communities and their actual and potential habitats.*
- *To increase Parks Victoria's knowledge of habitat requirements for National, State and Regionally significant species.*
- *To assist Parks Victoria with further development of long-term ecological management objectives.*
- *To identify key threats to threatened and significant species and communities, assess their impact and significance, and provide recommendations for mitigating or eliminating such threats.*
- *To assess the impact of proposed ecological burning operations on, National State and Regionally significant species and communities, using Wilsons Folly's recent burning operations as a reference.*
- *To identify and map sites of significance:*
    - *Habitat sites for National, State and selected regionally significant species.*
    - *Mature Moonah remnants.*
    - *Highest value vegetation sites.*

- *Identify and map existing vegetation communities, and provide discussion on the present and desired condition of these communities.*

1.1.2 Project Personnel

The team established for this project is comprised of several individuals with many years of experience with the ecology and species associated with Point Nepean. This approach exploits the substantial volume of combined local knowledge, familiarity and understanding of the ecological nature of the study area.

Personnel engaged in assessing vegetation and flora surveys for this project include Gidja Walker, Imelda Douglas, Andrew Picone (Practical Ecology) and Claire Moxham (ARI/DSE). In addition Claire Moxham provided strategic advice on fieldwork, sampling techniques and interpretation of plant communities and associations.

The fauna survey team was coordinated by Malcolm Legg, Glenn Ehmke and Paul Bertuch (Mal's Environmental and Ecological Services). Hans Bruner performed hair and scat analysis.

2. STUDY AREA

The study area, part of the land system often referred to as the Nepean Peninsula, represents the most westerly extent of the Mornington Peninsula. It is also the most westerly extent of the Gippsland Plains Bioregion. The Boonwurrung, part of the Kulin nation, are the traditional owners of Point Nepean. It is believed that Boon-Tal-Ang was the aboriginal name for Point Nepean (Parks Victorian and PNCT 2006). However, this may have been Woithurung's, who occupied lands on the western side of Port Phillip Bay, name for Point Nepean, as there are apparently references to the Boonwurrung referring to Point Nepean as Mon Mon (Aboriginal Language Unit).

The study area is comprised of several units of land totalling 560 hectares. This includes the entire 205ha of the former Commonwealth Defence Range Area, the 90ha Quarantine Station Precinct and the existing Point Nepean National Park (265ha). The Quarantine Precinct is scheduled to be transferred from the Commonwealth to the State for inclusion in the National Park by June 2009.

The high tide mark to the north, west and south represents the limit of the National Park boundary and the study area. To the east the study area is bound by Mornington Peninsula Shire's Police Point Reserve, the Portsea Golf Club and the title boundary between London Bridge Road and the Wilsons Folly area within the existing National Park.

The study area's geographic context is illustrated in Map 1. Map 1 also provides an overview of the study area's management zones, main tracks or roads and locality names.

2.1 Climate

The study area experiences a maritime climate of generally hot summers and cool to mild winters. Coastal breezes play a significant influence on local climate. From 1904 to 1978 the Bureau of Meteorology had a weather station at the Portsea Quarantine Station. Information of the climate of the study area has been extracted from this data and current data taken from the Point Lonsdale Lighthouse approximately 4km away (Bureau of Meteorology 2006).

The hottest temperature on record is from the Point Lonsdale Lighthouse at 44.5 (deg c). The highest record from the Portsea Quarantine Station is 40.4 (deg c). Minimum temperatures for Point Lonsdale Light House and the Portsea Quarantine Station are -1.8 (deg C) and 0 respectively.

On average the highest month for rainfall is May for both the Point Lonsdale and the former Portsea Quarantine Station. The average annual rainfall for the Point Lonsdale Lighthouse and the former Portsea Quarantine Station is 661.1mm and 685.4mm respectively (Bureau of Meteorology 2006).

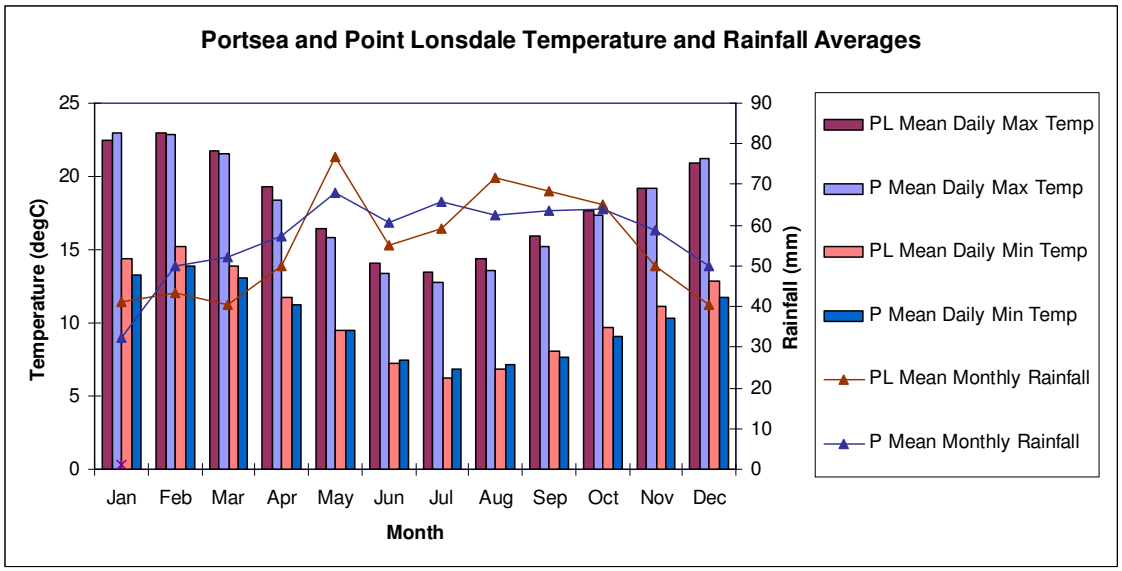


Figure 1. Minimum and maximum rainfall and temperature averages

Mean minimum and maximum temperature and rainfall for site located in or near the study area; Point Lonsdale (PL) and Portsea (P). Data Source: Bureau of Meteorology 2006

Frosts were observed during June and July within the study area while undertaking fieldwork for this project. This was most noticeable in the grassy bowls including Harrisons Bowl. Fog was also common which seemed to occur during summer in the late afternoon.

2.2 Physiography, Soils and Geology

The study area is part of a much larger zone known as the Port Phillip sunklands (Bird 1993, McGregor 1989). This zone is a structural depression bound by fault lines roughly on either side of Port Phillip Bay (Bird 1993).

Point Nepean is derived primarily from calcarenite sandstone dating back to the Pleistocene (Bird 1993, Parr-Smith and Smith 1978). More recent Holocene dunes have formed since the end of the last ice age and the subsequent changes in sea levels (Bird 1993).

According to Bird (1993) the Nepean Peninsula's current dune topography was formed over a process that began around 80,000 years before present. A falling sea level left sand exposed that formed dunes. A rising sea level about 10,000 years ago caused cutting and erosion. Wind, advancing onshore, carried and deposited the dunes where they exist today which covered previous terrestrial habitats (Bird 1993:176).

The study area is comprised of several landform units which include the following:

- Beaches;
- Primary dunes;

- Secondary dunes;
- Tertiary dunes;
- Flats; and
- Cliffs

The beach along Observatory Point is the longest stretch of sandy beach within the study area. It is also unique within Port Phillip Bay as it is comparatively un-altered and little visited. This beach is also unique within the bay as it experiences surf that curls around the Port Phillip Bay Heads. Sand is also being eroded in an easterly direction at a rate faster than it is being replenished resulting in erosion (McGregor 1989). This erosion is recorded on an earlier map from 1854 where it is noted that "heavy surf always breaks on this beach.

Primary dunes, described as frontal dunes by McGregor (1989), supporting short windswept plant communities and heavily influenced by salt spray occur sporadically along the south coast sometimes in association with beach between cliffs. There are several blow-outs where disturbance has occurred as a result of previous military land uses or potentially from natural disturbance or historical Boonwurrung land use.

Tertiary dunes comprise the bulk of the study area and are dominated by scrub and woodland remnants. These areas are described by McGregor (1989) as interdune hummocks. These areas are characterised by a topography that includes moderate to steep slopes, to an altitude of 54 metres, interspersed with bowls and low points to about 10 metres altitude. The steep slopes south of the Observatory Point flats may represent a previous shoreline (McGregor 1989). While the ridgelines behind that are more likely to be Aeolian rather than coastal or tidal.

A relatively low area of interdune flats occurs around Observatory Point. In these areas the soils are generally loose sands with a relatively well developed organic horizon (McGregor 1989).

Cliffs occur to a height of up to 30 metres along the south coast of the Nepean Peninsula. Here, Pleistocene dune calcarenite limestone is exposed and eroded to varying degrees. Short stretches of sandy beach and small calcarenite scree intersperse these cliff environments. Wind erosion and salt spray result in a sparse covering of vegetation. The Coastal Dune Scrub that has developed on the unconsolidated sands between the hardened calcarenite suggests that over the last several thousand years there has been rapid and ongoing changes.

Soil chemical analysis undertaken by Power *et al.* (1985) showed that much of the study area is highly alkaline with a pH range between 8 and 9. However pH testing undertaken during this study, particularly around Police Point showed variation with depth and site.

2.3 Land Use History

The study area is still of significance to the Boonwurrung people who occupied the area prior to European settlement. In addition, evidence of some of the earliest European settlement in Victoria can be found at Point Nepean (Parks Victoria and PNCT 2006).

European settlement of the area began with grazing which was then followed by lime burning. The study area also served as a Quarantine Station and as Defence Force grounds for the Commonwealth Government.

Parts of the study area have played a role in natural and cultural heritage conservation since the late 1980's when Army cadet offices moved to Sydney and released 265 hectares to the State Government allowing the creation of a National Park.

The following section briefly summarises previously published information on land use and management where it is likely to have influenced the current ecological condition of the study area. This, combined with the study area's geological evolution illustrates that there has been no great stretch of time where disturbance has not occurred on the Nepean Peninsula.

The cumulative effects of past land use within the study area is fundamental to understanding its current ecological condition and developing management approaches that are capable of delivering sustainable restoration outcomes and the maintenance of existing levels of biodiversity.

2.3.1 Aboriginal

The study area is within the traditional lands of the Boonwurrung people and is considered to be of high significance (Parks Victoria and PNCT 2006). Point Nepean has some of the highest densities of Aboriginal archaeological sites in Victoria (Australian Archaeological Survey Consultants 2005).

There are currently 60 documented Aboriginal archaeological sites within the study area and the adjacent Police Point Park (Australian Archaeological Survey Consultants 2005). Aboriginal sites within Point Nepean are believed to predate European settlement by approximately 4000 years (Parks Victoria and PNCT 2006). However, according to the draft *Aboriginal Archaeological and Cultural Heritage Project* (Australian Archaeological Survey Consultants 2005) report's review of previous studies there are stone artefact sites that date back approximately 6000 years and midden sites are at least 4000 years old. A majority of known Boonwurrung sites are along the Bass Strait coastline and the most significant areas within Point Nepean National Park are likely to be south of Defence Road but there have also been many recent findings within the Quarantine precinct.

The study area's relatively short geological history combined with its use by the Boonwurrung people suggests that the terrestrial ecosystems evolved with some form of

active management or manipulation. Although difficult to substantiate it is probable that the pre-European plant communities were a diverse association of closed heathland and scrub along the southern coast grading into a more open woodland characterised by varying dominance of Sheoak, Banksia, Moonah and other species characteristic of the calcarenite soils or other environmental conditions. It is believed that the open park-like landscape of particular areas of Point Nepean was maintained, in part, by Boonwurrung burning practices and other cultural activities (O'Neill 1988). The cessation of this management and the subsequent disturbance wrought on the landscape by European settlement has severely altered vegetation dynamics and has contributed to the predominance of closed scrub.

2.3.2 Early European

The study area's suitability for limeburning and grazing was realised by 1830s at which time a number of squatting leases were established (Power *et al.* 1985). The landscape was changed dramatically as settlers targeted resources such as lime and Sheoak for exploitation and modified the landscape with grazing. The acquisition of land for military and quarantine purposes brought new but substantial and ongoing impacts. However, early government use of the study area has been pivotal in the retention of broad-acre vegetated landscapes lost to urban encroachment further east on the Nepean Peninsula.

Limeburning

The earliest recorded European use of limestone on the Mornington Peninsula is from 1803. However, it was not until the 1840s that limeburning became the primary industry on the Mornington Peninsula replacing grazing, cropping and fishing (Harington 2000) and was the first real industry on the Nepean Peninsula (O'Neill 1988). Apart from being easier to extract, the lime from the Nepean Peninsula is alleged to have been of superior quality to material sourced from deep quarries. In preparing the lime large amounts of timber were felled and burned in kilns. In addition there was demand for timber for baker's ovens in Melbourne (O'Neill 1988). Lime for the Nepean Peninsula was also exported to Sydney (Hollinshed 1982).

Drooping Sheoak *Allocasuarina verticillata* was the main species targeted (Calder 1972, O'Neill 1988, Harrington 2000) and Coast Tea-tree was also used in bakers ovens (Calder 1972) This process, over several decades, played a significant early role in converting the historically described open woodlands found by early European surveyors on the Nepean Peninsula into the closed scrub that we see today. Timber became so scarce in the early 1850s that its collection was prohibited from Arthur's Seat to Point Nepean, except that used for limeburning which was Sheoak (Harrington 2000).

The changes in vegetation structure and diversity as a result of lime burning are still evident today. Drooping Sheoak is now sparse and is considered locally significant across the Mornington Peninsula. The changes in dominant species is not fully understood. However,

it is believed that Moonah *Melaleuca lanceolata* and other typical species such as Drooping Sheoak, Coast Banksia and Coast Tea-tree have changed in abundance and is reflective of a combination of disturbance including cutting timber for lime burning. According to O'Neill (1988) settlers at Point Nepean with lime licenses also had licences for timber cutting and grazing.

Grazing

Grazing of cattle, combined with the felling of trees for firewood, is likely to have had a dramatic impact on the native vegetation within the study area. Grazing began around 1836 when the study area became part of a squatting lease (Power *et al.* 1985, Nepean Historical Society 1984). While almost all of the mature Drooping Sheoak were felled to feed the lime kilns any natural recruitment is likely to have been grazed as the species is highly palatable to cattle and other herbivores. In addition palatable understorey species may also have been selectively grazed by cattle.

A cattle quarantine area was also established as part of the Quarantine Station operations. This area was located near Observatory Point and was about two hectares in size (Power *et al.* 1985) although early maps suggest 20ha.

Broad acre grazing is likely to have ceased around the beginning of the 1900's when the Commonwealth took possession of most of Point Nepean (Parr-Smith and Smith 1978).

2.3.3 Quarantine Station

The Quarantine Station has its origins as a 'Sanitary Station' that began operation in 1852 in an area already settled. The Quarantine Station played a significant role in the national context and was one of the most substantial facilities in Australia (Power *et al.* 1985). Originally, the Quarantine Station began with 547 hectares which was gradually reduced to 83 hectares in 1954. In 1978 the Quarantine Station closed and the land was transferred to the Army. An area cleared for grazing quarantined cattle near Observation Point was recolonised by Coast Tea-tree after the cattle were removed according to Parr-Smith and Smith (1978).

The Cemetery

The existing cemetery was built around 1854, after the original became exposed and eroded, and has been maintained since this time. Maintenance of the cemetery has allowed the persistence of native flora that has become scarce or completely lost in other parts of the study area. This is potentially due to regular maintenance since 1954 which has ensured dense woody growth, particularly from introduced species, has not eliminated the more sensitive herbs and grasses. This is discussed in further detail in the relevant results section.

2.3.4 Military Uses

Military use of the study site began in 1878 at the commencement of fortification constructions following gazettal of a large area of Point Nepean in 1877 (McGregor 1989, Power *et al.* 1985). Combined with other fortifications at Queenscliff, Swan Island, South Channel Island and Portsea, Port Phillip Bay was considered, during the 1890s, to be the most heavily fortified port in the southern hemisphere under control of the British Empire (McGregor 1989). Point Nepean has been used by the Army for Officer Cadet training (Parr-Smith and Smith 1978) from 1952 to 1985. And from 1985 to 1998 the School of Army Health occupied the Quarantine site for health officer training.

Fort Nepean

Fort Nepean was one of the largest fortifications of Port Phillip Bay (McGregor 1989). A total of 51 fortification structures or sites are scattered across the western end of the study site. They occur primarily west of The Bend. There are also structures north of Cheviot Beach and south of Defence Road.

The construction of these fortifications resulted in localised vegetation and habitat clearance and disturbance. African Boxthorn was also planted as part of the fortifications during this time. The operation of these fortifications from installation to their decommissioning is likely to have had ongoing local and minor impacts on adjacent vegetation and habitat relative to the entire study area. However, McGregor (1989) described the disturbance as considerable.

Defence Force Training

Following the decommissioning of fortifications, the Army continued to utilise the study area for bivouacs and field training exercises. As use of the Quarantine Station declined in the 1950s the Army utilised more of the facility's buildings from 1954 (Power *et al.* 1985) and eventually took control of the site in 1978.

Defence Force training has had a significant cumulative impact on over 200 hectares of land that has now become part of the Point Nepean National Park. The construction of firebreaks, numerous weapons ranges, bunkers and vehicle tracks combined with officer amenities such as ovals and other facilities resulted in vegetation and habitat clearance (McGregor 1989). The firing of live rounds in a variety of locations has also had a significant impact. Complete destabilisation as a result of continued firing of live rounds has caused the formation of localised blow-outs where no vegetation has re-established.

Continued military operations over the period of their tenure within the study area will have resulted in ongoing disturbance and modification to vegetation and habitat. It's probable that environmental weeds including invasive grasses were introduced by a variety of means, various habitats including grassy bowls were modified or lost and the disturbance to fauna

from noise and the constant moving of people and machinery. Combined, these activities have had a substantial impact on the condition of existing vegetation and habitats.

The impacts of military training are still having a direct impact on flora and fauna. A current process of UXO remediation is being implemented throughout the former range area. The necessary steps involved in meeting UXO remediation criteria require, in this instance the removal of vegetative cover to allow adequate searching using metal detectors. The implementation of this process will impact upon flora and fauna and is discussed throughout this report.

An indirect impact of military training is the occurrence of apparently accidental wildfires that occurred in 1952 and 1976. These fires burnt through parts of the study area including Wilsons Folly (Hughes 2001).

One final point on military use of Point Nepean is that the area had not been used for this purpose the resultant National Park and reserve network could have been much smaller. Urban and recreational development may have encroached much further west along the Nepean Peninsula than is currently the case.

2.3.5 Maritime

Point Nepean has provided navigational aids to shipping channels within Port Phillip Bay with beacons at Observatory Point. The Monash Break creates variation in habitat for both flora and fauna. Some species of grasses, native and introduced, are abundant in some sections and provide habitat for a number of reptiles.

2.3.6 Tourism and Conservation

Tourism began in Point Nepean when, in late 1988, the Commonwealth transferred two areas to the Victorian Government for the purposes of a National Park (McGregor 1989, Parks Victoria and PNCT 2006). While the first transfer of Commonwealth land to the Victorian Government for gazettal under the *National Parks Act 1975* bolstered the protection of a unique landscape for conservation and future generations it brought with it a new set of pressures on the natural environment.

In preparing the first detailed management plan for the study area, McGregor (1989) identified several limitations influencing the planning for visitor access. The small size of the first areas of National Park, the sensitivity of the geology to erosion and, the lack of visitor infrastructure are some key points.

The network of walking, cycling and vehicle tracks detailed in McGregor's Management Plan (1989) were generally adopted in the Mornington Peninsula National Park and Arthurs Seat State Park Management Plan (Parks Victoria 1998).

In a broad overview, public visitation of the Point Nepean National Park has established a regular human presence in a number of areas. The main areas of visitation have included walking trails and access roads from Observatory Point to the western tip of Point Nepean. This is likely to have had some impact on fauna, particularly resident or migratory shorebirds. The beach east of Observatory Point is currently closed as it is recognised as a Hooded Plover nesting site. However, the beach west of Observatory Point is of equal habitat significance.

2.3.7 Summary of Land Use and Impacts on Ecosystems

After several thousand years of Aboriginal land use and management by the Boonwurrung people the study area has undergone the most substantial change in the last 200 years. The impacts on native vegetation and habitat discussed in the above sections have been summarised in the table below.

Table 1. Summary of Land Use Impacts on Ecosystems

Land Use	Summary of Impact
Boonwurrung Land Use and Management	Maintenance of grassy open woodland-like environments on the inland dune system, probably co-dominated by Coast Banksia, Drooping Sheoak depending on the location in the dune system and biotic and abiotic factors.
Grazing	Establishment of introduced grasses. Felling of trees for timber and firewood needs associated with settlement. Browsing and loss of selected palatable species such as Drooping Sheoak and other ground storey. Drooping Sheoak recruitment may have been substantially depleted as a result of grazing prior to the removal of mature trees for burning in lime kilns.
Lime burning	Removal of timber for kilns. Selective targeting of Drooping Sheoak. Removal of mature Drooping Sheoak for kilns combined with the grazing of recruitment has resulted in the local extinction of Sheoak dominated woodland and the substantial depletion of the species from the study area.
Quarantine Station	The gradual increase of infrastructure over its 100 year history resulted in clearing areas for buildings, the establishment of a cattle quarantine area, disturbance to surrounding vegetation and the introduction of horticultural and garden species for lawns and ornamental plantings. The cumulative effects of this process have led to the degradation of native vegetation and habitat within the quarantine precinct and across the flats of Observatory Point.
Military	Disturbance to original vegetation for infrastructure such as roads and fortifications. Training activities including the firing of live ammunition in the range areas. Burning and clearing to maintain open landscape. Physical disturbance with no follow up maintenance. Contamination of study area zones with UXO requiring remediation. Introduction of exotic plants.
Heritage Conservation	Both the Aboriginal and European cultural significance of the study area has assisted in establishing the study area as a high profile site of public interest allowing a greater appreciation of the sites flora and fauna values. Some significant horticultural trees within the quarantine precinct are likely to be used as roosts or nest sites by indigenous birds.
Nature Conservation	The cessation of military activities in certain zones and limited human access has provided the opportunity for a number of regionally, state and nationally significant flora and fauna

Land Use	Summary of Impact
	values within the densely urbanised Port Phillip region to be retained. Many of these values, including breeding populations of many significant fauna, have been lost elsewhere.
Tourism	Increased human visitation to many areas within the study area will have an impact on particular species of fauna and potentially on vegetation.

3. OVERVIEW OF EXISTING MANAGEMENT

The study area has, for many years, been managed for a variety of purposes. This has included:

- Flora and fauna conservation;
- Aboriginal and European cultural heritage conservation;
- Tourism; and
- Military training.

The incremental decommissioning of military land and the subsequent transfer from Commonwealth to State ownership over the last 30 years has required the preparation of several management plans. In response to the first transfer of land the then Department of Conservation, Forests and Lands produced the Point Nepean National Park Management Plan (McGregor 1989). This Management Plan was superseded by the *Mornington Peninsula National park and Arthurs Seat State Park Management Plan* (Parks Victoria 1998) following further land transfer. This will soon be replaced by the *Point Nepean National Park and Point Nepean Quarantine Station Management Plant* being jointly prepared by Parks Victoria and the Point Nepean Community Trust (at the time of writing existing as a draft: Parks Victoria and PNCT 2006).

This section discusses current approaches to management for various purposes and how it relates to flora and fauna.

3.1 Burning

The 1998 Management Plan for the Mornington Peninsula National Park stated:

Develop an ecological burning program for Point Nepean to maintain and expand a mosaic of remnant grassland and woodland areas.

Fire has been used in Wilsons Folly for many years. According to internal notes and memos supplied by Parks Victoria, the aim of burns are to maintain the grassland and reduce the cover of invasive species. Observations made by Parks Victoria rangers over several years of management state that species diversity increases and the above aims are met (at least in the short term).

Further burning, which is being implemented concurrently with UXO remediation, is intended to provide the primary mechanism to achieve some level of restoring more open woodland communities with a grassy understorey that are perceived to have once covered part of the study area.

Burning is also part of the UXO remediation process. The aim of the burn process, according to Parks Victoria, is to assist in the reinstatement of the open grassy vegetation that is described in some early European historical accounts of the surrounding area. Large stands of Moonah are retained in the burn process. Site preparation for the proposed UXO remediation burn requires the flattening or 'crushing' of, predominantly Coast Tea-tree to achieve an even ground fuel load for effective burning. Drooping Sheoak, Wirilda, Coast Banksia and mature stands of Moonah are retained. Retained stands of Moonah are generally cleared of understorey weeds and other species to reduce fuel loads (D. Stephenson pers. comm.). Post fire monitoring will provide some indication of the success of this practice.

The history of disturbance at Point Nepean has created a level of uncertainty in planning for ecological restoration. The approach to the autumn 2007 burn in the former Firing Range accommodates both the needs of UXO remediation and the level of uncertainty about the vegetation's response to fire. The fuel of the proposed burn, effectively all dense areas of Coast Tea-tree within the zone were crushed. Due to UXO within the zone heavy machinery used to prepare the site for burns is limited in its capacity to turn on the site. Once containment lines have been constructed around the burn sites and the flattened vegetation has dried the site is ready for burning.

There is little evidence that any significant fauna utilise dense stands of Coast Tea-tree. However, the grassy bowls such as Harrisons Bowl do support Long-nosed Bandicoots and White-footed Dunnarts. Although these species may temporarily be displaced by fire they are capable of recolonising. This is evidenced by their strong presence in Wilsons Folly which has been burnt repeatedly.

3.2 UXO Remediation

The current management approach to UXO remediation within the study area includes the reduction and removal of vegetation within the most contaminated areas to facilitate the clearance of UXO hazards. Vegetation reduction methods include:

- Crushing and burning (as discussed above);
- Clearing by hand and
- Herbicide.

Clearing by hand is proposed in several zones where UXO contamination is lower. This process involves the use of herbicide and brush cutting on the understorey to enable adequate access for UXO detection and clearance. Herbicide application is primarily for dense Myrtle-leaf Milkwort **Polygala myrtifolia* that is prevalent throughout the study area. This will occur across approximately 7ha of UXO contaminated land.

3.3 Maintenance of Fauna Habitat

The 1989 (McGregor) and 1998 (Parks Victoria) Management Plans provide an outline of the then known values for the study area and management aims. While broad in scope and without any specific detail there are a number of management strategies targeted at specific species. Of particular importance is the ongoing management of Hooded Plover habitat.

Existing Hooded Plover management includes fencing, signage, beach closure during breeding and targeted pest animal control.

3.4 Pest Plant and Animal Control

3.4.1 Pest Plant Control

The 1989 Management Plan (McGregor 1989) outlines several key weed species that occurred at the time and control strategies in place by the then Department of Conservation Forests and Lands.

Currently there are a number of sites within the study area where weed management has been implemented. This includes Wilsons Folly, Happy Valley and sections along the walking trails and other high profile areas. Resources are also directed to the control of Boxthorn **Lycium ferocissimum* throughout the park. Woody weeds, predominantly Myrtle-leaf Milkwort are routinely controlled along the walking trails.

3.4.2 Pest Animal Control

McGregor (1989) identified control methods for the rabbit, foxes, feral cats, introduced rodents, dogs (domestic), introduced honey bees and exotic birds in the 1989 Management Plan. Control of introduced predators has occurred on an ongoing seasonal basis for many years. Fox control has occurred within the study area for approximately 12 years and has consisted of principally of baiting and den fumigation (Parks Victorian PNCT 2006). In 2006 a foot-hold trapping program was initiated throughout the study are. Running concurrently with this study the results of the first year of this program are discussed in the fauna section.

3.5 Public Access

Public access is currently restricted to the existing Point Nepean National Park (excluding Wilsons Folly). Access to these areas is still relatively controlled. The transport service, cycling and walking the length of Defence Road are the only means to traverse the length of the park. There is also vehicle access to Gunners Cottage and walking trails leading from this location.

Public access is proposed for a number of areas that are currently inaccessible for safety reasons and they have only recently ceased their use as military precincts. This includes the former range area (205ha) and the Quarantine Station (90ha). Both of these areas have been off limits to the general public for decades. As part of the hand over of Commonwealth Land to the State of Victoria and its annexation as National Park there are proposals to allow access to several locations (Parks Victoria and PNCT 2006). For the former Range Area this includes:

- *Walking and cycling on defined trails;*
- *Access to spectacular coastal views; and*
- *Provision for guided tours*

For the former Quarantine Station this includes:

- *Recreational links to Police Point;*
- *A new jetty and water based tourism facilities;*
- *Various forms of development within the Quarantine Station precinct;*
- *Improved access to the Quarantine Station for vehicles and cyclists; and*
- *Recreational links with Fort Nepean.*

These items are part of the planning initiatives proposed for the Point Nepean National Park and Quarantine Station in the new Draft Management Plan (Parks Victoria and PNCT 2006). Information contained within this report is pertinent to any planning decisions, most if not all of the above, may affect the flora and fauna of the study area.

4. FLORA AND VEGETATION COMMUNITIES

Point Nepean has been the subject of numerous botanical and vegetation studies dating back to the 1970s. The earliest records for the area on DSE's Flora Information System (FIS) date back to 1971. In addition, the earliest comprehensive assessment of the study area's vegetation communities dates back to 1978. There has also been scientific research and student reports prepared on the vegetation dynamics and responses to fire. Despite the number of previous studies there has not been a single comprehensive study systematically covering the entire study area.

This section provides information on the flora and vegetation communities of the study area through:

- reviewing existing information, and
- documenting new information obtained during field surveys during 2006.

New information was obtained on the flora, Ecological Vegetation Classes (EVCs) and vegetation condition of Point Nepean National Park and the Quarantine Station during this study.

4.1 Literature Review

Calder's (1972) Masters thesis *The Natural Vegetation Pattern of the Mornington Peninsula with Particular Reference to the Genus Eucalyptus* provided the first comprehensive overview of vegetation formations of the Mornington Peninsula including much discussion of the Nepean Peninsula. In describing vegetation patterns Calder considered geology, aspect and other physiological factors such as exposure to coastal influences. Much consideration was also given to historical disturbance and the extant expression of vegetation that may be representative of succession or dis-climax and climax communities. Calder primarily described the Nepean Peninsula as being characteristically devoid of eucalypts with the original mature vegetation being much more open typical of a woodland with a grassy understorey. Calder's assessment of vegetation formations highlighted that the Nepean Peninsula is a unique landscape that harbours many species restricted to the limestone soils and coastal habitat. Calder also discusses the advancement of Coast Tea-tree *Leptospermum laevigatum* beyond its coastal fringe habitat in response to disturbance since European arrival and the subsequent 'scrub' communities that have replaced open woodlands with observations made at Mount Martha and Arthurs Seat. Calder draws on a variety of historical sources to suggest that the combined effects of disturbance on the Nepean Peninsula since European arrival have resulted in the formation of a closed scrub dominated by Coast Tea-tree in many areas that once supported open woodland of Drooping Sheoak *Allocasuarina verticillata* (syn. *Casuarina stricta*), Wirilda *Acacia retinodes* var. *uncifolia* and Moonah *Melaleuca lanceolata* var. *lanceolata* as secondary tree layers. It is also reported by Calder that there are historical records of aboriginal burning of the grassy

understorey such as Tuck (1804) but this may have been at Flinders or Main Ridge. Calder (p.240) classified much of the vegetation of the Nepean Peninsula as a '*seriously disturbed*' Drooping Sheoak – Moonah Woodland characterised by the afore mentioned species and Small-leaved Clematis *Clematis microphylla,* Thyme-leaf Rice-flower *Pimelea serpyllifolia* var. *serpyllifolia,* Coast Swainson-pea *Swainsona lessertiifolia,* Coast Beard-heath *Leucopogon parviflorus* and Kidney-weed *Dichondra repens*. Significant species listed by Calder included Drooping Sheoak, Wirilda, Common Eutaxia *Eutaxia microphylla,* Coast Swainson-pea, Coast Twin-leaf *Zygophyllum billardierei,* Moonah, Australian Hound's-tongue *Cynoglossum australe* and Pale Fan-flower *Scaevola albida.* Calder later published a summarised version of this study in 1986 called *Peninsula Perspectives.*

In 1978 Parr-Smith and Smith prepared a report on *The Terrestrial Vegetation of Point Nepean.* In their assessment of the study area they list 140 species of vascular plants and described eleven units of vegetation. Their methodology involved a rigorous process utilising interpretation of aerial photography and the quadrat sampling of 41 sites. Of the 140 flora species recorded 60 are introduced. Species considered significant by Parr-Smith and Smith includes the Rare Bitter-bush *Adriana quadripartita*. Seven other species are mentioned on the same page of their report but it is not clear if they considered these species to be significant. Quadrat sizes were 25sqm and cover abundance scores were based on the Braun-Blanquet methodology. Data was then presented in a two-way table to determine community associations. In their accompanying vegetation map Parr-Smith and Smith list structural formations based on Specht (1970) which include Open Forest, Low Closed Forest, Low Open Forest, Closed Scrub, Open Scrub, Tall Shrubland, Closed Heath, Open Heath, Low Shrubland, Tall Open-shrubland, Low Open Shrubland, Grassland, Tussock Grassland, Open Tussock Grassland and Open Grassland. Their vegetation mapping has been digitised for this project and provides a basis for a more up-to-date assessment of the study area's vegetation assessment.

In 1985 (Power *et al.*) the Graduate School of Environmental Science at Monash University published *Analysis of the Heritage Significance of the Commonwealth Holdings at Point Nepean/Portsea (Environmental Report No. 23).* Their report covered the social, built and natural environment. This report provides valuable background information on various historical uses of the study area as well as an evaluation of the criteria used to determine the relative significance of the site. Chapter 7 discusses various components of the natural environment including climate and geology and flora and fauna. Section 7.2 discusses vegetation and 7.2.1 discusses and describes the various communities. Power *et al.* (1985) listed 186 species in Appendix F of their report on the study area. This includes 108 indigenous species including six non vascular plants and 78 introduced species. Their study excluded horticultural areas associated with the built environments. They considered three species to be significant in their assessment of the study area. These were, as listed in their report, the Rare Bitter-bush, large specimens of Thyme Rice-flower *Pimelea serpyllifolia* and Pink Fairies *Caladenia latifolia.* Power *et al.* (1985) provided a generalised description of vegetation based on Parr-Smith and Smith (1978). Nevertheless, Power *et al.* (1985) describe three broad categories which are comprised of three or four sub units; Scrub Communities consisting of Open Forest, Low Closed Forest and Closed Scrub; Disturbed

Sites consisting of Shrubland – Grassland, Grassland and Denuded Areas; Coastal Sites support Coastal Scrub, Heaths, Coastal Cliffs and Foredunes.

The discussion on coastal vegetation in the LCC's (1991) Melbourne Area Descriptive Report identified a variety of vegetation units occurring along the coastal areas of the study area. The now outdated vegetation units described by the LCC relevant to the study area include several variations of what they describe as Coastal Dune Scrub. The LCC (1991) describe Moonah dominated scrubs as a distinct floristic unit within their broad application of Coastal Dune Scrub. The LCC also stated that the increasing abundance of Coast Tea-tree and Coast Beard-heath has reduced the extent of this community.

In 1989, the Department of Conservation Forests and Lands published the *Point Nepean National Park Management Plan Point Nepean Section* (McGregor 1989). At the time Point Nepean National Park consisted only of the area containing Wilsons Folly, Observatory Point and land to the west and similarly land to the west of approximately Cheviot Beach. Despite this the *Point Nepean Management Plan* by McGregor (1989) also provided comprehensive flora and fauna information on the former range area and the Quarantine precinct. Figure 9 lists six significant species and provides an illustration of their known occurrence within the Park including what was then Defence Force land. Significant species listed by McGregor include Rare Bitter-bush and what was then known as the Coast Bitter-bush *Adriana klotzschii* which is now known as the pubescent form of the Coast Bitter-bush, Dune Thistle *Actites megalocarpa,* Native Sow-thistle *Sonchus hydrophilus,* Drooping Sheoak *Allocasuarina verticillata* and Coast Banksia *Banksia integrifolia.* It is unclear why the author considered these species to be significant. A total of 140 species are listed in the vascular plant list for the study area of which 61 are introduced. McGregor's (1989) management plan reproduced the Parr-Smith and Smith (1978) vegetation map.

The 1998 (Parks Victoria) *Mornington Peninsula National Park and Arthur's Seat State Park Management Plan* states that there has been no consistent and comprehensive flora surveys of Mornington Peninsula National Park. Sections of the study area were previously within this park prior to the transfer of the 205ha former Range Area and creation of the Point Nepean National Park. The Management Plan does not distinguish between the different sections of the park, which stretches from Greens Bush to Cape Schanck and along the southern coast to Point Nepean, when referring to significant species. Appendix 2 of the Plan lists 51 rare or threatened and regionally significant species for the Mornington Peninsula National Park in its entirety. A number of these species occur within what is now known as Point Nepean National Park.

Oates and Taranto's (2001) *Vegetation Mapping of the Port Phillip and Westernport Region* provides a comprehensive overview of all the EVCs that were known to occur within the region at the time. According to their report three EVCs occur on the Nepean Peninsula; Coastal Headland Scrub (EVC161), Coastal Tussock Grassland (EVC 163) and Coastal Alkaline Scrub (EVC 858). Oates and Taranto (2001) note that the EVC Coastal Alkaline Scrub has previously been known as Moonah Woodland and Calcarenite Dune Woodland.

They also state that Moonah Woodland is a Floristic Community of Coastal Alkaline Scrub but more research is required.

In 2001, Hughes undertook a study into the vegetation dynamics of Wilsons Folly within the study area. Hughes (2001) reviewed past land use and management that may have influenced the vegetation within the study area with a particular emphasis on fire. Hughes observed a number of changes in the composition of vegetation immediately following fire. However, her concluding sentiments advocated caution in the use of fire and reiterated many uncertainties.

Brett Lane and Associates (2002) compiled a *Flora and Fauna Overview Report* in collaboration with Greening Australia. This document is an unpublished consultants report prepared for the Department of Defence. Contained with the overview report is a technical report prepared by Greening Australia; *Portsea Defence Land Master Planning Project: Vegetation Assessment* (Trengove 2002). In a limited assessment of Defence Force land within the study area in 2002 a total of 78 vascular species were recorded which included 46 indigenous species and 32 exotic species (including the Slender Cypress-pine #*Callitris gracilis* which was flagged as potentially indigenous) (Trengove 2002). Nine species were considered significant by Trengove (2002) including Coast Wirilda *Acacia retinodes* var. *uncifolia* which is rare in Victoria. The eight other species were considered to be of regional significance based on their limited abundance and distribution in the region. The Mornington Peninsula and the Port Phillip Bay area were described as the regional basis for determining their significance. This report focused on Defence Force land north of Defence Road within the study area. According to Trengove one vegetation community was present; Coastal Moonah Woodland. Trengove (2002) described two condition levels; relatively intact and degraded.

Defining the Floristic Community, Coastal Moonah Woodland in the Gippsland Plains Bioregion by Moxham and Cheal (2005) provides the most comprehensive definition of the community. They discuss characteristics of the community that have suffered from anthropogenic disturbances, circumstances where classification of its occurrence is equivocal and a saline variant of the community. Moxham and Cheal (2005) also developed a key for Coastal Moonah Woodland occurring within the Gippsland Plains Bioregion.

Adaptive Management of the threatened plant community Coastal Moonah Woodland: a report on year one of its implementation by Moxham *et al.* (2005) provides a detailed description of Coastal Moonah Woodland. In addition, extensive detail condition, research and monitoring, refining the description and the further development of a key to aid in the identification of the community are provided in this report.

In July 2006 Parks Victoria and the Point Nepean Community Trust published the *Point Nepean National Park and Point Nepean Quarantine Station Draft Management Plan* which was open for public comment. Appendix 5 of the draft Management Plan lists rare or threatened and regionally significant flora (Parks Victoria and PNCT 2006). The list has been updated and the final version will reflect the findings contained in this flora and fauna

report (Ehmke *et al.* 2008). The draft plan also listed two Ecological Vegetation Classes (EVCs), Coastal Alkaline Scrub and Coast Headland Scrub, and four vegetation communities.

DSE's Flora Information System (FIS) (July 2005 version) lists 61 indigenous species and a further 41 introduced species within the study area.

DSE mapping of EVCs which is available online and in previously published CD format (DSE 2003) lists Coastal Alkaline Scrub or Calcarenite Dune Woodland (858), Coastal Headland Scrub (161) and Coastal Tussock Grassland (163) as occurring within the study area.

4.2 Methods

In accordance with the project brief the overall aim of the flora and vegetation assessment of the project is to detect all vascular plant species and vegetation associations occurring within study area, including identification of significant species and communities. This process has involved a three step approach of:

- reviewing existing information (see section 4.1),
- development of a strategic fieldwork methodology, and
- documenting new information obtained during fieldwork for this project.

4.2.1 Taxonomy

Plant taxonomy in this report follows Walsh and Stajsic (2007) for scientific names and Cross *et al.* (2001) for common names.

In many quadrats plants could not be assigned to a particular species. In such cases they were identified to the genus level. However, in a number of cases the species were identified within the study area prior to the commencement of quadrat fieldwork. For example both the Veined Helmet-orchid *Corybas diemenicus* and the Slaty Helmet-orchid *C. incurvus* were identified well before quadrat sampling commenced. They have both been included in a defined area species list but were not identified beyond *Corybas* spp. in the quadrat sampling.

4.2.2 Site Selection and Stratification

Species lists and vegetation associations from previous studies were collated and summarised. This information was then used to target on ground searches for significant species, provide a list of know species for fieldwork and refine sample location for vegetation associations.

Stratification of monitoring sites and vegetation mapping was undertaken utilising geographic information systems. The following GIS layers (MGA 94 zone 55) were obtained from the Department of Sustainability and Environment Corporate Geospatial Data Library: aerial photography image Melbourne 2005, topography and extant Ecological Vegetation Classes. The topography layer was then modelled to provide altitude, slope and aspect. The Parr-Smith and Smith (1978) map was considered the most detailed vegetation representation of the area and was thus digitised and geo-rectified for use in the stratification process.

This information was modelled to produce a rough layer of vegetation types. The boundaries of these vegetation types was then refined by hand utilising the aerial photography. These boundaries were then ground truthed during the rapid assessment field sampling and the GIS layer updated.

4.2.3 Field Surveys

Vegetation was assessed for both its type and quality. Vegetation communities were identified to EVC level and their quality was assessed through a rapid assessment score sheet.

Field surveys were undertaken utilising four methodologies as to address specific questions.

1. Targeted searches to determine the presence of National, State and regionally significant vascular plant species.

2. Rapid assessments to obtain vegetation quality in selected areas of interest and gain further information on areas to conduct floristic sampling.

3. On ground detailed floristic sampling to determine vegetation associations and establish permanent monitoring plots.

4. Combination of the above to provide a complete vascular plant species list of study area incorporating previous information.

Targeted Searches

National, State and regionally significant vascular plant species that were identified through the literature search were targeted for on ground searches beginning in winter and continuing through to late summer. Locations were mapped, habitat characteristics recorded through rapid assessments (described below) and some species photographed.

Rapid Assessment

A rapid assessment methodology was constructed to obtain information on vegetation quality and habitat characteristics throughout the park. Sample locations were randomly determined through GIS stratification of extant EVCs, the Parr-Smith and Smith (1978) map and topography. On ground assessment recorded the following characteristics; GPS location, EVC type, altitude, aspect, height of dominant canopy species (m), dominant canopy species ranked 1-3, dominant weed species ranked 1-3 and the cover of canopy trees, midstorey trees, grasses, shrubs, herbs/forbs, litter, logs, bare ground, moss. Significant species were also documented. Thirty sites were sampled with rapid assessment sheets throughout the park.

While field operatives were undertaking rapid assessments vegetation boundaries were being adjusted on field maps. This information has been used to produce the vegetation quality map of the study area (Map 6a).

Floristic Surveys and Permanent Monitoring Sites

On ground detailed floristic sampling was undertaken to determine vegetation associations and establish permanent monitoring plots in selected vegetation types.

Sample locations were randomly determined through the new vegetation layer that was determined from the GIS stratification of extant EVCs, the Parr-Smith and Smith (1978) map, topography and aerial photographic image.

Three floristic quadrats were randomly placed in most EVCs. These were marked by a stake in the north east corner for ease of relocation as permanent monitoring sites. In each 10 x 10m quadrat the following characteristics were recorded: GPS location, aspect, altitude, height (m) of dominant canopy species, EVC type, the cover of canopy trees, midstorey trees, shrubs, perennial grasses, perennial forbs, weeds, litter, bare ground, moss, logs >10cm diameter, branches <10cm diameter, presence/absence of lichens. The dominant life forms of the following were recorded and ranked 1-3; canopy trees, midstorey trees, shrubs, grasses, weeds. All vascular plant species were identified and their cover recorded using a modified example of the Braun-Blanquet scale based on Walker and Tunstall (1981) (Table 2). Structural classification of vegetation types are according to Specht (1970).

Table 2. Quadrat cover abundance values

Cover value	Cover of foliage/branch	Number of individuals
+	<5%	Few
1	<5%	Many
2	5 – 25%	Any number
3	25 – 50%	Any number
4	50 – 75%	Any number
5	75 – 100%	Any number

UXO Monitoring Sites

In accordance with the project brief and discussions with Parks Victoria monitoring sites utilising the above methodology were established in selected areas within the UXO contaminated former Range Area. The sites were established in accordance with OH&S procedures regarding UXO clearing and monitoring began on 1 March 2006.

4.2.4 Defining Significance

Species and communities have been assigned one of several conservation significance ratings. These range from national, State, regional or high-local. Appendix 1 outlines the methodology for assigning these significance ratings.

4.2.5 Data Storage and Analysis

Hard copies of quadrat sheets and rapid assessment forms are stored at both ARI and Practical Ecology. All quadrat data, incidental records and a defined area species list has been entered into Practical Ecology's version of FIS and submitted to DSE. ARI also possesses various electronic versions of the data. Field notes, original recording sheets and maps used during fieldwork are held by both Gidja Walker (Practical Ecology) and Claire Moxham (ARI).

Quadrat codes for this project are from E010801 through to E01862. Incidental records are from I07301 through to I07342 and I07460 to I07488 and I07490 to I07500. The defined area species list code is T06062.

Using Viridans software a two way species frequency table was produced. This process required creating a data subset using only quadrats from this study and those undertaken recently by Moxham (*in-prep).* In total 62 quadrats were compared with each other using a similarity analysis known as the Jaccard coefficient. The results of this process provide floristic groupings based on similarities of the presence or absence of species. The data is

further arranged into large and small groups based on frequency of species occurrence. Small groupings were not used in this analysis.

Rapid assessment data is stored in Excel format and is held at ARI.

4.2.6 Limitations

The project commenced in late January 2006 after finalising a variety of administrative considerations. Therefore the original proposed duration of the project from November 2005 to December 2006 was amended to January 2006 to February 2007. This resulted in delaying all botanical fieldwork until approximately winter 2006.

However, in order to meet the project requirements of establishing monitoring plots in the areas proposed for burning (as of March 2006) quadrat sampling was undertaken in the least optimal time of year. Numerous geophytes and annuals are not evident at this time (late summer) and will not have been detected. Sampling was undertaken in early March as the sites were originally proposed for burning in late March 2006. Further, due to the changes in the program of UXO remediation from the initial project brief monitoring in all of the intended remediation locations was not possible. The initial intention of vegetation mapping was to determine vegetation associations at the plant community level, however, due to finding many more EVCs in the study area than was previously recorded and the increase in UXO monitoring sites it was not feasible to determine all vegetation associations at the community level.

A number of plants recorded within the study area were only identified to the genus level. This included a number of grasses and other exotic species detected during quadrat sampling. The unusually dry spring resulted in a shorter than anticipated survey period. Particular species were identifiable to the genus level and recorded as a spp. However, these species may have been previously recorded in the defined area species list.

Consideration was given to surveying for non-vascular flora during the initial planning phases of this project. However, resource constraints prevented following through on the sampling of non vascular flora and similarly with fungi.

4.3 Results

4.3.1 Vascular Plants

A total of 280 vascular plants were recorded during this survey. Of these several were only identified to the genus level which included a number of exotic species. It is possible that a few species identified only to the genus level during quadrats were earlier recorded on a defined area species list to species level which may slightly increase the total number of species listed in this report.

Of the 280 species 165 are native and 115 are introduced. The table below illustrates that the known number of species previously recorded for the entire study area in previous studies and database records has been dramatically increased.

Table 3. Comparative Illustration of species recorded during previous studies.

Study	Native	Exotic	Total
This Study	165	115	280
Tonkinson & Beardsell (1999)	40	29	69
Parr-Smith & Smith (1978)	73	62	135
FIS Pt Nepean (July 2005 Version)	46	36	82

Appendix 2 lists all species recorded in this study in systematic order. Appendix 3 lists all species recorded within the study area from all existing FIS data. Note that not all survey data from previous studies was entered into FIS and that the Tonkinson and Beardsell (1999) study was of a limited area.

4.3.2 Significant Species

A total of 13 species of State or national significance were detected within the study area during this survey and are shown on Map 7. Two more species are suspected but yet to be confirmed. And a further species was previously recorded by Jim Willis (FIS July 2005). A further 64 species were considered regionally significant. All other indigenous species are considered to be of local to high local significance. Species of State or national significance are listed in the table below. Regionally significant species are listed in Appendix 4 and a selected number have been identified on Map 3.

Table 4. Species of State or National Significance recorded during this survey.

FFG	EPBC	DSE	Scientific Name	Common Name
		r	*Acacia uncifolia*	Coast Wirilda
		v	*Adriana quadripartita* (pubescent form)	Coast Bitter-bush
L		e	*Adriana quadripartita* s.s. (glabrous form)	Rare Bitter-bush
		k	*Amphibolis antarctica*	Sea Nymph
		r	*Austrofestuca littoralis*	Coast Fescue
L		e	*Corybas* sp. ? aff. *diemenicus* (coastal)	Late Helmet-orchid
		r	*Colobanthus apetalus* var. *apetalus*	Coast Colobanth
		k	*Lotus australis*	Austral Trefoil
		r	*Olearia* sp. 2	Peninsula Daisy-bush
		r	*Oxalis rubens*	Dune Wood-sorrel
		k	*Oxalis thompsoniae*•	Fluffy-fruit Wood-sorrel
		r	*Poa poiformis* var. *ramifer*	Dune Poa
L	VU	v	*Pterostylis cucullata*	Leafy Greenhood
		r	*Pultenaea canaliculata*	Coast Bush-pea
		k	?*Sarcocornia quinqueflora* subsp. *tasmanica*	Beaded Glasswort
		r	*Zygophyllum billardierei*	Coast Twin-leaf

L – Listed under FFG Act; VU – vulnerable under EPBC Act.. DSE Victorian status: r – rare, v – vulnerable, e – endangered, k – poorly known. • – not recorded during this survey.

Photos in the following sections were taken by Gidja Walker, Andrew Picone and Nic McCaffrey.

Coast Wirilda

Coast Wirilda *Acacia uncifolia* is a small tree or large shrub growing to a height of 10 metres. This species regenerates readily from soil stored seed following disturbance but also grows by coppicing from roots (Maslin 1996). It is only found on calcareous sands or sandy loams within the Port Phillip Bay area and at Wilsons Promontory. This species is listed as rare (r) in Victoria by DSE (2005).

Coast Wirilda is locally common on the Nepean Peninsula and within the study area. Recruitment is common along the slashed breaks beside tracks through out much of the park which may be more a response to root disturbance than germination of seedlings. It predominantly occurs in the Coastal Alkaline Scrub EVC (858) which is widespread within the study area. There are mature groves in Wilsons Folly which are likely to have been a response to the 1976 fire.

Point Nepean National Park and the adjacent stretch of the Mornington Peninsula National Park provides some of the largest and contiguous areas of habitat for this taxa where

ongoing ecological and evolutionary processes continue to operate. Many other areas where this species occurs, particularly on the Nepean Peninsula are often fragmented and disturbed due to a history of land use. Together with Wilsons Promontory, the study area provides one of the most substantial populations of this taxa in an area of contiguous habitat. The species is geographically but locally common. There are no perceived threats to this species.

Coast and Rare Bitter-bush

Both the Coast and Rare Bitter-bush *Adriana quadripartita* (pubescent and glabrous form) occur within the study area. The Coast Bitter-bush is listed as vulnerable by DSE (2005) while the Rare Bitter-bush is listed as endangered by DSE and is also listed as threatened under the *FFG Act 1988*.

Both forms are disturbance dependent for recruitment. Substantial recruitment was observed by Hughes (2001) following prescribed burns in Wilsons Folly in 1998. Generally, the species occurs in open situations and is restricted to coastal or near coastal situations across Victoria. As the species is dioecious populations consist of both male and female plants which rely on wind pollination (Gross and Whalen 1996). Observations made during this survey are that the pubescent form is for common on lime outcrops while the glabrous form is more in bowls and that they rarely grow together.

Both the Coast and Rare Bitter-bush have never been common in Victoria and their extent has likely been reduced by coastal development (Gross and Whalen 1996). Threats within the study area could arise from disturbance to growing plants from track maintenance, misidentification as a weed (by inexperienced staff or volunteers) or off target damage during weed control activities and burning at too short intervals.

Sea Nymph

Sea Nymph *Amphibolis antarctica* is a marine herb that occurs in shallow sea water on sandy, mud or rock platforms. This species is poorly known (k) in Victoria (DSE 2005).

This species was previously recorded near the Port Phillip Heads where it was observed again during this study. Although, marine flora was not the focus of this project and it may occur at other suitable habitat on surrounding rock platforms.

Coast Fescue

Austrofestuca littoralis is listed as rare in Victoria (DSE 2005) and is restricted to coastal sand dune habitats from East Gippsland through to the South Australian border. It is also found in most other states. This species may be being displaced by the introduced Marram-Grass *Ammophila arenaria* (Walsh 1994, Webb *et al.* 2000) and Sea Wheat-grass *Thinopyrum junceiforme*. Within the study area this species occurs in small patches on shady perched shelves along the ocean side cliffs one or two metres above the beach.

Late Helmet-orchid ?

This as-yet unidentified species is considered significant because of its resemblance to the Late Helmet-Orchid *Corybas* sp. aff. *diemenicus* (Coastal) J. Jeans pers. comm.). The Late Helmet-orchid is listed as threatened under the *FFG Act 1988* and is listed as endangered by DSE (Coates 2003, DSE 2005).

The unidentified species should be identified when it flowers again in 2008. It was photographed flowering on 25 July 2006. Only one flowering plant was observed. Numerous other non-flowering Helmet-orchids and Veined Helmet-orchid *C. diemenicus* were observed at the same locality.

Austral Trefoil

Lotus australis is a small spreading or upright herb to about 60cm tall with bright pink pea flowers in spring. It has a wide distribution within Victoria and also occurs in all other states. Growing in a variety of habitats including coastal and inland grasslands and woodlands there is considerable variation within this species. Some authors have described different varieties (Jeans 1996). This species is listed as poorly known (k) in Victoria (DSE 2005).

Within the study area this species occurs sparsely with the Coastal Dune Grassland and Spray-zone Coastal Shrubland EVCs. This species has been previously recorded within the study area and along the adjacent ocean stretch of the Mornington Peninsula National Park.

Peninsula Daisy-bush

The Peninsula Daisy-bush *Olearia* sp. 2 is a small shrub to around 0.5 metres high. It is found at few localities along the Victorian Coast and is believed to be endemic to this state. This species is listed as rare in Victoria (DSE 2005). Two plants were observed.

Fluffy-fruit and Dune Wood-sorrel

The Fluffy-fruit Wood-sorrel *Oxalis thompsoniae* was recorded in the study area by Jim Willis in 1989 (FIS 2005) and was not observed during this study. This species has a conservation status of poorly known in Victoria. There is some speculation that the species may be introduced as it is frequently associated with historically disturbed sites.

The Dune Wood-sorrel *Oxalis rubens*, listed as rare by DSE (2005), was recorded in several locations within the study area including the Monash Break and the cemetery. However, at this stage it is unclear if this species prefers higher light levels in open habitats or it was just overlooked in denser vegetation.

Dune Poa

Poa poiformis var*. ramifer* is distinguished from the more common tussock forming var. *poiformis* by its rhizomatous or stoloniferous habit and purplish leaf sheaths (Walsh 1994). The variety is uncommon throughout its range in Victoria where it is confined to three or four localities along the coast.

It appears to occur most frequently among the complex mosaic of EVCs near the narrow western end of the study area. No direct threats have been observed but the species could be displaced by introduced species and subsequent off-target damage during weed control.

Leafy Greenhood

Pterostylus cucullata is listed as vulnerable under the *EPBC Act 1999*, threatened under the *FFG Act 1988* and as endangered by DSE (DSE 2005). The population in Point Nepean National Park differs from all other populations in that the labellum is yellow to orange and the lateral sepals are yellow merging to white and green. All other populations are a

reddish brown where the Point Nepean plants are yellow. The significance and the uniqueness of this population cannot be overstated.

The Leafy Greenhood is a widely distributed species with occurrences, primarily along the coast, in South Australia, Victoria, Tasmania and New South Wales (Backhouse and Jeans 1995). There are two distinct forms recognised; the inland and the coastal form. On the Mornington Peninsula this species is restricted to the limestone Calcarenite soils of the Nepean Peninsula and is principally found in Coastal Alkaline Scrub.

Within Point Nepean National Park this species is known from a single locality. This site must remain confidential and not become known to the general public. The site is highly visited and is currently in an area of easy access. Despite lacking woody vegetation the general area supports ground storey flora of Coastal Alkaline Scrub.

Threats to this species across its range include urban and rural development, weed invasion, introduced herbivores and illicit collection (Backhouse and Jeans 1995). Within Point Nepean National Park all of the above threats apply except for urban and rural development.

Because the location of this species would be revealed through detailed management recommendations, these are not found in this document. Management recommendations for the Leafy Greenhood have been provided to in the form of a confidential Memorandum of Advice. The Flora and Fauna Guarantee Action Statement (No. 54) (Bramwells 2003) should also be consulted.

Coast Bush-pea

Coast Bush-pea *Pultenaea canaliculata* is listed by DSE (2005) as rare in Victoria. This species is restricted to coastal habitat west of Wilsons Promontory and extends into South Australia. Growing to a height of 1 to 2 metres this species is generally restricted to fringing coastal habitats and occurs in Coastal Headland Scrub and often in sheltered rocky situations (Corrick 1996). Within the study area this species was observed growing to a height of 60cm in exposed situations along the ocean coast.

Beaded Glasswort

Sarcocornia quinqueflora Beaded Glasswort was recorded sporadically along the ocean coastline near the narrows on an artificial berm created by the rock wall, mid way and just west of London Bridge on limestone within the spray zone. Confirmation is required to identify if this is subspecies *tasmanica*. It appears caespitose (rather than rhizomic) and is on rocky substrates rather than mud. A plant of *Sarcocornia* was observed that resembled the subspecies but there was no seed present to confirm identification. This form of Beaded Glasswort is listed as poorly known in Victoria by DSE (2005).

Coast Twin-leaf

Coast Twin-leaf *Zygophyllum billardierei* is listed as rare in Victoria by DSE (2005) and is restricted to coastal habitats west of Wilsons Promontory. It is also found in South Australia, Western Australia and Tasmania (Jeans 1999).

This spreading or slightly scrambling shrub in relatively common within the study area where it is predominantly found in open sections of Coastal Headland Scrub and occasionally Coastal Alkaline Scrub. It is generally restricted to limestone soils and coastal dunes (Jeans 1999) and regenerates well after fire. The study area and remnant areas along the south coast of the Nepean Peninsula represent the only substantial records for the species within the Gippsland Plains bioregion.

4.3.3 Introduced Species

A total of 115 introduced species were recorded within the study area. A summary of weed prioritisation according to species invasiveness and occurrence in the study area is provided below. This prioritisation is based on the expertise in weed management of the current study team and in reference to Carr *et. al*. (1992) and Walker *et al.* (1993).

Weeds that are disturbance regenerated and virtually impossible to control, such as some herbaceous and grass species, are classified *ubiquitous species*. Although they are found throughout the study area the control of these species is recommended in priority areas only such as sites where they threaten significant indigenous species.

Exotic species that dominate the vegetation structure in an area, replacing the ecological role of similar native species in providing food and habitat for fauna, are considered *keystone species*. These species now play a role in ecosystem dynamics and a long term management approach should be undertaken for their control.

Exotic species that occur in *small patches* scattered throughout an area in moderate or low abundance are of variable risk to EVCs occurring at Point Nepean. These species may be relatively easy to control depending on their invasiveness which is ranked 1-3. Where: 1= high risk species, eliminate from site; 2 = moderate risk species, undertake control measures and 3 = low priority species. Table 5 below lists all S1 species and keystone species considered top priority for management.

Table 5. Priority exotic species ranked for keystone species (K) and high risk species (S1).

BOTANICAL NAME	COMMON NAME	STATUS
Ammophila arenaria	Marram Grass	**K**
Polygala myrtifolia	Myrtle-leaf Milkwort	**K**
Thinopyrum junceiforme	Sea Wheat-grass	**K**
Asparagus asparagoides	Bridal Creeper	**K/S1**
Sporobolus africanus	Rat-tail Grass	**K/S1**
Phalaris aquatica	Toowoomba Canary-grass	**S1**
Asparagus scandens	Asparagus Fern	**S1**
Carpobrotus spp.	Pigface	**S1**
Chrysanthemoides monilifera subsp. monilifera	African Boneseed	**S1**
Coprosma repens	Mirror Bush	**S1**
Dipogon lignosus	Common Dipogon	**S1**
Ehrharta erecta	Panic Veldt-grass	**S1**
Eucalyptus botryoides	Southern Mahogany	**S1**
Euphorbia paralias	Sea Spurge	**S1**
Festuca arundinacea	Tall Fescue	**S1**
Gazania spp.	Gazania	**S1**
Nassella trichotoma	Serrated Tussock	**S1**
Oxalis pes-caprae	Soursob	**S1**
Rhamnus alaternus	Italian Buckthorn	**K/S1**
Senecio elegans	Purple Groundsel	**S1**
Silene vulgaris subsp. vulgaris	Bladder Campion	**S1**
Pittosporum undulatum	Sweet Pittosporum	**S1**
Lycium ferocissimum	African Box-thorn	**S1/S2**

Monitoring Sites

In effect, all quadrat sites can become monitoring sites. However, three quadrats (59, 60 and 61) were established within the area burnt this year in accordance with the project brief.

A total of 38 taxa were recorded in these pre burn monitoring sites. However, some species remain unidentified and, as previously mentioned the time of assessment was not optimal for detecting perennial and annual species.

The average number of species was 19.3 for the three quadrats which included some species that were not identified. Data for these three quadrats is provided in Appendix 5.

Of the 62 quadrats sampled within the study area 24 were undertaken in Wilsons Folly to examine the long-term impacts on floristic composition as a result of burning. An further 12 were sampled in UXO remediation areas (including the aforementioned three) and the remaining 26 quadrats were sampled throughout the remainder of the study area in a variety of EVCs. Refer to Map 2.

Table 6. Monitoring site locations and the number of plots established.

Quadrat Monitoring Sites	Number
Wilsons Folly Burn Areas	24
UXO Remediation Areas	12
Floristic Quadrats	26
Total	62

All quadrat data including a unique identifying number, date, location, recorder and all species data has been supplied in electronic format with this report. It is also retrievable from the DSE's FIS.

4.3.4 Ecological Vegetation Classes

An Ecological Vegetation Class (EVC) is a unit of consistent vegetation displaying broadly similar botanical, life form and ecological attributes reflecting broadly consistent environmental conditions (Oates and Taranto 2001; DNRE 2002). EVCs have been mapped across Victoria and assist in establishing conservation priorities throughout the State. Within each EVC there can be a varying number of floristic communities which represent a narrower unit of floristic, life form and ecological characteristics that are repeated over any given landscape (DNRE 2002; Oates and Taranto 2001; Woodgate *et al.* 1991).

The study site supports eight EVCs and an additional two EVC mosaics. A mosaic is considered to be an area supporting at least two EVCs that exist at a scale that is beyond that at which the site is being mapped (Oates and Taranto 2001). Each EVC and their bioregional conservation status is listed in Table 7 below. Map 5 illustrates their distribution throughout the study area.

Table 7. Ecological Vegetation Classes occurring within the Study Area

EVC No.	EVC	Bioregional Conservation Status
1	Coastal Dune Scrub/ Coastal Dune Grassland Mosaic	Least Concern
3	Damp-sands Herb-rich Woodland	Vulnerable
160	Coastal Dune Scrub	Least Concern
161	Coastal Headland Scrub	Depleted
162	Coastal Headland Scrub/Coastal Tussock Grassland Mosaic	Not listed for Gippsland Plains
163	Coastal Tussock Grassland	Least Concern
309	Calcareous Swale Grassland	Vulnerable
858	Coastal Alkaline Scrub	Depleted
879	Coastal Dune Grassland	Endangered
876	Spray-zone Coastal Shrubland	Rare
311	Berm Grassy Shrubland	Endangered

A comparative table containing each of the above EVCs and their equivalent vegetation units from all major previous studies is contained in Table 8.

Table 8. Comparison of the different vegetation associations at Point Nepean.

Ecological Vegetation Class (This study)	Parks Victoria Grouping	Parr-Smith & Smith (1978) Grouping	Parr-Smith & Smith (1978) Subgroups	Tonkinson & Beardsell (1999) Grouping
Coastal Alkaline Scrub (858)	Coastal Moonah Woodland	Scrub Complex	1 Scrub complex	Moonah Woodland/ Coastal Dune Scrub
Coastal Alkaline Scrub (858)	Coastal Grassy Woodland	Disturbed Complex	2a Scrub Grassland	Coastal Dune Scrub
Calcareous Swale Grassland (309)	Coastal Grassy Woodland	Disturbed Complex	2b Grassland	Coastal Dune Scrub
Coastal Alkaline Scrub (858)	Coastal Grassy Woodland	Disturbed Complex	2c Denuded	Disturbed Areas
Coastal Alkaline Scrub (858)	Headland Scrub	Coastal Complex	3a Coastal Scrub	Coastal Dune Scrub
Coastal Headland Scrub (161), Coastal Dune Scrub (160)	Dune Scrub Complex	Coastal Complex	3b Heath	Coastal Headland Scrub
Coastal Tussock Grassland (163), Spray-zone Coastal Shrubland (876)	Headland Scrub	Coastal Complex	3c Coastal cliffs	Coastal Headland Scrub
Beach/Cliff (999), Berm Grassy Shrubland (311), Coastal Dune Grassland (879)	Beach/Cliff	Coastal Complex	3d Foredune	Beach/Cliff
Disturbed (997)	Disturbed Areas	Coastal Complex	3e Blowouts	Disturbed Areas
Beach/Cliff (999)	Beach/Cliff	Coastal Complex	3f Sandy Beach	Beach/Cliff

The following sections describe each EVC and the defining study area characteristics such as environmental conditions and main species. Local expressions of EVCs may vary to the generic bioregional descriptions. The species listed in this section relate to conditions at the study area only and may vary substantially to bioregional character species lists.

Damp-Sands Herb-rich Woodland (EVC 3)

Quadrats: 21, 22 and 25

Altitude: <40 Metres

Landscape position: inland, associated with lower pH in depressions.

Soils: fertile grey sandy loams (Oates and Taranto 2001)

Structure: woodland/scrub.

Distribution within study area: Park entrance and Police Point.

Condition status within study area: Disturbed, weed invasion including Boxthorn.

Character Species		
Eucalyptus viminalis ssp pryoriana	*Dodonaea viscosa ssp. spatulata*	*Acacia mearnsii*
Pteridium esculentum	*Exocarpos cupressiformis*	*Stellaria pungens*
**Pittosporum undulatum*	**Rubus fruticosus spp agg.*	

Within the study area Damp-sands Herb-rich Woodland has been mapped as occurring near the entrance to the study area and in the Police Point Reserve. This EVC has been described on the basis of the occurrence of species that do not normally grow on alkaline soils.

It is characterized by a number of indicator species which are not generally found in the other EVCs on the Nepean Peninsula. These include: Black Wattle *Acacia mearnsii*, Sticky Hop-bush *Dodonaea viscosa* ssp*. spatulata*, Coast Manna-gum *Eucalyptus pryoriana*, Cherry Ballart *Exocarpos cupressiformis*, Austral Bracken *Pteridium esculentum* and Prickly Starwort *Stellaria pungens*. The weeds which invade this association are also different with Sweet Pittosporum *Pittosporum undulatum* dominating in some areas, and the presence of Blackberry *Rubus fruticosus* spp. agg.

This is likely to have been an important vegetation type for the traditional owners due to the co-existence of Manna Gum, Black Wattle and Cherry Ballart, all important resources and which are uncommon on the Nepean Peninsula. Map 4 shows the restricted distribution of Manna Gum.

Coastal Dune Scrub (EVC 160)

Quadrats: No sampling was undertaken in this EVC.

Altitude: <40 Metres

Landscape position: Exposed foredune and secondary dunes.

Soils: Deep calcareous and unconsolidated sands uniform in texture subject to salt spray and disturbance or erosion from onshore winds (Oates and Taranto 2001).

Structure: Closed scrub to 5m tall.

Distribution within study area: Southwest aspect of Cheviot Hill and nearby dunes, around Eagles Nest and the north shore of The Narrows. Approximately 13ha occurs within Point Nepean National Park.

Condition status within study area: Disturbed, weed invasion including Boxthorn.

Character Species		
Leptospermum laevigatum	*Rhagodia candolleana* ssp. *candolleana*	*Dichondra repens*
Acacia longifolia var. *sophorae*	*Tetragonia implexicoma*	*Carpobrotus rossii*
Leucopogon parviflorus	**Polygala myrtifolia*	

Within the study area Coastal Dune Scrub has been mapped as occurring on the south west aspect of Cheviot Hill and towards Eagles Nest in the west of the study area. These sites differ from Coastal Alkaline Scrub as a result of their exposure to coastal winds, unconsolidated sandy substrates and their floristic composition.

The absence of species typical of Coastal Alkaline Scrub (EVC 858) such as Coast Wirilda and Thyme Rice-flower can also be a useful indicator of this EVC.

This EVC forms a closed and often dense scrub up to 5m in height. Coast Tea-tree is dominant on secondary dunes and Coast Wattle usually occupies the most exposed situations on foredunes (Oates and Taranto 2001). Where Coast Tea-tree forms an even aged dense thicket there can be very few understorey species although a diversity of herbs, geophytes and mosses may be seasonally present. However, in mature stands there is often light gaps generated from wind throw or decline in Coast Tea-tree. Seaberry Saltbush. Bower Spinach and Karkalla may be present along with several species of grasses and herbs.

Coastal Headland Scrub (EVC 161)

Quadrats: 4, 17 and 18.

Altitude: <40 Metres

Landscape position: Steep and exposed coastal headlands exposed to strong and salt laden winds (Oates and Taranto 2001).

Soils: Generally, derived from a variety of parent material. Within study site on calcified dune and limestone cliffs and headlands.

Structure: Closed heath-like scrub generally less than 2m tall.

Distribution within study area: Occurs primarily along the south coast of the Study Area extending into Mornington Peninsula National Park. Also occupies substantial areas of the narrow western area of Point Nepean. Approximately 24ha occurs within the Study Area.

Condition status within study area: Generally intact, with minor incursions of weeds. African Boxthorn is present at some locations.

Character Species		
Leptospermum laevigatum	*Rhagodia candolleana* ssp. *candolleana*	*Dichondra repens*
Acacia longifolia var. *sophorae*	*Alyxia buxifolia*	*Carpobrotus rossii*
Melaleuca lanceolata ssp. *lanceolata*	*Ozothamnus turbinatus*	*Actites megalocarpa*
Correa alba	*Olearia axillaris*	*Lepidosperma gladiatum*
Leucopogon parviflorus	*Ficinia nodosa*	*Apium prostratum*

Within the study area Coastal Headland Scrub consistently occurs along the south coast and is continuous with the adjacent Mornington Peninsula National Park. This community is likely to have suffered the least impact since European settlement.

Structurally this EVC forms a closed and often dense scrub up to approximately 1m in height. A variety of species can be locally dominant. At some sites Moonah is present and occasionally dominant. Gaps can be occupied by herbs such as Dune Thistle, Swainson Pea or Sea Celery.

Coastal Tussock Grassland (EVC 163)

Quadrats: No sampling was undertaken in this EVC.

Altitude: <40 Metres

Landscape position: Steep and exposed coastal ledges exposed to strong and salt laden winds (Oates and Taranto 2001).

Soils: Generally sand or shallow stony loams.

Structure: Tussock grassland.

Distribution within study area: Occurs as discontinuous thin bands along the south western coast of the study area. Approximately 1ha occurs within the study area.

Condition status within study area: Generally intact.

Character Species		
Austrostipa stipoides	*Poa poiformis* var. *ramifer*	*Senecio pinnatifolius*

This EVC is sparsely scattered along the western end of the study area's southern coastline. There are no substantial areas within Point Nepean National Park and it is restricted by soil and environmental conditions.

Structurally this EVC is characterised by tussock grasses interspersed with small herbs or shrubs from neighbouring communities.

Calcareous Swale Grassland (EVC 309)

Quadrats: 59, 31 and 39.

Altitude: <40 Metres

Landscape position: at the lowest point in interdune hollows or swales.

Soils: Generally sandy loams with a higher organic content.

Structure: Tussock grassland.

Distribution within study area: Very restricted to a few localities within the hinterland zones; Harrison's and Little Harrison's Bowl and near by. Approximately 1.5ha occurs within Point Nepean National Park.

Condition status within study area: Generally intact where it still occurs. Small herbaceous weeds present.

Character Species		
Poa labillardierei var. *labillardierei*	*Ajuga australis*	**Orobanche minor*
Dichondra repens	*Convolvulus erubescens*	
Senecio pinnatifolius	*Senecio odoratus*	

This EVC is sparsely scattered along the western end of the study area's southern coastline. There are no substantial areas within Point Nepean National Park and it is restricted by soil and environmental conditions. It is unclear to what extent this EVC occurs in Wilsons Folly. It is likely to exist in the lower depressions.

Structurally this EVC is characterised by tussock grasses interspersed with small herbs or shrubs from neighbouring communities. It is a recently described EVC and is often referred to as a Grassy Bowl.

Coastal Alkaline Scrub (EVC 858)

Quadrats: Most quadrats are in this EVC.

Altitude: <50 Metres

Landscape position: across the tertiary dune system and hinterland of study area.

Soils: Deep alkaline sands derived from calcareous deposits that have now stabilised.

Structure: Varying from a low open woodland to a closed scrub depending on age and disturbance.

Distribution within study area: Widespread and continuous throughout study area. Approximately 433ha occur within the Study Area.

Condition status within study area: Varying with few sites that are both mature and not dominated in the mid strata by introduced species.

Character Species		
Leptospermum laevigatum	*Rhagodia candolleana* ssp. *candolleana*	*Dichondra repens*
Acacia uncifolia	*Alyxia buxifolia*	*Austrostipa flavescens*
Melaleuca lanceolata	*Pimelea serpyllifolia* ssp. *serpyllifolia*	*Dianella breviculmis*
Allocasuarina verticillata	*Swainsona lessertifolia*	*Lepidosperma gladiatum*
Leucopogon parviflorus	*Hibbertia sericea*	

Coastal Alkaline Scrub is the most widespread EVC within Point Nepean National Park. There are a number of complex sub-formations within the EVC which may represent various stages of succession following disturbance. The FFG Act listed Coastal Moonah Woodland is a component of this EVC.

Within the context of the study area this EVC is expressed in a diversity of formations with different dominant species. There are sites where Moonah forms a consistent canopy, other

areas where this species is mixed with Drooping Sheoak or Coast Wirilda. There are also Moonah and Coast Tea-tree associations and other areas where Coast Tea-tree is the sole dominant.

Structurally this EVC varies from an open woodland with tussock grasses, shrubs and numerous herbs and nonvascular species in the understorey to a closed scrub with little or no understorey. The open woodland areas are characterised by mature Moonah and can still retain a rich ground flora despite a thick covering of weeds in some areas. Slaty and Veined Helmet-orchid can be locally abundant as can Pink Fairies *Caladenia latifolia.* Small areas still retain a diversity of grasses and herbs.

Quadrat data analysis from within the EVC has resulted in five groupings or sub-communities. However, there is a disproportionate bias of quadrats in the Wilsons Folly area due to ongoing research by ARI. Preliminary evaluation of these groupings has lead to consideration of various expressions of succession within this EVC.

Coastal Dune Grassland (EVC 879)

Quadrats: E01802, E01803, E01814.

Altitude: 1-5 Metres

Landscape position: Foredunes.

Soils: Sand.

Structure: open grassland with a variety of herbs.

Distribution within study area: Very restricted to a few localities along the southern ocean side of the study area. Approximately 1ha occurs within the study area.

Condition status within the study area: Generally intact where it occurs. Small herbaceous weeds present.

Character Species		
Spinifex sericeus	*Ficinia nodosa*	*Lotus australis*
**Ammophila arenaria*	*Crassula sieberiana*	*Carpobrotus rossii*
Senecio pinnatifolius	*Apium prostratum* ssp. *prostratum*	

This EVC is scattered along the eastern end of the study area's southern coastline and at Observatory Point. There are no substantial areas within Point Nepean National Park as it is restricted by the limited extent of foredune habitat. However, it comprises some of the most intact examples of this EVC known within the bio region.

Structurally this EVC is characterised by rhizomatous grasses interspersed with small herbs and halophytes.

Spray-zone Coastal Shrubland (EVC 876)

Quadrats: E01807, EO1810.

Altitude: <40 Metres

Landscape position: exposed and rocky wind-swept sites with a south west aspect subject to salt spray.

Soils: Skeletal, gravely to non-existent.

Structure: short open shrubland.

Distribution within study area: reasonably widespread within suitable habitat but otherwise restricted to a thin band influenced by exposure and a south westerly aspect. Approximately 23 ha occurs within the Study Area.

Condition status within the study area: Generally intact. Small herbaceous weeds present.

Character Species		
Rhagodia candolleana ssp. *candolleana*	*Apium prostratum*	*Dichondra repens*
Alyxia buxifolia	*Ficinia nodosa*	*Carpobrotus rossii*
Ozothamnus turbinatus	*Leucophyta brownii*	*Actites megalocarpa*
Correa alba	*Olearia axillaris*	

Within the study area Spray-zone Coastal Shrubland occurs along the narrow section of the Nepean Peninsula. This EVC also extends through the adjacent coastal sections of the Mornington Peninsula National Park. This EVC is likely to have suffered little impact since European settlement.

Berm Grassy Shrubland (EVC 311)

Quadrats: E01820, E01813, E01812.

Altitude: 1-5 Metres

Landscape position: restricted to sand deposits at foot of larger tertiary dunes.

Soils: Sand.

Structure: an open Shrubland interspersed with grasses and halophytes.

Distribution within study area: Restricted to small areas on the bay side in the west of the study area.

Condition status within the study area: Generally intact where it occurs. Small herbaceous weeds present.

Character Species	
Atriplex cinerea	*Disphyma crassifolium* ssp. *clavellatum*
Rhagodia candolleana ssp. *candolleana*	*Ficinia nodosa*
Senecio pinnatifolius	

This EVC is restricted to a single known locality within Point Nepean National Park. It occurs on the southern coast side near Fort Pearce and along the northern shore near the Quarantine precinct.

Structurally this EVC is characterised by rhizomatous grasses interspersed with small herbs and several halophytes.

4.4 Discussion

Prior to this study there were previously thought to be three EVCs present within the study area. There are now known to be nine EVCs and two additional EVC mosaics. Furthermore, there are 280 species of vascular plants recorded within Point Nepean National Park. An increase of 198 from 82 species prior to this study. Only 46 indigenous species were previously recorded on the DSE's FIS.

This section discusses several aspects of the vegetation or specific species characteristic of Point Nepean. These items are considered significant in the sense that they are noteworthy for further discussion that did not fit into above sections. For example, Drooping Sheoak is not regionally significant but it is of high local significance due to its historic depletion and slow recovery and requires discussion.

Many of the flora or vegetation attributes discussed in this section have management recommendations in section 8 of this report.

4.4.1 Fire

The fire history of the Nepean Peninsula is not well documented. Historical references to fire from the Mornington Peninsula are often vague or broad in their use of locality names. The Nepean Peninsula and particularly the study area is likely to have had a very different fire ecology to other areas of the Mornington Peninsula. While intuitive, this conclusion is based on the general absence of fire dependent species and the fact that Point Nepean is afforded protection from wildfire by its location and the prevailing winds.

However, the Calcareous Swale Grasslands, and potentially the understorey of more open tussock grass dominated woodlands are likely to have been burnt in Boonwurrung land management practices to maintain habitat for both flora and fauna resources. Biomass reduction, such as fire, in grasslands is vital to maintain inter-tussock herbs and prevent graminoids from becoming rank (Lunt 1991). A fire horizon can be observed on the steep and eroded fore-dune west of Observatory Point but it is unlikely that this is pre-European as it is mixed with building rubble. A similar observation was also made near Wombat Oval. This potentially indicates that the study areas most substantial fires occurred since European arrival.

When considering the use of fire in ecological management and restoration within the study area, the season, frequency and extent of the burn will all influence the response of vegetation. Furthermore, the affects of fire now are likely to be different to pre-European fires due to introduced species, burning techniques and the absence of some fauna such as the Grey Kangaroo. Autumn burns encourage Coast Tea-tree, which is considered a successional element in the recovery of alkaline scrub and woodland communities. In areas that have not been burnt in the last 30 0r 40 years, such as sites near Wombat Oval, Coast Tea-tree has become senescent and is not regenerating. Frequent burning is likely to result

in an ongoing expression of the earliest successional stage of Coastal Alkaline Scrub with a gradual reduction in floristic diversity and a predominance of Coast tea-tree.

Research currently being undertaken into the ecology of Moonah Woodland regeneration (C. Moxham) at Wilsons Folly suggests that there is a reduction in obligate seeders after successive burns. This includes Coast Banksia and the Rare and Coast Bitter-bush. Short intervals between fires can cause plant mortality before it has reached reproductive maturity and established the seed bank in preparation for the next fire event. Internal notes and memorandums supplied by Parks Victoria also draw attention to the attrition of Drooping Sheoak and Coast Banksia in Wilsons Folly.

4.4.2 Drooping Sheoak

Drooping Sheoak is believed to have previously been a much more prominent component of the vegetation of the Nepean Peninsula. For example, the flat area near Observatory Point is described in the 1850s with drooping Sheoak abundant enough to be described by the observer; *"low sandy country lightly wooded with acacia and sheoak"* (Surveyor General's Office 7 September 1854). The historic depletion of this species and its slow recovery make this species of high local significance. Observations of this species made throughout the duration of fieldwork for this project are described here together with other considerations about its ecology and recovery.

Drooping Sheoak currently has a scattered and sparse distribution throughout the study area (refer Map 4). A number of dead Drooping Sheoak stumps were observed in areas that now support a closed scrub of Coastal Tea-tree. There are small recruitment cohorts with some strong reestablishment on Observatory Point. Although difficult to fully understand the natural distribution of Drooping Sheoak within the study area relative to topography, soil, exposure and moisture, there may be an association with other species. Although speculative, there may have been a distinct community characterised by Small-flower Flax-lily, larger tussock grasses, Sweet Bursaria and other species that can tolerate the smothering litter loads dropped by this species.

The species slow recovery within the study area may be, in part, to continued grazing pressures. In restoration projects on the Coorong National Park in South Australia it was found that Drooping Sheoak required protection from rabbits while other species did not (Cooke 1987). Grazing pressures on Drooping Sheoak within Point Nepean National Park may come from Black Wallaby and Rabbit populations.

Within the park there appears to be a gender imbalance with more male plants than seed bearing female plants. Some stands of Drooping Sheoak appear to be all a single gender (near Wombat Oval) and in addition it is unclear what level of fertility there is within the population. It was noted that flowering did occur throughout the year and that some seed capsules appeared to have no viable seed. This may have been caused by heavy frosts or by a lack of nutrients available to the trees during drought stress. Research on this species on

Kangaroo Island has identified a link between cone production and nutrient status of the soil (Chapman and Paton 2007).

There has been some replanting of this species surrounding public areas within the park but these plants may not be of local provenance.

A number of management actions could be undertaken to assist in the recovery of this species within Point Nepean. Facilitating recruitment through a variety of techniques and further research on its ecology on the Nepean Peninsula are needed. These are discussed in further detail in the recommendations section.

4.4.3 Winged Spyridium

There are only two known plants of this species at one site within Point Nepean National Park. These are the only known plants within the Gippsland Plains Bioregion. They also represent the know eastern extremity of its natural range. This species is more common in coastal bioregions in western Victoria where it extends into South Australia. This species is illustrated on Map 3 of Selected Regionally Significant Species.

4.4.4 Moonah

Moonah is synonymous with the Nepean Peninsula and in particular the National Park. It is characteristic of the dominant EVC and the FFG Act listed community. The species also provides an unusual landscape character that is not common in Victoria and is virtually absent from all other areas of the Port Phillip region. The species is also of scientific interest with ongoing research being undertaken by ARI.

The size, structure and habitat of this species can vary enormously depending on substrate aspect, exposure and past management regimes. Tall individuals with a single trunk usually grow in sheltered sites. However, individuals that have many trunks are a likely artefact of previous felling having re-sprouted from lignotubers although there are some veteran multi trunked individuals which may indicate a much older disturbance event. Where sand has blown over calcarenite and buried trees, one individual may occupy a large area and be represented by a multitude of small stems giving the impression of a cohort of individuals. The species can also layer and produce substantial roots from branches that rest on the ground. There are a number of veteran individuals within the study area. These have the potential to be several hundred (or more) years old.

The recruitment ecology of Moonah is not well understood. Research (Moxham 2005) and observations from within the study area and the natural range of Moonah suggest that water availability, harvesting of seed by ants and browsing by herbivores potentially have a significant impact on the recruitment of this species.

Following fire, scorched branches will re-sprout provided the intensity does not kill the branch entirely. If this is the case it will re-sprout from lignotubers. Some veteran old trees suggest that the last major fire event (at least in some areas) was several hundred years ago. Not all multi stemmed individuals are thought to be an artefact of post European clearing.

Other observations by the authors include;

- Growth rings are an unreliable measure of age,
- Moonah will form a mid-storey tree amongst Drooping Sheoak and Coast Wirilda,
- There may be mycorrhizal associations; pH test showed root hairs are strongly acidic.

4.4.5 Orchids

Prior to this study there were no Orchidaceae recorded from Point Nepean National Park that were documented on the FIS. There are now eight identified species and potentially three other species that were not observed flowering in spring 2006.

The most abundant species are the Slaty and Veined Helmet-orchids and Pink Fairies. Both species can be locally abundant in Coastal Alkaline Scrub and Coastal Dune Scrub within the study area. Helmet-orchids persist under Myrtle-leaf Milkwort *Polygala myrtifolia,* but Pink Fairies require light. *Cyrtostylis* species are less abundant and it is unclear how they are affected by Myrtle-leaf Milkwort. Mosses are often associated with the occurrence of orchids. Onion Orchids were only observed within the cemetery and along one track near Observatory Point.

The only colony of nationally significant Leafy Greenhoods is in a modified environment associated with historical structures. However, there may be an association with Drooping Sheoak which has been observed in other areas of the Nepean Peninsula outside the study area

Introduced invertebrates may be having an impact on orchid populations. The bosses of many Helmet-orchids are often eaten by Portuguese millipedes. Following the discovery of the red-bossed Helmet-orchid that superficially resembled the nationally significant Late Helmet-orchid a meeting was arranged for the in-situ identification of the species. An inspection the day before the meeting revealed that the plant had been badly damaged by herbivorous insects. Further research on identifying this species is required.

4.4.6 Grassy Bowls

The Calcareous Swale Grassland EVC is often referred to as a Grassy Bowl. They are located in the lowest depressions amongst Calcarenite Dune Woodland. A variety of grasses occur

within them and they are of zoological significance. Coast Tea-tree is likely to have reduced the extent of these grassland communities.

Heavy frosts were observed within these habitats in June 2006. Moonah is intolerant of frost as are many shrubs and trees of the surrounding vegetation.

These grassland communities may have been specifically managed by the traditional owners prior to European arrival. Kangaroos, which are now locally extinct, may have been the principle browser of the dominant grasses. Biomass reduction may have helped maintain the health and vitality of the tussock grasses.

In some instances there are regular shrub occurrences within the grasslands including Rare Bitter-bush and Scented Groundsel. In Wilsons folly there are cohorts of Banksia associated with grassy depressions with a lower pH. These sites do not currently fit easily into any of the aforementioned EVCs. And there are many unknown ecological attributes regarding the distribution and abundance of Coast Banksia in calcarenite dominated regions. Other sections of Wilsons follow along the ridgelines are likely to be expressions of Calcarenite Dune Woodland.

The burning of these grasslands is likely to produce different results depending on the seasons as is the case with most other communities. Seasonal timing of the burn is also likely to affect regeneration of Coast Tea-tree. Rare and Coast Bitter-bush both regenerate well after fire (Hughes 2001). With increased visitation and public access to these area there is a greater risk of unplanned fires.

4.4.7 Undescribed Community 1

An interesting alliance occurs occasionally on the ocean cliffs within the spray-zone. It is closely aligned floristically with Salt Marsh EVCs but is found on rocky substrates. The halophytes supported by this include Trailing Hemichroa *Hemichroa pentandra*, Beaded Glasswort *Sarcocornia quinqueflora* ?ssp. *tasmanica* and Coastal Noon-flower *Disphyma crassifolium* ssp *clavellatum*. Patches of this type of herb field also occur further east along the coast such as Spray Point and generally cover a small area (< a few square metres).

It intergrades with EVC311 Berm Grassy Shrubland on artificial berms created by rock walls closer to the point (also at Mt Martha and Anthony's Nose).

4.4.8 Undescribed Wetland Community

At the lowest point of Harrisons Bowl is a damp site with Nobby Club-rush *Ficinia nodosa* and a Buttercup species *Ranunculus sp..* This area has also been noted on old maps as a pond and could be both ecologically and culturally significant given the lack of freshwater resources within the study area. This site is identified as a Swampland Community on Map 5.

4.4.9 Phytophthora

Phytophthora (*Phytophthora cinnamomi)* is the most widespread and destructive of the 32 species of Phytophthora found in Australia (PTG 2003). It is a microscopic disease causing dieback and death of indigenous and introduced species of plants by limiting the flow of nutrients and water the plant needs for healthy growth. Within the study site the most vulnerable species potentially at risk to Phytophthora infection is the Coast Banksia.

Once infected, plants are often highly stressed and usually die during dry weather. Many native and indigenous species of plants are highly susceptible to Phytophthora. For this reason the spread of Phytophthora is also listed as a threatening process under both the FFG Act 1988 and the EPBC Act 1999.

Phytophthora infestations cannot be eradicated from sites but several management procedures can limit the spread and intensification of outbreaks (DSE 2005). Phytophthora occurs in many areas on the Mornington Peninsula and could easily be introduced into Point Nepean National Park. Typical symptoms, such as the yellowing and eventual dieback of susceptible plants, could arise from a variety of causes. Stands of Coast Banksia, among other species, are susceptible to Phytophthora.

5. FAUNA

5.1 Literature Review

The extent to which past records of significant fauna represent the extant vertebrate biodiversity at the site is unclear given limited past access to large areas of the site. In addition, a noted decline of fauna on the Mornington Peninsula and in the Gippsland Plain Bioregion has occurred since a number of surveys at the site were conducted. The former Range Area in particular represents a substantial area of habitat, comprised of a number of different habitat communities which has not been comprehensively surveyed. Despite past access limitations, research has been carried out in some parts of the study area. The major surveys carried out at Point Nepean are outlined below.

Marston (2002)

The most recent fauna survey at Point Nepean (Marston 2002), investigated terrestrial vertebrate fauna at four sites, two in the quarantine area and two within the former Range Area, in which they detected 31 bird and 12 mammal species. Native mammals were identified from indirect signs and predator scats, and no live animals were actually trapped as part of the survey. Two of the records from predator scats, Bush Rat and Agile Antechinus, are highly questionable. Swamp Rats are the dominant native rodent on the Mornington Peninsula and are known to occur at Point Nepean. Swamp and Bush Rats are competitively exclusive and do not co-exist, there are no confirmed records of Bush Rats species on the Mornington Peninsula. Given that the Agile Antechinus record from this survey was from a predator scat it could have originated from outside the site. Given that no other records of this highly trappable species from the study area exist, this record should be considered unconfirmed. Neither reptiles nor amphibians were surveyed as part of this study.

Horrocks and Brown (1993)

Horrocks and Brown (1993) conducted bird surveys in Point Nepean between July 1986 and September 1987. Surveys were conducted over 13 days in total, mostly in spring and summer. Horrocks and Brown (1993) identified 71 bird species including Spotted Quail-thrush, Caspian Tern, Pacific Gull and Pied Cormorant. General conclusions from the study were that there was a relatively uniform species assemblage throughout most of the site, but that more open habitat with grassland affinities contained the greatest diversity of bird species.

Brown and Horrocks (1988)

Brown and Horrocks (1988) investigated Bat fauna at nine sites within Point Nepean between July 1986 and September 1987. Incidental observations of other terrestrial vertebrate species were also recorded and predator scat analysis conducted. Four bat species were

identified in this survey; Gould's Wattled Bat, King River Eptesicus, Little Forest Bat and Lesser Long-eared Bat. Substantially more captures were recorded in spring, although this was possibly due to an associated increase in survey effort. Incidental observations revealed eight reptile species; Tree Dragon, White's Skink, Garden Skink, Southern Grass Skink, Eastern Three-lined Skink, Metallic Skink, Common Blue-tongued Lizard, White-lipped Snake and Lowland Copperhead. Over 70% of prey items identified in predator scat analysis were Swamp Rats, Black Rats or European Rabbits, while one Long-nosed Bandicoot and three Common Ringtail Possum hairs were also identified.

McLean (1986)

The study by McLean (1986) represents one of the more comprehensive fauna studies conducted at Point Nepean. Terrestrial mammals, reptiles, amphibians and invertebrates were sampled over a six month period in 1985 using pitfall and Elliot traps. Sites were established at five locations; Wilsons Folly, Cheviot Hill, the Crematorium, a "Fire Site" actually in Harrison's Bowl and a "Bay Site" along Coles track. This is the only survey to have previously identified White-footed Dunnarts, which were trapped consistently at Cheviot Hill (18 captures), Wilsons Folly (seven captures) and the Fire site (one capture). Notably, few captures (2 in total) were recorded in winter months. Swamp Rats were trapped consistently at the Bay site, Cheviot Hill and Wilsons Folly. Reptiles identified at the five sites were Tree Dragon, White's Skink, Garden Skink, Eastern Three-lined Skink, Metallic Skink and White-lipped Snake. Wilsons Folly, once again was found to have the highest number of reptile captures (11) followed by Cheviot Hill (9). Agile Antechinus were not identified, despite the use of Elliot traps.

As well as surveying terrestrial vertebrates, McLean (1986) also reported details of invertebrate fauna at the aforementioned sites. The relative abundance of most species was generally relatively low in winter months in comparison to autumn. Abundance of invertebrates was also found to be highest at Wilsons Folly and lowest numbers in the fire site (nearly three times less).

Overall results from this investigation suggested that the disturbed Moonah habitat was poor habitat for terrestrial vertebrates relative to the Coastal Dune Scrub and Grassland habitats of Wilsons Folly and Cheviot Hill.

Power *et al.* (1985)

A limited field survey of the Quarantine Station and former range areas was conducted in 1983 by Power *et al.* (1985). The survey targeted mammals using Elliot and pitfall traps and terrestrial invertebrates using pitfall traps. Although it is not clear from the report in which season these surveys took place, or what methodology was employed for invertebrate sampling, results revealed the presence of over 40 insect and arachnid species of which one, *Hadrotarsus fulvus* was considered rare. The reports lists Swamp Rat as the only notable native mammal found among a number of un-named introduced mammal fauna, presumably Black Rat and House Mouse. Agile Antechinus was again not recorded.

Callanan and Gibson (1977)

One of the earlier investigations of mammal fauna at Point Nepean was conducted by Callanan & Gibson (1977) who used Elliot and cage traps in an unknown number of sites within Point Nepean and at other sites on the Mornington Peninsula. They found Swamp Rat, Black Rat, House Mouse, Short-beaked Echidna and Common Ringtail Possum at Point Nepean, but did not detect Long-nosed or Southern Brown Bandicoots. This was despite finding Southern Brown Bandicoots at Rosebud and Arthur's Seat. White-footed Dunnarts were found at Boneo Swamp, Mt. Martha and Main Ridge, but none were recorded at Point Nepean, possibly due to the lack of pitfall trapping.

Incidental Sightings of Significant Fauna

A list of incidental sightings provided by Parks Victoria (D. Stephenson), revealed the consistent, albeit infrequent, discovery of live or dead long-nosed Bandicoots, as well as forage diggings over much of the site (although it should be noted that the forage diggings of different Bandicoots and Potoroos are virtually impossible to distinguish from one another). A number of Hooded Plover breeding records were also evident.

Despite a number of faunal surveys at the site, a number of species (in particular, Bandicoots, Dunnarts and Antechinus) have gone largely undetected in recent years. This is most likely due to limitations in survey techniques (in particular the absence of pitfall trapping for Dunnarts), the renowned trap shyness of Bandicoots and the relatively limited scope of individual surveys (most consisted of only four to five sites).

5.2 Methods

5.2.1 Existing Information

All records for the area 38° 20" 10'S, 144° 44" 30'E by 38° 16" 60'S, 144° 38" 00'E were extracted from the Atlas of Victorian Wildlife (AVW) and Atlas of Australian Birds (Barrett *et al.* 2003). Records were plotted on GIS, vetted and spatially erroneous records removed. A list of incidental sightings by PV staff was also obtained and plotted into GIS with the assistance of PV staff (D. Stephenson). Records of significant species are listed in the results section, and a full listing of existing records is provided in the accompanying database.

5.2.2 Site Selection and Stratification

A total of 39 sites throughout both the restricted access and public areas of the study area were established (Table 9; Map 8), with sites stratified according to broad habitat type (see habitat descriptions below). In addition to sites in remnant vegetation, a number of sites were established in maintained cleared areas such as the Rifle Range and Monash

Navigation Break which, although essentially grasslands, were treated as a separate habitat units due to their inherently different species composition and management regimes. The number of sites assigned to each habitat type was broadly proportional to the abundance of that habitat type within the site according to (Parr-Smith & Smith 1978). At least 3 sites were located in each of the major habitat types where possible (Table 9; Map 8).

Table 9. Fauna Site Details.

Survey method abbreviations are; (e) Elliot trap, (c) cage trap, (cat) cat cage trap, (h) hair tube, (p) pitfall trap, (ci) corrugated iron, (spot) spotlight, (bat) anabat bat detector (b) bird survey and (in) incidental observation.

Site no.	Site name	Habitat type	Survey methods
1	Golf Course	Coast Tea-tree/Moonah Woodland	ci, h, c, b
2	Wilsons Folly East	Grassy Woodland	p, e, ci, h, c, b
3	Wilsons Folly West	Grassy Woodland	e, ci, h, c, b
4	Wilsons Folly South	Grassy Woodland	p, e, ci, h, c, b
5	Sierra Nevada Track	Coast Tea-tree/Moonah Woodland	e, ci, h, c, b
6	Crematorium	Moonah Woodland	e, ci, h, c, b
7	Harrison's Bowl North	Coast Tea-tree/Moonah Woodland	p, e, ci, h, c, b
8	Quarantine Moonah South	Moonah Woodland	e, ci, h, c, b
9	Quarantine Moonah West	Moonah Woodland	p, e, h, c, b
10	Monash Break North	Cleared	p, e, h, c, b
11	Wombat Flat	Moonah Woodland	p, e, ci, h, c, b
12	Wombat Foreshore	Foredunes	p, e, h, c, b
13	Monash Foreshore	Foredunes	p, e, ci, h, c, b
14	Observatory Point	Coast Tea-tree/Moonah Woodland	p, e, ci, h, c, b
15	Coles Track	Coast Tea-tree/Moonah Woodland	p, e, ci, h, c, b
16	Happy Valley	Moonah Woodland	p, e, ci, h, c, b
17	Eagles Nest	Headland Scrub	e, ci, h, c, b
18	Pearce Barracks	Headland Scrub	e, ci, h, c, b
19	Fort Nepean South	Headland Scrub	e, ci, h, c, b
20	Hand Grenade West	Moonah Woodland	e, h, c, b
21	Rifle Range	Cleared	p, e, h, c, b
22	Rifle Range Heath	Coastal Heath	p, e, ci, h, c, b
23	Monash Break South	Cleared	p, e, h, c, b
24	Monash Light South	Moonah Woodland	e, h, c, b
25	Hand Grenade East	Moonah Woodland	e, ci, h, c, b
26	25m Range	Coast Tea-tree/Moonah Woodland	e, ci, h, c, b
27	Boonwurrung Track	Coastal Heath	p, e, ci, h, c, b
28	Sierra Nevada	Coastal Heath	p, e, ci, h, c, b
29	Butlers Track Intersection	Grassy Woodland	e, ci, h, c, b
30	Little Harrison's Bowl	Grassy Woodland	e, ci, h, c, b
31	Cheviot Valley	Coastal Heath	p, e, h, c, b
32	Cheviot Foreshore	Headland Scrub	p, e, , h, c, b
33	Cheviot Hill	Headland Scrub	p, e, h, c, b
34	Eagles Nest Bowl	Cleared	e, ci, h, c, b
35	Corsair Rock	Other	b
36	Jarman Oval	Cleared, Grassy Woodland	p, e, h, c, b
37	Defence Rd. 25m Range	Moonah Woodland	p, e, h, c, b
38	CO's House	Other	e, ci, h, c, b
39	Visitor Centre	Other	b

Site locations were chosen to maximize spatial independence; however some sites were established in relatively close proximity to one another due to logistical constraints (Map 8). Sites less than 250m apart were excluded from statistical analyses due to autocorrelation.

Habitat Type Descriptions

At a fine (i.e. within site) scale, vegetation structure has consistently been found to be the primary determinant of faunal composition in Australia (Bennett 1993; Catling & Coops 1999; Mac Nally *et al.* 2000; Mac Nally *et al.* 2001; Chambers & Dickman 2002; Gibson *et al.* 2004; Yeoman & Mac Nally 2005). Thus, habitat types were based mainly on structural vegetation attributes such as dominant canopy species, vegetation height and understorey/ground layer characteristics. Broadly, habitat types follow classifications of Parr-Smith & Smith (1978), although given that almost 30 years have passed since this work, each site was assessed individually using the Parr-Smith & Smith (1978) descriptions as a basis.

Grassy Woodlands – sites 2, 3, 4, 29 and 30.

Dominant vegetation structure; Native grasses
Secondary species; open (generally <50% cover) canopy of Coast Banksia and Drooping Sheoak, and emergent Coast Tea-tree.

EVCs; 309 *Calcareous Swale Grassland,* 858 *Coastal Alkaline Scrub*

Located in two main parts of the study area, five sites were chosen to characterise the fauna of Grassy Woodlands at Point Nepean. Sites two, three and four were located in Wilsons Folly, an area which has been actively managed in the past first by the military, as an 'open' combat training area, then by Parks Victoria as an 'open' habitat area. Sites 29 and 30 were located in the former range area in and around Harrison's Bowl and differed somewhat from Wilsons Folly in that they were comprised of more discrete 'Grassy Bowls' in naturally treeless topographic depressions. It should be noted that these sites are inherently different from the Grassy Woodland in Wilsons Folly as they have not been actively managed in the past.

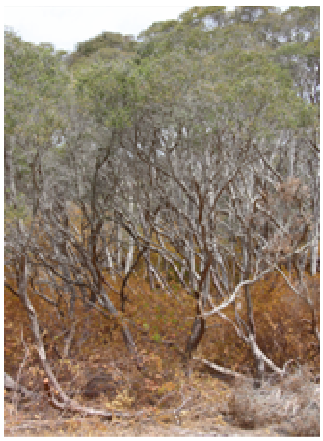
Wilsons Folly (left) and a small 'grassy bowl' in Harrison's Bowl surrounded by Moonah and Coast Teal-tree (right).

Moonah Woodlands – sites 6, 8, 9, 11, 16, 20, 24 and 25

Dominant vegetation structure; Moonah
Secondary species; Coast Tea-tree, Myrtle-leaf Milkwort, native grasses/sedges

EVC; 858 *Coastal Alkaline Scrub*

Abundant throughout much of the site, particularly in hinterland areas away from the Bass Straight Coastline, Moonah Woodlands sites were characterised by a canopy of Moonah and various understorey species, most commonly Coast Tea-tree and the invasive weed Myrtle-leaf Milkwort. The quality (in terms of weediness) of Moonah Woodland sites varied substantially from relatively mature Moonah Woodlands with little Myrtle-leaf Milkwort invasion and relatively open grassy understoreys (below left), to areas of even aged regenerating Moonah dominated in parts by Myrtle-leaf Milkwort and Coast Tea-tree (below right). More mature Moonah Woodlands often possess coarse woody debris, with mosses and lichens also present in these areas.

A mature Moonah Woodland habitat with grassy understorey (left) and an even aged classed Moonah regrowth with dense Myrtle-leaf Milkwort understorey (right).

Coast Tea-tree/Moonah Woodlands – sites 1, 5, 7, 14, 15 and 26

Dominant vegetation structure; Coast Tea-tree, Moonah
Secondary species; Myrtle-leaf Milkwort, Coast Beard Heath

EVC; 858 *Coastal Alkaline Scrub*

A number of sites were established in areas co-dominated by Coast Tea-tree and Moonah. These sites are effectively scrub habitats, often associated with past human disturbance, and have dense canopy cover that lets little light reach the ground. Many of these sites, particularly in the former range area, were comprised of a monoculture canopy of dense Coast Tea-tree two or three metres high and possessed little understorey vegetation (see below). Other sites were more floristically and structurally diverse, containing a mix of Moonah and Coast Beard Heath and sometimes severely infected with Myrtle-leaf Milkwort.

Despite some variation in canopy vegetation, all of the sites in this habitat type were characterised by lacking ground layer vegetation (i.e. grasses, sedges, mosses or lichens).

A monoculture of dense, even aged Coast Tea-tree lacking understorey and ground layer vegetation.

Coastal Heath – sites 22, 27, 28 and 31

Dominant vegetation structure; Moonah (<2m), Coast Tea-tree, Coast Beard Heath
Secondary species; Moonah (<2m)

EVCs; 161 *Coastal Headland Scrub,* 160 *Coastal Dune Scrub*

A thin strip of Coastal Heath habitat extends from London Bridge down much of Point Nepean's Bass Coast to Cheviot Hill. Lacking a true 'canopy' structure many Coastal Heath habitats are floristically similar to Coast Tea-tree/Moonah Woodlands, however the canopy species (mostly Moonah, Coast Tea-tree and Coast Beard Heath) are stunted by strong coastal winds. Coastal Heath habitats do not exceed two metres in height and are usually almost impenetrable from above. They are however often relatively open in comparison at ground level allowing foraging opportunities for terrestrial fauna (see below).

Coastal Heathland vegetation

Coastal Headland Scrub – sites 17, 18, 19, 23 and 33

Dominant vegetation structure; Moonah (stunted), Coast Tea-tree, Coast Beard Heath
Secondary species; *Correa alba*, Sea Box, Coast Daisy Bush

EVC; 161 *Coastal Headland Scrub*

Coastal Headland Scrub sites were established on highly exposed areas with shallow substrate. The lack of soil structure and high exposure to wind and salt spray makes vegetation in these habitats sparse relative to that of Coastal Headlands, with bare ground and dune sands significantly more evident despite a similar floristic structure.

Coastal Headland Scrub vegetation.

Cleared Habitats – sites 10, 21, 23 and 34

Dominant vegetation structure; Exotic Grass
Secondary species; Native Grass

Anthropogenically created clearings are evident at a number of sites within Point Nepean including Monash Navigation Break, Rifle and Hand Gun Ranges, Cemetery, Crematorium and Tip sites. Mostly dominated by introduced grasses, these areas constitute distinct habitats in their own right. Some sites such as the Cemetery and parts of Monash Break form almost intact native grasslands.


Monash Break (left) and the Rifle Range (right).

Foredunes – sites 12 and 13

EVCs; 879 *Coastal Dune Grassland,* 311 *Berm Grassy Shrubland*

Foredunes are evident on both the Port Phillip Bay as Bass Straight coastlines. These areas exist just above the high tide mark and are narrow (<10m) habitats with no structure except for the sparse grasses which establish themselves in the sand.

Foredune Habitat

Other Habitats – sites 35, 38 and 39

Beacon Rock (site 35) is a calcarenite rock which sits at the very end of the Nepean Peninsula at Port Phillip Heads. It protrudes approximately three metres above the high tide mark and is the key high tide roost for coastal birds and shorebirds in the area. There is also an extensive intertidal rock platform leading from the tip of Point Nepean to Beacon

Rock. Other sites established were site 38 on the eastern Port Phillip Bay coastline near Police Point, and site 39 at the current Visitor Centre.

Beacon Rock with intertidal rock platform in foreground.

5.2.3 Survey Methodologies

Specific sampling methodologies are outlined below, and entailed a mixture of methodologies aimed at maximising the detection probabilities for all species potentially inhabiting the study area. Cage, Elliot and pitfall trapping was conducted outside the breeding season of key species in order to avoid pouch young mortality in Marsupial species. Sites were sampled simultaneously where possible, however due to logistical constraints there was some variation in sampling times. Traps were checked each morning and evening of sampling periods. Trapping was conducted under research permit number 10002918.

Incidental records of significant species were also recorded and mapped using GPS or interpretation of geo-rectified aerial photography.

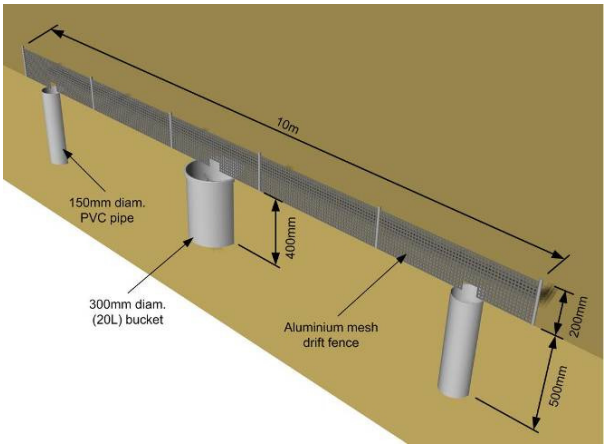
While the scope of this assessment called only for the incidence of species to be established, details of relative abundance were recorded where possible.

Bird Surveys

Bird surveys were conducted at each site using timed 1ha area searches. Area-based surveys were conducted four times per site, for 30 minutes in each season over the survey period. The dimensions of bird survey areas varied according to the characteristics of the habitats being surveyed (see Appendix 8).

In addition to spatially discrete, site-based sampling, monthly bird surveys were conducted in each of the four main areas of the site; Wilsons Folly, the Quarantine Station, former Range Area, Coastal Headland Scrub, and Coastal/Marine habitats (essentially roost and feeding sites e.g. Corsair Rock). The area searched in these surveys was proportional to the extent of the habitat types at the site, therefore relative habitat value cannot be directly inferred from these results.

Pitfall Trapping



Pitfall traps were established at 21 sites throughout the study area (Table 9; Map 8). Pitfall trap sites consisted of a 200mm high, 10m long aluminium drift fence supported by bamboo stakes with one 20L bucket centrally located, and two 150mm diameter PVC stormwater pipes near either end of the drift fence. This design was chosen to maximise the detection probability for the full range of reptiles and small terrestrial mammals likely to be extant at the site. The relatively deep PCV pipes were used to ensure captures of White-footed Dunnart, which have a tendency to escape from shallow pitfalls and are not readily captured in Elliot traps (Friend *et al.* 1989). Pitfall lines at each site were each opened for a total of 36 nights and 36 days over the survey period.

Elliot Trapping

Elliot traps were deployed at each site along linear transects, each consisting of 10 traps spaced at 10m intervals. Trapping was conducted between May and August 2006 with traps open for a total of 10 nights at each site.

Cage Trapping

Cage traps 60x22x22cm were used to sample medium sized mammals (particularly Bandicoots). Five cage traps were placed along 50m transects (10m apart) at each site. Trapping was conducted in conjunction with Elliot trapping (i.e. 10 nights per site).

Cat Trapping

Cat trapping was conducted at a number of sites throughout the study area. Cat traps 70x30x30 were baited with Fried Chicken and scent was placed at the entrance of each

trap. Cat trapping was conducted for three weeks during the cat breeding season. Traps were checked each morning during the trapping period and closed during the day.

Corrugated Iron

A number of sites within the study area located on impenetrable substrates (e.g. Coastal Cliff habitats), making the establishment of pitfall traps impractical. Areas contaminated with unexploded ordinance at the time of surveys also precluded the installation of pitfall traps in some areas. Sampling for reptiles and small mammals in these areas was conducted using corrugated iron roofing placed in sunny areas. Corrugated iron sheets were left out continuously over the study period and were checked in conjunction with pitfall trapping periods.

Hair Identification

Typical hair tube used during the study
Photo P. Bertuch

Hair tubes made from 30cmx25cm clear plastic sheets folded and held in place with horseshoe shaped rod were used to collect hair from medium sized mammals (e.g. Bandicoots, Rodents and Macropods). Ten hair tubes spaced 20m apart were placed along trap lines at each site. Hair tubes were left out for 14 days at each site, then collected and analysed by Paul Bertuch and Hans Brunner. It should be noted that the hair tubes used here targeted medium sized mammals, and were not suitable for sampling small mammals, e.g. Dunnarts or Antechinus, which were instead sampled using other methods outlined.

Predator Scat analysis

Predator scats were collected incidentally at a number of locations throughout the site. The contents of scats were identified by Paul Bertuch and Hans Brunner through hair analysis and visual identification.

Incidental observations

Incidental observations of species not likely to be revealed using other methods and/or trap shy species (e.g. large snakes, Echidnas and Macropods) were recorded and either assigned to a nearby site, or entered as incidental observations in the database.

Active reptile searches

A number of active searches for basking and diurnally foraging reptiles were conducted by M. Legg in appropriate conditions (i.e. fine weather in spring and summer). Searches were conducted at sites as well as in other areas likely to support reptile species. Results were assigned to the appropriate site or entered as incidental observations in the database.

Spotlight surveys

Spotlighting was carried out over four nights in summer 2005-2006 and spring 2006 during a range of weather conditions best suited for fauna activity. Several species were identified such as owls, bandicoots, possums, wallabies and micro bat activity was the greatest during late summer as thunderstorms rolled in.

Microbat Surveys

Microbat echolocation calls were recorded over four nights throughout the study site and analysed by M. Legg using Anabat software.

Data Storage

All fauna records are supplied electronically in an Access Database. Records have also been submitted to the Atlas of Victorian Wildlife and Atlas of Australian Birds.

Data Analysis

State and national faunal classifications follow the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2003). Species listed under treaties or agreements to which the Federal Government is party are identified as nationally significant. For the purposes of this report such treaties or agreements consist of bilateral migratory bird agreements with Japan (JAMBA) and China (CAMBA) and the Agreement on the Conservation of Albatrosses & Petrels.

Regionally significant species are defined as species that are significant within the Gippsland Plains Bioregion. Regional significance classifications for birds were defined using published information on declining species in Victoria and the bioregion in particular (Robinson & Traill 1996; Reid & Landsberg 1999; Radford & Bennett 2005).

Mapping

An electronic GIS file outlining all study sites is provided on the accompanying compact disc. The file is in MapInfo™ format and has associated with it an attribute table defining

survey methodologies used at each site. The file uses Map Grid of Australia 1994 (MGA94), zone 55 coordinates.

5.3 Results

5.3.1 Existing Records

The atlas of Victorian Wildlife lists a total of 135 species of vertebrate fauna (119 of which are native) in the study area. These consist of 98 birds (including seven introduced species), 24 mammals (including six marine and five introduced species) and 13 reptiles (Table 10; also see database provided). Although some of the species included in this list are likely to be vagrant (e.g. Arctic Jaeger, Eastern Curlew and some marine mammals), the diversity of resident vertebrate species at the site is substantial.

Details of these records are contained in the spreadsheet (Existing_Fauna_Records.xls) and the spatial location of the records is recorded on the GIS files accompanying this report.

Table 10 below presents Atlas of Victorian Wildlife and Atlas of Australian Birds records for vertebrate species of conservation significance (i.e. regional, state or nationally significant) in the study area.

Table 10. Significant Species detected within the study area from existing Records

Significance abbreviations are; (CE) critically endangered, (EN) endangered, (VU) vulnerable, (NT) near threatened, (J) JAMBA, (C) CAMBA, (A) Agreement on the Conservation of Albatrosses & Petrels, (L) FFG listed, (R) regionally significant.

Common Name	National Status	Victorian Status	Regional Status
Mammals			
Agile Antechinus			R
Black Wallaby			R
Long-nosed Bandicoot			R
Southern Brown Bandicoot	EN	NT	
Southern Right Whale	EN	CE	
White-footed Dunnart		VU	
Birds			
Australasian Gannet			R
Bassian Thrush			R
Black Falcon		VU	
Black-browed Albatross		EN	
Black-eared Cuckoo		NT	
Black-faced Cormorant		NT	R
Blue-winged Parrot			R
Brush Bronzewing			R
Crested Tern			R

Common Name	National Status	Victorian Status	Regional Status
Eastern Curlew		NT	R
Eastern Yellow Robin			R
Fairy Tern		EN	
Flame Robin			R
Grey Currawong			R
Hooded Plover		VU	
Kelp Gull			R
Little Penguin			R
Northern Giant-Petrel	VU	NT	
Olive Whistler			R
Pacific Gull		NT	
Painted Button-quail			R
Peregrine Falcon			R
Pied Cormorant		NT	
Pied Oystercatcher			R
Scarlet Robin			R
Shy Albatross	VU	VU	
Sooty Oystercatcher		NT	
Southern Boobook			R
Spotted Quail-thrush		NT	
Striated Fieldwren			R
White-fronted Tern		NT	
Reptiles			
Marbled Gecko			R
Metallic Skink			R
Southern Grass Skink			R
Tree Dragon			R
White-lipped Snake			R

The vast majority of existing fauna records are sourced from previous specific studies (see literature review) and are thus spatially clustered around the areas targeted in those studies. Some areas of Point Nepean such as the Quarantine Station and Wilsons Folly have been comparatively well surveyed over the years, while others such as the former Range area have been surveyed only sporadically.

5.3.2 New Records

Birds

A total of 86 bird species were detected within the study area over the survey period (Table 11). They included seven nationally significant species, one of which, the Shy Albatross (which is listed as vulnerable under the EPBC Act) and six other species listed under international treaties or agreements (Table 11). Fourteen state significant birds (i.e. specified under FFG legislation or in the VROT listing) were also recorded (Table 11). While

none of the nationally significant birds detected are resident at Point Nepean (i.e. actually depend on habitat resources within the site), at least nine of the fourteen state significant species are resident at the site (Table 11). In addition, 14 regionally significant birds were recorded. All of these regionally significant birds, with the exception of Blue-winged Parrot, are resident at or around the site (although Flame Robins, Shining Bronze-Cuckoos and Swamp Harriers are seasonal migrants).

Table 11. Birds detected during surveys.

Species prefixed with an asterix are introduced. Significance abbreviations are; (EN) endangered, (VU) vulnerable, (NT) near threatened, (J) JAMBA, (C) CAMBA, (A) Agreement on the Conservation of Albatrosses & Petrels, (L) FFG listed and (R) regionally significant. Note: the right hand column is a continuation of the list following Brown Goshawk. Status abbreviations correspond to species in the left hand column.

Common Name	EPBC	FFG	VROT	Treaty	Regional
Shy Albatross	VU	L		A	
Hooded Plover		L	VU		
White-bellied Sea-Eagle		L	VU	C	
Caspian Tern		L		C	
Powerful Owl		L			
Black-browed Albatross			EN	A	
Crested Tern				J	
Short-tailed Shearwater				J	
White-throated Needletail				C	
Black-faced Cormorant			NT		
Brown Quail			NT		
Pacific Gull			NT		
Pied Cormorant			NT		
Sooty Oystercatcher			NT		
Spotted Quail-thrush			NT		
White-faced Storm-Petrel			NT		
Black Falcon			VU		
Blue-winged Parrot					R
Brush Bronzewing					R
Buff-banded Rail					R
Crescent Honeyeater					R
Eastern Yellow Robin					R
Flame Robin					R
Kelp Gull					R
Little Penguin					R
Mistletoebird					R
Painted Button-quail					R
Shining Bronze-Cuckoo					R
Southern Boobook					R
Spiny-cheeked Honeyeater					R
Swamp Harrier					R
*Common Blackbird					
*Spotted Turtle-Dove					
*Common Starling					
Australasian Gannet					
Australian Magpie					
Australian Raven					
Australian Shelduck					
Barn Owl					
Black Swan					
Black-faced Cuckoo-shrike					
Brown Falcon					
Brown Goshawk					

Common Name
Brown Thornbill
Common Bronzewing
Crested Pigeon
Crimson Rosella
Eastern Rosella
Eastern Spinebill
Fan-tailed Cuckoo
Galah
Golden Whistler
Great Cormorant
Grey Butcherbird
Grey Fantail
Grey Shrike-thrush
Horsfield's Bronze-Cuckoo
Laughing Kookaburra
Little Black Cormorant
Little Pied Cormorant
Magpie-lark
Masked Lapwing
Musk Lorikeet
Nankeen Kestrel
New Holland Honeyeater
Peregrine Falcon
Red Wattlebird
Red-browed Finch
Rufous Whistler
Satin Flycatcher
Silver Gull
Silvereye
Singing Honeyeater
Spotted Pardalote
Straw-necked Ibis
Striated Thornbill
Superb Fairy-wren
Tawny Frogmouth
Wedge-tailed Eagle
Welcome Swallow
Whistling Kite
White-browed Scrubwren
White-faced Heron
Willie Wagtail
Yellow-faced Honeyeater

Grassy Woodland birds

Although Grassy Woodlands habitats are limited at Point Nepean, a number of ground-dwelling/ground-foraging woodland birds were recorded within the site. True ground-dwelling birds (i.e. birds that forage, nest and shelter on the ground) included Brown Quail and Spotted Quail-thrush (both of which are listed as Near Threatened in Victoria) as well as the Painted Button-quail (which is regionally significant). These three species were found only in Grassy Woodland habitats in Wilsons Folly.

Spotted Quail-thrush (left) and Brown Quail (right). Both photos © Chris Tzaros.

Principally granivorous, these birds feed early in the morning or late afternoon/evening on seeds and occasionally on foliage and invertebrates on or near the ground (Marchant *et al.* 1994). Given their ground-dwelling habitat, these species are particularly vulnerable to predation by cats and foxes. All three of these birds are extremely cryptic, particularly during daylight hours when they are least active, and only call consistently during the breeding season in spring.

Red-browed Finch. Photo © G.Ehmke.

In addition to the three truly ground-dwelling species aforementioned, two other species, Brush Bronzewing and Red-browed Finch, also displayed a strong preference for Grassy Woodland habitat at Point Nepean. While Bronzewings and Red-browed Finches nest in vegetation above the ground, they do spend a significant portion of time at or near the ground foraging for seeds and terrestrial invertebrates.

Non ground-foraging species, Crescent Honeyeater and Swamp Harrier, were also found to be characteristic of Grassy Woodland habitats within the site. Crescent Honeyeaters are spring-summer migrants to the site where they breed and were recorded only in Wilsons Folly and Harrisons Bowl. Crescent Honeyeaters were often seen feeding on Banksia flowers in Wilsons Folly. Swamp Harriers are also spring-summer migrants to the area (although they do not seem to breed within the site) and were one of the more commonly seen raptors during this period. Other raptors seen hunting in Grassy Woodlands included Black-shouldered Kite, Wedge-tailed Eagle, Whistling Kite and Brown Falcon. Australian Shelduck were also observed foraging in Wilsons Folly in winter 2006.

Black-shouldered Kite with Swamp Rat captured in Wilsons Folly. Photo G.Ehmke

Woodland birds

Woodland habitats at Point Nepean are characterised by a relatively generalist assemblage of birds. Consequently, many species have distributions that extend beyond woodland complexes into Coastal Heath, Coastal Headland Scrub and Grassy Woodlands. While these species often forage in a range of habitats, they are most abundant in woodland complexes and often require woodland habitat for nesting.

Eastern Yellow Robins are breeding residents in woodlands complexes at Point Nepean. They nest in swales in Moonah, Coast Tea-tree and introduced plants such as Boxthorn. Although this species is found in coastal areas, they are most common in woodland complexes. Eastern Yellow Robins construct cup-shaped nests, lightly decorated with lichens and mosses. They are often seen perching sideways on tree trunks foraging for insects.

Eastern Yellow Robin (left), Grey Shrike-thrush (centre) and Grey Fantail nest in Coast Tea-tree (right). Photos G. Ehmke and P. Bertuch.

Grey Shrike-thrush are also widespread throughout much of the site, but prefer woodland complexes. Grey Shrike-thrush use partial tree hollows as nesting platforms and nest mostly on old growth Moonah. They are opportunistic feeders preying mainly on insects and reptiles. They are generally tolerant of human activity in their surrounds.

White-browed Scrubwren and Superb Fairy-wren are both widespread throughout the site, but again, are most commonly found in woodland complexes with relatively complex understoreys. They do however forage in more open habitats where insect prey is more abundant. Both species are breeding residents at Point Nepean.

Grey Fantails are locally common throughout much of the site during spring and summer. The majority of Grey Fantails migrate north in March-April after breeding in Woodland complexes. Grey Fantail nests can be found in scrub and woodland habitats throughout the study area in spring and summer.

Golden Wistlers are common in woodland areas at times during the year, but are largely absent at other times. This species may migrate locally in and out of the site.

Yellow-faced Honeyeaters are another habitat generalist at Point Nepean, and are one of the most common birds at the site. They were recorded at the vast majority of sites during the survey, but were most common in woodland complexes.

Brown Thornbills are widespread in most habitats throughout the site, and nest in dense vegetation in woodland areas.

In contrast to the aforementioned species, Spiny-cheeked Honeyeaters are woodland specialists at Point Nepean. Spiny-cheeked Honeyeaters were common in woodland complexes, but rarely found in Coastal Heath or Heathland habitats.

Spiny -cheeked Honeyeater (left), photo © Chris Tzaros. Brown Thornbill (right) photo © G. Ehmke.

Brown Goshawks are resident at the site and are most commonly seen in hinterland areas of the study area where they hunt woodland birds and other prey. This is another species which seems to specialise in woodland habitats. Brown Goshawks were not observed

breeding within the site, but given their presence throughout the year, and the observation of a number of juvenile birds, probably nest nearby, if not within Point Nepean.

Three Owls were recorded at Point Nepean including the FFG listed Powerful Owl which was heard calling at Fort Nepean during a spotlight survey in May 2006. Barn Owls were heard calling around the Gunners Car Park area in spring 2006, but Southern Boobooks were the only common Owl species at Point Nepean. Southern Boobooks can be heard calling at night, and occasionally seen roosting during the day. Tawny Frogmouths were also recorded at two sites during spotlight surveys.

Coastal Heathland/Headland birds

Singing Honeyeaters are breeding residents at Point Nepean, and are characteristic of Coastal Heath and Coastal Dune Scrub habitats. This species is specialist in these habitats and displayed almost no overlap with Spiny-cheeked Honeyeaters.

While Silvereyes are common throughout much of the site, particularly in spring and summer when they breed, they are most commonly seen in Coastal Habitats along the Bass Coast. Some Silvereyes migrate out of the area during winter.

Singing Honeyeater (left) and Silvereye (right). Both photos © Glenn Ehmke.

In contrast to the hinterland habitat preference shown by Brown Goshawks, Nankeen Kestrels and Peregrine Falcons hunt along the Bass Strait Coast and can be seen frequently from London Bridge to the Forts at the Point. While Nankeen Kestrels do not seem to breed at the site, one Peregrine Falcon pair has bred consistently at the same site in the coastal cliffs along the Bass Strait Coast for a number of years (see Map 10). This pair fledged two young in 2006 which were seen flying independently as late as January 2007 at which time they presumably dispersed from the site.

Black Falcons were also observed on a number of occasions during winter and spring flying over coastal habitats along the Bass Strait Coast. Black Falcons are listed as vulnerable in Victoria (DSE 2003).

Although Red Wattlebirds are resident in relatively low numbers throughout much of the site, large flocks of up to 200 birds can occasionally be seen around the narrow coastal strip from Cheviot Hill to Fort Nepean.

White-throated Needletails are summer spring-migrants to Australia and make their way down the east coast arriving in coastal Victoria around December. They can be seen flying overhead, mainly along coastal sections of the study area mainly from December to March.

Young Peregrine Falcons in their cliff-based nest. Photo G. Ehmke.

Open country birds

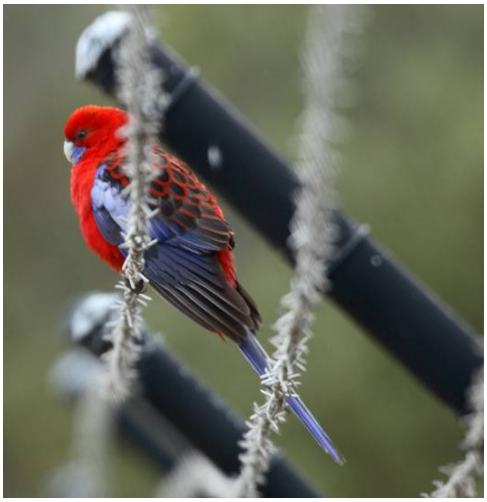
There are a number of cleared habitats extant throughout the study area. These areas provide foraging opportunities for 'open country' birds such as Australian Magpie, Magpie-lark, Laughing Kookaburra, Ravens and Rosellas.

Australian Magpies are breeding residents often seen in pairs or small family groups along Defence Road and Monash Break and generally in woody fringes adjacent to open habitats.

Crimson and Eastern Rosellas were also commonly seen in these areas where they foraged for seeds. Both species of Rosella are hollow nesters and thus breeding opportunities are limited within Point Nepean. However, old Moonah does sometimes form hollows large enough for these species to breed in. Eastern Rosellas were observed breeding in a large Moonah near the 25m range along Defence Road (see below).

Flame Robins can also be seen in open areas during autumn and winter when they migrate into the region from their high country breeding grounds.

Raptors such as Whistling Kites and Brown Falcons can also be seen at times in and around the study area. These species typically forage in open country habitats.




Crimson Rosella (left, photo G.Ehmke) and Eastern Rosella chicks in Moonah Hollow (right, photo M.Legg).

Shorebirds

The varied habitats on offer around the Point Nepean coastline provide important foraging, roosting and breeding habitat for a number of resident shorebirds.

Adult Hooded Plover with beach nest (inset left) near Observatory Point and rock isolet nest with recently hatched chicks at Sierra Nevada Rock on the Bass Coast (inset right) Photos G. Ehmke.

Hooded Plovers are breeding residents at Point Nepean and can be seen year round along the Bass Strait Coast beaches and sporadically on Port Phillip Bay beaches in Nepean and Ticonderoga Bay (see Map 10). Hooded Plovers are Australia's only exclusively beach-dependent bird (i.e. they spend all of their lives in beach habitats) and are considered vulnerable in Victoria under the FFG Act 1988. Hooded Plovers tend to flock together during

their non-breeding period, foraging along the beach shoreline amongst beach-cast seaweed and on rock platforms along the Bass Strait Coast. Towards the end of winter, Hooded Plovers pair off and hold territories approximately one kilometre long. They breed anytime between August and February often making numerous attempts (up to seven in one season have been recorded) to fledge a chick. Nests consist of a simple scrape on the ground (see above) and are established anywhere between the high tide mark and dunes on higher energy coastlines. Chicks are fully precocial and leave the nest within a few hours after hatching to start feeding. Chicks and eggs are extremely vulnerable, and each have a survival rate of only around 20% (Weston 2003).

Hooded Plover eggs are highly exposed to predators and can also be easily crushed by humans or dogs. Chicks are even more vulnerable to predation, from a range of avian and terrestrial predators and can also be trampled. Chicks cannot fly until approximately five weeks after hatching, and their only defence is to hide from potential danger. Thus much of their time is spent hiding next to beach debris or in foredune vegetation. This prevents chicks from being able to forage resulting in reduced fitness and starvation in some cases. Hooded Plovers thus are highly sensitive to human disturbance.

Hooded Plovers were observed nesting at three locations within Point Nepean in the 2006-2007 breeding season, between Monash Break and Observatory Point in Ticonderoga Bay, east of Cheviot Beach on the Bass Strait Coast and on Sierra Nevada Rocks (see Map 10). At least four separate nesting attempts were made (although there may have been more which were not recorded), with the pair near Cheviot beach fledging two chicks in December 2006.

Hooded Plover chicks with Adult near Cheviot Beach in December 2006. Photo G. Ehmke.

Sooty Oystercatchers and White-faced Herons can be seen on rocky shorelines along the Bass Strait Coast and Port Phillip Heads year round. Sooty Oystercatchers, which are listed as Near Threatened in Victoria, feed on Molluscs and other intertidal invertebrates on rocky shore platforms. Sooty Oystercatchers nest on rock isolets away from land predators. At least two pairs of Sooty Oystercatchers bred at Point Nepean during Spring-Summer 2006, one on an isolet off the Bass Strait Coast and another at Nepean Rock. One juvenile bird was observed foraging and flying around rock platforms with its parents in late December 2006.

Juvenile Sooty Oystercatcher with parents (egg inset) (left) and White-faced Heron (right). Photos © G. Ehmke.

Coastal birds

Point Nepean and the surrounding waters (including the Port Phillip Heads Marine National Park and Ticonderoga Bay Sanctuary) provide habitat for a number of migratory and resident coastal bird species.

Australasian Gannets (below left) are the most common coastal bird at Point Nepean and can be seen flying in and out of Port Phillip Heads on most days throughout the year. This species nests nearby at Pope's Eye. Short-tailed Shearwaters on the other hand, are seasonal migrants to Port Phillip Bay where they breed in spring and summer before returning to the Northern Hemisphere. Large flocks of Short-tailed Shearwaters can be seen foraging in Port Phillip Bay and flying in and out of the heads. White-faced Storm-Petrels can also be seen flying in and out of Port Phillip Bay during spring and summer from their breeding colonies on Mud Islands and South Channel Fort.

Australian Gannett (left, photo G. Ehmke) and Short-tailed Shearwaters (right) diving for food (right Photo G. Ehmke).

Both Crested and Caspian Terns are visible flying and or foraging off the Point Nepean coast or roosting on Nepean Rock at various times of the year. Caspian Terns are by far the larger of the two Tern species and can also be distinguished by their strongly coloured red bills (see below). Caspian Terns are listed under FFG legislation in Victoria, as well as the CAMBA agreement on migratory species. The movement patterns of Caspian Terns are poorly understood, but in Victoria birds generally disperse from colonies after breeding (Higgins &

Davies 1996). Crested Terns are also partially migratory although their large scale movements are relatively poorly understood. In Victoria, evidence suggests that a large proportion of the population disperses from breeding areas after young fledge around January. Crested Terns are far more numerous than Caspian Terns at Point Nepean and groups of 200 or more birds can be seen roosting on Nepean Rock from spring to early autumn. Both species of Tern breed on nearby Mud Islands.

Caspian (left) and Crested Terns on Nepean Rock. Photo G. Ehmke

Pacific Gulls can be found all around the Point Nepean coastline on both bay and ocean beaches and Intertidal rock platforms. Kelp Gulls can also be found in these habitats however they are far less common then the similar looking Pacific Gull. Neither species was observed breeding within the site.

Sub-adult Pacific Gulls (left) and Juvenile Pacific Gull (right). Both photos G. Ehmke.

Great and Black-faced Cormorants are the most commonly seen of five cormorant species at Point Nepean. Great Cormorants have a relatively dispersed distribution around the Point Nepean coastline and can be seen roosting on Sierra Nevada and other supratidal rocks on the Bass Strait Coast as well as at Nepean Rock. Black-faced Cormorants have an aggregated distribution relative to Great Cormorants and can be seen roosting in groups of around 30 most days, and up to 100 during March on Nepean Rock. Pied, Little Pied and Little-black Cormorants were also observed at Point Nepean, albeit in smaller numbers than either the Black-faced or Great Cormorants. None of the cormorant species were observed breeding at Point Nepean.


Great Cormorants roosting on Sierra Nevada Rock (left) and Black-faced Cormorants roosting on Nepean Rock. Both photos G. Ehmke.

Little Penguins were occasionally seen feeding in Nepean and Ticonderoga Bays and on one occasion roosting on Nepean Rock. Little Penguins breed at Phillip Island and regularly disperse into Port Phillip Bay to feed.

Introduced birds

Three introduced species; Spotted Turtle-dove, Common Blackbird and Common Starling were recorded within Point Nepean. Common Blackbirds were widespread and abundant throughout the site and were consistently recorded at the vast majority of sites. This species was most abundant in woodland complexes, but was also found in all other habitats across the study area. Common Blackbirds are not aggressive towards native birds, however they are the principal dispersal vectors for a number of weed species including Italian Buckthorn.

Spotted Turtle Doves were found only in one part of the study area (five sites total) around Eagles Nest and Cheviot Hill (see below). Common Starlings also had a relatively narrow distribution being confined to the Quarantine Station area where they presumably nested in and around buildings and Cypress Pine trees.

Monthly bird counts

Table 12 lists the relative monthly abundance of bird species in the five main areas of the study site. Groupings evident in the tables reflect species occurrence and relative abundance within particular park areas. First, species were grouped as residents, seasonal migrants or vagrants.

Resident species are those which can remain within the study area throughout most or all of the year and depend on resources within a given area for most, if not all of their habitat needs. Resident species however, may not necessarily breed within the study area. Seasonal migrants are species which visit the study area in particular periods either to breed (generally spring-summer migrants) or over-winter (winter migrants).Vagrant species are those which were recorded only occasionally in a given area, or were consistently recorded off site as over-fly's.

Resident species were grouped according to index values derived from their relative occurrence and abundance within each area. Index values were calculated by assigning numeric values to relative abundance classifications (3 for common, 2 for uncommon and 1 for rare), summing these values across each month, then standardising the values relative to the highest possible value (3x14; i.e. 42). Rare residents were defined as those species with index values less than 0.33 (which corresponds to a rare rating in each month). Resident species with index values higher than 0.33 were classified as common residents.

Common residents were mostly generalist species such as Superb Fairy-wren, Brown Thornbill, White-browed Scrubwren and Eastern Yellow Robin and honeyeaters. Rare residents were generally more specialised in their habitat requirements and included ground-foraging/dwelling birds and raptors.

Crescent Honeyeaters and the three Cuckoo species are examples of spring-summer migrants that breed at the site, while species such as Swamp Harrier, White-faced Storm-Petrel and Short-tailed Shearwater are spring-summer migrants that breed nearby. Flame Robins were the only true winter migrant to be recorded. Australasian Gannets are an example of a vagrant species consistently recorded flying past the site, but never actually utilising habitat within Point Nepean. Other vagrant species such as the Black-faced Cuckoo-Shrike may have been recorded in habitat within the site but were only present for a short period of time.

Table 12. Monthly bird counts in selected areas.

Abbreviations are; (A) abundant, (C) common, (Un) uncommon, (R) rare and (B) breeding. See above for description of index values.

Quarantine Station

Species	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Index
Common residents															
*Common Blackbird	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Superb Fairy-wren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Brown Thornbill	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Red Wattlebird	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Spiny-cheeked Honeyeater	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Yellow-faced Honeyeater	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
White-browed Scrubwren	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Silvereye	CB	CB	C	C	C	C	C	C	C			C	C	C	0.86
Australian Raven	C	C					C	C	C	C	C	C	C	C	0.71
Grey Shrike-thrush	UnB	UnB	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.67
Willie Wagtail	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.67
Magpie-lark			C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.64
Eastern Yellow Robin	CB	CB	C	C	C	C	Un	Un	Un	Un					0.62
Crimson Rosella	C	C	C	C	C	C				Un	Un	Un			0.57
Brown Goshawk			Un	Un	Un	Un			Un	Un	C	C	C	C	0.57
Australian Magpie	C	C	C	C	C	C				Un	Un	Un			0.57
Grey Fantail	C	C					Un	Un	C	Un	Un	Un	Un	Un	0.55
Whistling Kite				Un	Un	Un	C	C	C			Un	Un		0.45
Grey Butcherbird	Un	Un	Un	R	R				R	Un	Un	Un	Un	Un	0.45
Masked Lapwing	C	C	C	C	C	C									0.43
*Spotted Turtle-Dove	CB	CB	C	C	C	C									0.43
Eastern Rosella		C	C							C	C	C			0.36
Rare residents															
Striated Thornbill	Un	Un	Un												0.14
Southern Boobook			Un			C									0.12
New Holland Honeyeater										Un	Un				0.10
Laughing Kookaburra				Un	Un										0.10
Eastern Spinebill			R	R	R										0.07
Golden Whistler					R										0.02
Seasonal migrants															
Swamp Harrier	C								C	Un	Un	Un			0.29
Mistletoebird			C	C	C	C									0.29
Galah									Un	C	C				0.19
Fan-tailed Cuckoo									Un	Un	Un				0.14
Shining Bronze-cuckoo									Un	Un	Un				0.14
Crested Pigeon													Un	Un	0.10
White-throated Needletail			C												0.07
Flame Robin				R	R										0.05
Vagrants															0.00
Black-faced Cuckoo-shrike					R										0.02
Rufous Whistler								R			R				0.05
Wedge-tailed Eagle	Un	Un					Un	Un	Un						0.24
Tawny Frogmouth	Un														0.05

Table 12 (continued)
Coastal Heathland/Headland Scrub

Species	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Index
Common residents															
*Common Blackbird	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Superb Fairy-wren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
White-browed Scrubwren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Brown Thornbill	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Singing Honeyeater	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Yellow-faced Honeyeater	C	C	C	C	C	C	Un	Un	C	C	C	C	C	C	0.95
Silvereye	CB	C	C	C	C	C	C	C	C	Un	Un	C	C	C	0.95
*Spotted Turtle-Dove	CB	CB	C	C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	0.81
Red Wattlebird	CB	CB	C	C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	0.81
Eastern Yellow Robin	CB	CB	C	C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	0.81
Spiny-cheeked Honeyeater			C	C	C	C	C	C	C	Un	Un	Un	Un	Un	0.74
Brown Goshawk	C	C	C	Un		Un	Un	Un	Un	Un	Un	Un	Un	Un	0.69
Grey Shrike-thrush	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.67
Welcome Swallow	C	C				C			C	Un	Un	Un	Un	Un	0.52
Australian Magpie	Un	Un	Un	Un	Un	C	R	R	R						0.38
Rare residents															
Whistling Kite				Un						Un	Un	Un	Un	Un	0.29
Wedge-tailed Eagle	C	C					Un	Un	Un						0.29
Peregrine Falcon					R	R	R	R	R	R	R	R	R		0.21
Nankeen Kestrel														R	0.02
Seasonal migrants															
Swamp Harrier	C								C	Un	Un	Un			0.29
White-throated Needletail		C													0.07
Satin Flycatcher											R				0.02

Coastal

Species	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Index
Common residents															
Black-faced Cormorant	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Little Pied Cormorant	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Great Cormorant	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Pacific Gull	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Silver Gull	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Sooty Oystercatcher	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	UnB	UnB	UnB	0.67
Pied Cormorant	C	C	C	C	C	Un									0.40
Crested Tern	C	A	A	C	C	C							Un	C	0.40
Kelp Gull	Un	Un	Un	Un	Un	Un					R	R	R		0.36
Rare residents															
Hooded Plover	RB	R	R	R	R	R	R	R	R	RB	RB	RB	RB	RB	0.33
Masked Lapwing	Un	Un	Un	Un	Un	Un									0.29
Caspian Tern								R	R	R					0.07
White-faced Heron													R	R	0.05
Seasonal migrants															
White-faced Storm-Petrel***											R	R			0.05
Short-tailed Shearwater***											C	C	C	C	0.29
Vagrants															
Australasian Gannet**	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Little Penguin					C	C	C	C	C	C	C	C		R	0.60
Shy Albatross*						Un	C	C	C	C	C				0.40
Black-browed Albatross*						Un	C	C	C	C	C				0.40
Straw-necked Ibis													R	R	0.05

** Albatross are occasionally seen off the coast of Point Nepean*

*** Australasian Gannets are common overflys along the entire coastal secion of the park*

**** These species are commonly seen moving in and out of Port Phillip Heads*

Table 12 (continued)

Wilsons Folly

Species	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Index
Common residents															
Superb Fairy-wren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
White-browed Scrubwren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Brown Thornbill	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Silvereye	C	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Red Wattlebird	C	C	C	C	C	C	Un	Un	Un	Un	Un	Un	C	C	0.86
Brown Goshawk	Un	Un	Un	Un	Un	Un	C	C	C	C	C	C	Un	Un	0.81
*Common Blackbird	CB	CB	C	C	C	C				C	C	C	C	C	0.79
Grey Shrike-thrush	UnB	UnB	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.67
Eastern Yellow Robin	UnB	UnB	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.67
Yellow-faced Honeyeater	CB	CB	C	C	C					C	C	Un	Un	Un	0.64
Spiny-cheeked Honeyeater	CB	CB	C	C	C	C								Un	0.48
Golden Whistler	CB	CB	Un	Un	Un		Un	C	C						0.48
Australian Magpie	C	C	C	C	C	C									0.43
Grey Fantail					Un	C	C					C	Un	Un	0.36
Rare residents															
Eastern Rosella	Un	Un				Un	Un	C	C						0.33
Red-browed Finch				C	C	C	C								0.29
Mistletoebird							C	C	C						0.21
Painted Button-quail		Un				Un									0.10
Brush Bronzewing		Un	Un												0.10
Grey Butcherbird				Un	Un										0.10
Brown Quail			R			Un									0.07
Buff-banded Rail	R														0.02
Spotted Quail-thrush													R		0.02
Seasonal migrants															
Crescent Honeyeater	UnB	Un					Un	Un	Un	Un	Un	Un	Un	Un	0.48
Swamp Harrier	Un								C	C	Un	Un			0.29
Musk Lorikeet	C							C	C						0.21
Horsfield's Bronze-Cuckoo									Un	Un	Un				0.14
Vagrants															
Wedge-tailed Eagle	Un	Un					Un	Un	Un						0.24
Welcome Swallow	Un	C				C									0.19
Singing Honeyeater		R													0.02
Black-shouldered Kite												R			0.02
Australian Shelduck									R	R					0.04

Table 12 (continued)

Range area

Common Name	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sept-06	Oct-06	Nov-06	Dec-06	Jan-07	Index
Common residents															
Superb Fairy-wren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
White-browed Scrubwren	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Brown Thornbill	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Yellow-faced Honeyeater	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
*Common Blackbird	CB	C	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Silvereye	CB	CB	C	C	C	C	C	C	C	C	C	C	C	C	1.00
Spiny-cheeked Honeyeater	CB	CB	C	C	C	C	C	C	C	Un	Un	C	C	C	0.95
Grey Shrike-thrush	UnB	UnB	Un	Un	Un	Un	C	C	C	C	C	C	C	C	0.86
Eastern Yellow Robin	C	C	C	C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	0.81
Australian Magpie	C	C	C	C	C	C	Un	Un	Un	C	C	C			0.79
Spotted Pardalote	C	C	Un	Un	Un	Un	Un	Un	Un	Un	Un	C	C	C	0.79
Brown Goshawk	Un	Un	C	C	C	C	Un	Un	Un	Un	Un	Un	Un	Un	0.76
Red Wattlebird	CB	CB	C	C	C	C	C	C	C	Un	Un				0.74
Peregrine Falcon			Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.57
Golden Whistler	CB	CB	C	C	C		Un	Un	Un	Un					0.55
Whistling Kite				Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	Un	0.52
Brown Falcon			Un	Un	Un	Un	Un	Un	Un		Un	Un	Un	Un	0.52
Grey Fantail	CB	CB	C	C					C	C	Un	Un			0.52
Eastern Rosella	CB	C			Un	Un	Un	Un	Un				Un	Un	0.48
Grey Butcherbird	Un	Un	Un	R	R				R	Un	Un	Un	Un	Un	0.45
Crimson Rosella					Un	Un	Un	Un	Un	Un	Un	Un			0.38
Rare residents															
Welcome Swallow		C							C	Un	Un	Un	Un		0.33
New Holland Honeyeater	Un	Un	Un	Un		Un	R	R	R						0.31
Mistletoebird			C	C	C	C									0.29
Brush Bronzewing			R			Un									0.07
Eastern Spinebill		Un				Un	R	R	R						0.17
Red-browed Finch		R	R												0.05
Southern Boobook						Un									0.05
Seasonal migrants															
Swamp Harrier	Un	Un							Un	Un	Un	Un	Un	Un	0.38
Crescent Honeyeater	UnB	Un							R	R	R	R	R	R	0.24
Shining Bronze-Cuckoo	UnB	UnB							Un	Un					0.19
Galah									Un	C	C				0.19
Flame Robin				Un	Un										0.10
White-throated Needletail		C													0.07
Vagrants															0.00
Musk Lorikeet	C														0.07
Wedge-tailed Eagle		Un	R				Un	Un	Un						0.21

Mammals

Twenty-three mammals were detected during the study comprising five introduced species, five terrestrial species and two arboreal species as well as seven bats and four marine mammals (Table 13). Species of conservation significance observed included the state significant White-footed Dunnart as well as the regionally significant Long-nosed Bandicoot, Swamp Rat, Black Wallaby and Southern Forest Bat. Humpback and Southern Right Whales, both of which are nationally significant were also observed incidentally during the survey period.

Table 13. Mammals detected during surveys.

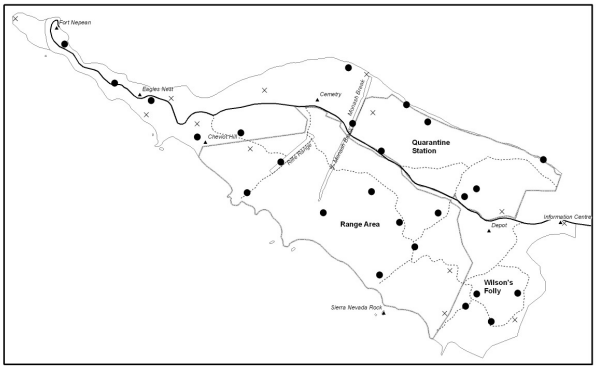
Species prefixed with an asterix are introduced. Significance abbreviations are; (CE) critically endangered, (EN) endangered , (VU) vulnerable, (NT) near threatened, (L) FFG listed, (R) regionally significant. Survey method abbreviations are; (e) Elliot trap, (c) cage trap, (cat) cat cage trap, (h) hair tube, (p) pitfall trap, (spot) spotlight, (bat) anabat bat detector and (in) incidental observation.

Common Name	FFG	EPBC	VROT	Regional	No. records	No. Sites	Method
Terrestrial and arboreal mammals							
White-footed Dunnart	L	VU			15	11	e, p, h
Long-nosed Bandicoot				R	17	11	c, h, cat, scat
Swamp Rat					46	18	c, e, h, scat
Short-beaked Echidna					26	25	c, p, cat
Black Wallaby				R	37	21	h, in, spot, scat
Common Ringtail Possum					18	18	spot, in, scat
Common Brushtail Possum					2	2	spot
Bats							
Gould's Wattled Bat					N/A	N/A	bat
Chocolate Wattled Bat					N/A	N/A	bat
Eastern False Pipistrelle							bat
Lesser Long-eared Bat					N/A	N/A	bat
Large Forest Bat					N/A	N/A	bat
Southern Forest Bat				R	N/A	N/A	bat
Little Forest Bat					N/A	N/A	bat
Marine mammals							
Australian Fur Seal					2	N/A	in
Humpback whale	VU	VU			1	N/A	in
Southern Right Whale	EN	CE			1	N/A	in
Common Dolphin					2	N/A	in
Introduced mammals							
Black Rat					47	22	c, e, h, scat
House Mouse					90	30	c, e, h, p, scat
Red Fox					36	25	h, fox
Cat (feral)					27	22	cat, in
European Rabbit					2	2	in, scat

Terrestrial and arboreal mammals

Short-beaked Echidna

Short-beaked Echidna was recorded at most sites within the park, and were regularly seen on tracks and roads. Diggings were also abundant in most areas throughout the park. Subterranean invertebrates (e.g. termites and ants) seem relatively abundant and widespread throughout the site and Echidnas are likely have access to this food source for the entire year. Although water may be a limiting factor for Echidnas a number of individuals were observed drinking at leaking taps (G. Ehmke, pers. obs.).

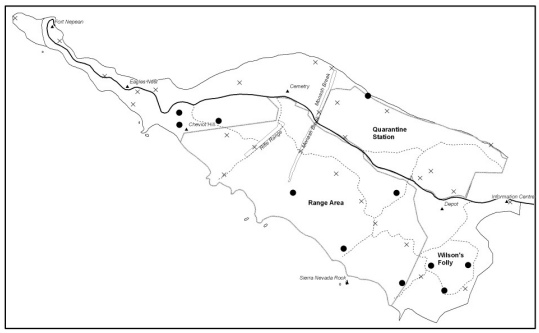


Short-beaked Echidna (right) and its distribution within the study area (left). Photo G. Ehmke.

The Short-beaked Echidna mates in late winter when a single female can be observed being followed by males. About two weeks after copulation, a single soft-shelled egg is laid into the female's pouch. It hatches after ten days and is retained in the pouch for three months, suckling on the mother's milk. When the juvenile produces spines it leaves the pouch, but probably stays in the nest until mature. Juveniles are usually observed around when they are twelve months or more old (Strahan 1995).

White-footed Dunnarts

White-footed Dunnarts were recorded at 11 sites (15 captures total) within the study area. The ratio of trapped individuals was biased towards adult males (9 adult males, 3 immature males and 2 adult females, along with one hair record). Female and immature White-footed Dunnarts were trapped only in Wilsons Folly (sites 2, 3 and 4).

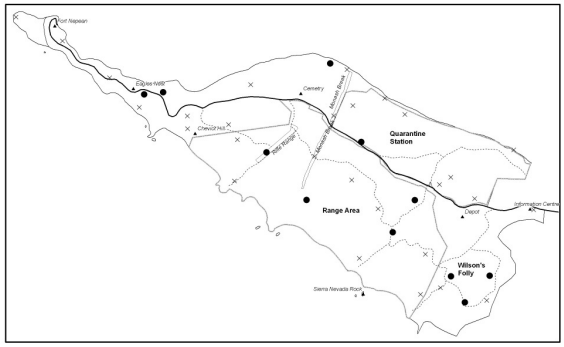


White-footed Dunnart (right) and its distribution within the study area (left). Photo M. Legg.

White-footed Dunnarts feed on a variety on invertebrates, small lizards and amphibians (Lunney *et al.* 1989; Hutchings 1996). White-footed Dunnarts begin to mate in late July-August and give birth to up to 10 live young which attach to the mothers teat for approximately eight weeks before being suckled in the nest for another month (Strahan 1995). Nests generally consist of holes in the ground lined with soft leaves and grasses, and are sometimes established in or under logs (Lunney & Leary 1989; Lunney *et al.* 1989; Hutchings 1996).

Long-nosed Bandicoots

Long-nosed Bandicoots were found at 11 sites (17 records total; 11 cage trap, 1 cat trap and 5 hair tube records). The gender ratio of Long-nosed Bandicoots captured in cage traps was relatively even (7 females and 5 males, the rest of the records from hair samples). Trapping was conducted concurrently where home range overlap was likely to minimise the possibility of recaptures (e.g. the three sites in Wilsons Folly were sampled at once). Although Long-nosed Bandicoots are notoriously trap shy (Menkhorst 1995), the survey effort expended as part of this research was substantial, utilising cage traps, hair tubes and remote cameras. The relatively low capture rate evident despite the intense survey effort suggests Long-nosed Bandicoots exist only at low densities at the site.



Long-nosed Bandicoot (right) and its distribution within the study area (left). Photo M. Legg.

Bandicoot diggings were evident throughout much of the study area at one time or another during the survey period, however in general they were more abundant in open habitats and virtually absent from areas infested with Myrtle-leaf Milkwort or dominated by Coast Tea-tree. Bandicoot forage diggings are typically conical, with a relatively neat mount of substrate excavated on one side of the digging (below left). Short-beaked Echidna diggings are common and widespread at Point Nepean and are distinguished from Bandicoot diggings by their irregular excavation and spoil evident on both sides of the digging (below right). It should be noted that Echidnas can also make smaller exploratory diggings by probing the substrate with their long beaks. Although these exploratory diggings are conical, they are small relative to Bandicoot diggings and lack an excavation mound.

Bandicoot forage diggings (left). Note the conical excavation with spoil on one side of the digging only. Short-beaked Echidna digging on right. Both photos P. Bertuch.

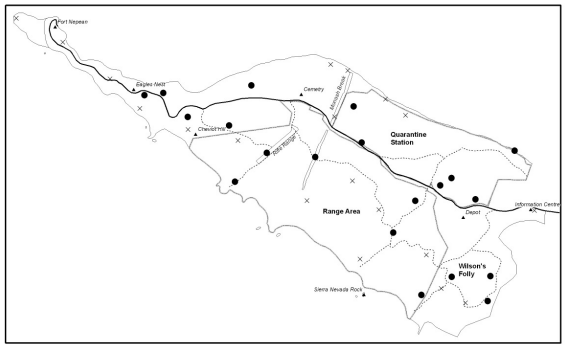
Long-nosed Bandicoots appear to congregate in Grassy Woodlands and grassy bowls to breed in late winter and spring. A nest is constructed on the ground amongst dense thickets or grasses and dirt is kicked over it before rain. Two to four young are raised in the pouch and are weaned at an early age.

Unidentified macropod

During hair analysis, a number of macropod hairs were found which could not be identified as being from a Black Wallaby (the only macropod species known to be extant at the site). The hairs obtained lacked the characteristic pigmentation along the main shaft typical of Black Wallaby hairs, and also displayed a rippled edge on the medulla usually found on the hairs of potoroo species. Although the samples attained could not be confirmed as potoroo hairs, the characteristics indicated that they were more likely to be from a potoroo than a wallaby (Hans Brunner, pers. comm.). Long-nosed Potoroos do occur in the region (e.g. French Island), although they are not known from elsewhere on the Mornington Peninsula.

Black Wallaby

Black Wallabies were recorded at most 'hinterland' areas of the study area, particularly at dawn and dusk when they emerge from woodland areas to graze on grass and other plant matter in more open habitats and to drink from rain puddles on the road and leaking taps. It appears that a larger sub-species with a white tip on the tail was introduced from the Kooweerup area in 1979.



Black Wallaby distribution within the study area (left) and adult Black Wallaby (right). Photo G. Ehmke

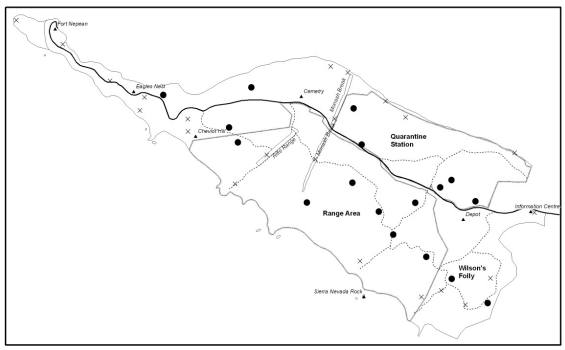
Although Black Wallabies are widespread and commonly observed, open areas (i.e. key foraging habitat) are relatively limited within the study area. The maximum number of Black Wallabies counted simultaneously was 20 during a spotlight survey. Although the total population is probably higher than this, it may not be significantly higher given the relative lack of open grassy areas at the site. An albino specimen was also encountered within the Range Area.

Adult Black Wallabies (one Albino) with Joey. Photo M. Legg.

Possums

Due to the lack of large hollow-bearing trees at the site, Common Brushtail Possums were rare at Point Nepean, although they may be resident in buildings around the Quarantine Station (which were not sampled as part of this survey).

Common Ringtail Possums, on the other hand were widespread in areas with well developed Coast Tea-tree or Moonah vegetation were they can readily build dreys.



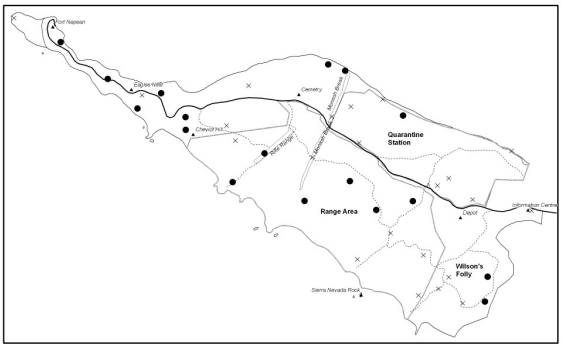
Common Ringtail Possum at Cape Schanck (right) and its distribution within the study area (left) Photo © G. Ehmke.

Dreys are made from strips of bark and sticks and lined on the inside with soft leaves and other organic matter. Usually a breeding pair along with two pouch young occupies these dreys. They venture out at night to feed on leaves, flowers and insects. Their favoured food within the study site is Coast Tea-tree leaves. Common Ringtail Possums were commonly seen or heard at night during the spotlight walks.

Swamp Rat

Swamp Rats were observed in Coastal Dune Scrub, Coastal Heathland and Grassy Woodland habitats. Swamp Rats were not found in mature Moonah Woodlands (i.e. no records at sites 20, 16, 6, 8 and 9). This native rodent appears to occupy dense understorey throughout the site in medium to low population numbers (such as Sword Sedge and Poa). Underneath this vegetation they excavate runways and build nest chambers at the end in burrows up to one meter long. These are apparent throughout their distribution within the study area. They feed on a variety of rhizomes, seeds and other various vegetation matters from the local

graminoids. Most Swamp Rats were caught in Elliot traps, although some were caught in pitfall traps.



Swamp Rat distribution within the study area (left) and a Swamp Rat (right). Photo M. Legg.

Breeding occurs from spring to autumn, and three weeks after gestation three to five naked young are born in the nest. Three to four weeks later they leave the nest as independent individuals. Mature females may have several litters throughout the season (Menkhorst 1995). In coastal environments Swamp Rats generally select closed heath habitats, often with abundant sedges (Twyford 1997).

Bats

Microbats are nocturnal, and eat three times their body weight in insects each night–making them very important around agricultural and urban areas. During the colder months of the year they shut down and hibernate within tree hollows or under bark, venturing out only as climatic conditions become warmer.

All seven microbats were identified using Anabat Bat Detector with the greatest abundance around Wilsons Folly and along Defence Road (Table 14).

All bat species recorded are considered to be of high local significance because they are dependant on old trees which possess hollows or mature bark which are limited on the Mornington Peninsula and in the Gippsland Plains bioregion because of past habitat loss and degradation.

Table 14. Microbats recorded on the Anabat II Bat Detector.

Species	Date	Number recorded	Area Observed
Gould's Wattled Bat	14/02/06	35	Throughout Range.
	23/02/06	25	Wilsons Folly.
	09/03/06	50	Along Defence Road.
	04/10/06	5	Wilsons Folly
Chocolate Wattled Bat	04/10/06	2	Wilsons Folly
Eastern False Pipistrelle	14/02/06	2	Throughout Range.
Lesser Long-eared Bat	14/02/06	5	As above.
	23/02/06	3	Wilsons Folly
	09/03/06	2	Along Defence Road.
	04/10/06	3	Wilsons Folly
Large Forest Bat	09/03/06	2	As above.
Southern Forest Bat	14/02/06	5	Throughout Range.
	23/02/06	3	Wilsons Folly.
Little Forest Bat	14/02/06	20	Throughout Range.
	23/02/06	16	Wilsons Folly.
	09/03/06	20	Along Defence Road.

Microbats can be seen on warm nights flying past the light beam of a torch, catching and eating insects while in flight. Future microbat recordings could result in further species identification, as some species are common one month and then absent the next.

Little Forest Bat (left) and Lesser Long-eared Bat (right). Both Photos © M. Legg.

Marine mammals

During winter, Southern Right and Humpback Whales were occasionally seen in Bass Straight off the coast or entering the bay with a calf to seek refuge from Killer Whales and sharks. They appear to be entering the bay as part of their northward migrations more often as numbers slowly increase.

Australian Fur Seals can often be seen loafing in the waters off Port Phillip Head, and occasionally basking on Corsair Rocks.

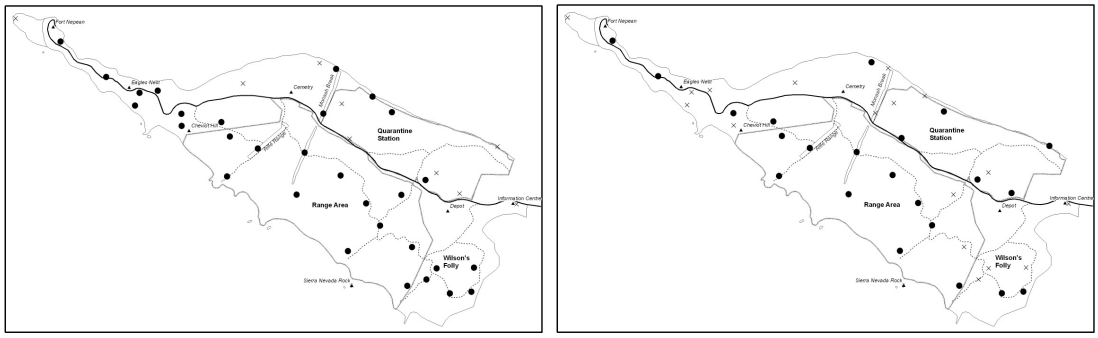
Groups of Common Dolphins are regularly seen in Ticonderoga and Nepean Bays.

Young Australian Fur Seal on Nepean Rock. Photo G. Ehmke.

Introduced mammals

House Mouse and Black Rat

Introduced mammals were widespread and abundant throughout the study area. House Mice were the most frequently observed and widespread mammals sampled; (90 records at 30 sites; Table 13). Black Rats were also extremely common (47 records at 22 sites; Table 13). Neither the House Mouse nor Black Rat showed any habitat preference and were found in all habitat types across the site.



Distribution of House Mouse (left) and Black Rat (right) within the study area.

Black Rats are omnivorous and compete with native Swamp Rats, Dunnarts and Antechinus for food resources while also occupying nesting resources used by these species. In addition, Black Rats are known to predate on eggs and young of ground foraging and nesting birds such as the Hooded Plover (Weston 2003).

European Rabbit

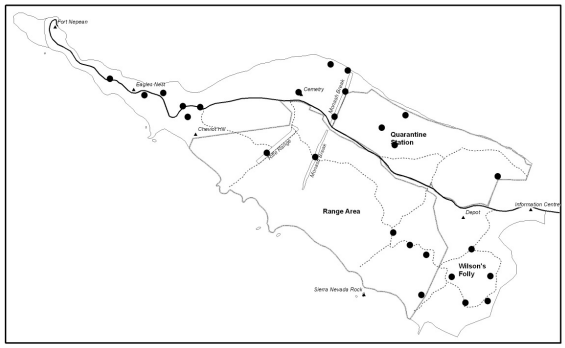
European Rabbits were observed at a number of locations, particularly in summer and autumn 2006, most commonly in disturbed areas where introduced grasses are prevalent such as along Defence Road as well as at Pearce Barracks. Rabbit numbers however seem to have decreased substantially as of summer 2006-2007.

Red Fox

In addition to a regular seasonal baiting program, an intensive foot-hold trapping program was initiated by Parks Victoria at number of sites across the study area in April and June 2006. Results presented here are gained from this program as well as hair tube results conducted as part of this survey (Table 13).

Red Foxes were also widespread and common throughout much of the study area as indicated by an abundance of indirect signs, in particular tracks and scats, which were frequently observed along tracks and beaches. While hair tubes were deployed at all sites, the bait used targeted native marsupials and was unlikely to be highly attractive to Foxes. However the hair tubes used were relatively large and consequently foxes would have been able to probe inside the tubes. As a result, six records were obtained using hair tubes, with the remaining 30 records being from the foot-hold trapping program (Table 13).

Records from hair tubes and the fox trapping program indicate the foxes are widespread across the site. The absence of records along the Bass Coastline in Coastal Heathland and Coastal Dune Scrub habitats may reflect the lack of trapping effort in these areas. However, although fox tracks were observed along Bass Coast beaches near London Bridge, none were observed further west along the Bass Coastline (i.e. northwest of Monash Break). This may reflects the inaccessibility of this part of the coastline. Interestingly, Hooded Plovers and Sooty Oystercatchers successfully fledged young from this area of the coast (Map 10).

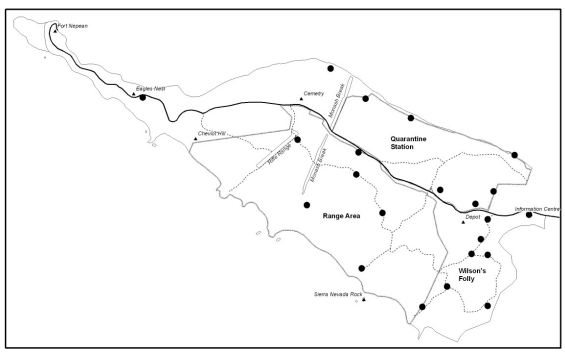


Distribution of Red Fox within the study area (left) and a Red Fox caught in a foot-hold trap. Photo P. Bertuch.

Feral Cat

A Feral Cat trapping program was carried out between November 2005 and December 2006 as part of ongoing feral predator control within the study area. Results presented here are sourced from that program.

Fourteen Feral Cats were trapped at 22 locations at Point Nepean. Given Feral Cats renowned reluctance to enter traps, it is likely that the cat population extant at the site is substantially higher than these results indicate. This is evidenced by the presence of cat tracks at a number of locations (particularly along tracks and Port Phillip Bay beaches) at the same time cat trapping was being carried out.



Feral Cat distribution within the study area (left) and Feral Cat and Red Fox tracks (right) within the study area. Photo G. Ehmke.

Scat analysis results revealed that both Red Foxes and Feral Cats prey on Long-nosed Bandicoots at Point Nepean as well as Swamp Rats, Black Wallabies and Common Ringtail Possums which were the most common prey item for both species (Fig. 2). Both foxes and cats seem to prey heavily on birds and also Black Rats and House Mouse. These results concur with Wallis *et al.* (1996) who identified Common Ringtail Possum, Swamp Rat, Black Rat and European Rabbit as common prey species of Red Foxes.

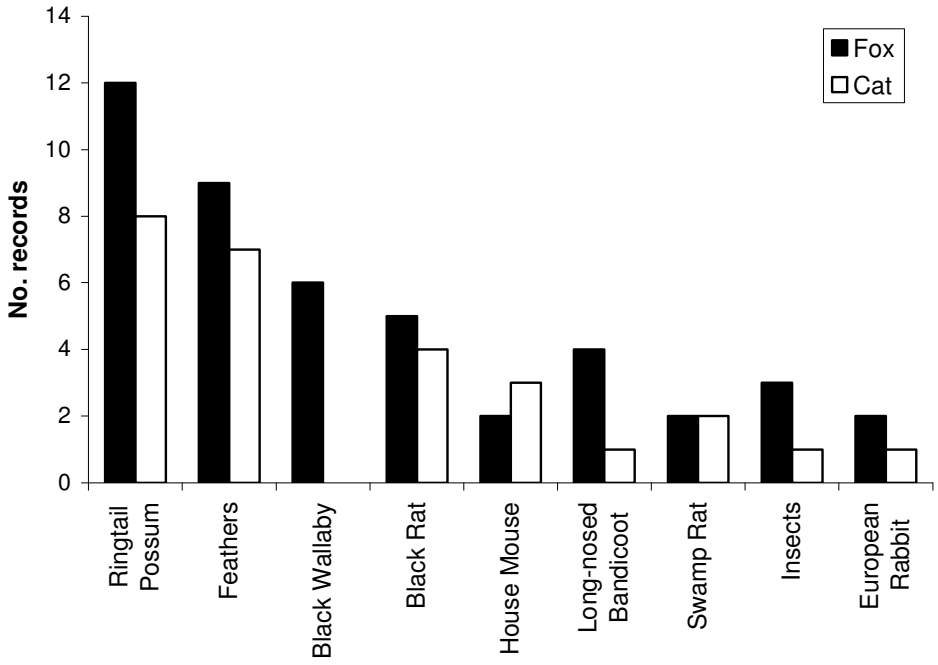


Figure 2. Number of prey items identified from Fox and Cat scats.

Reptiles

A total of 12 reptiles, eight lizards and four snakes, and one amphibian, the Southern Bullfrog, were recorded during surveys (Table 15).

Table 15. Reptiles and Amphibians detected during surveys.

Significance abbreviations are; (R) regionally significant. Survey method abbreviations are (p) pitfall trap, (ci) corrugated iron, and (in) incidental observation.

Common Name	FFG	EPBC	VROT	Regional	No. records	No. Sites	Method
Lizards							
Blotched Blue-tongued Lizard					15	11	ci, p, in
Common Blue-tongued Lizard					2	2	ci
Eastern Three-lined Skink					16	13	ci, p
Garden Skink					12	11	ci, p
White's Skink				R	7	4	p
Tree Dragon				R	10	5	ci, p, in
Southern Grass Skink				R	2	2	ci, p,
Metallic Skink					2	2	in
Snakes							
Eastern Brown Snake				R	1	1	ci
Mainland Tiger Snake					5	5	ci, p, in
White-lipped Snake					2	2	in
Lowland Copperhead					2	2	in
Amphibians							
Southern Bullfrog					3	3	p

Lizards

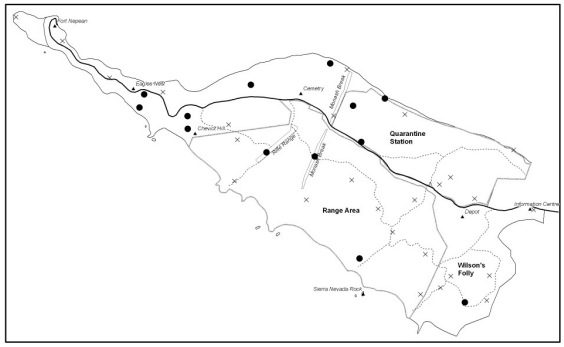
Five small skinks were observed over the study period, as well as Common and Blotched Blue-tongued Lizards and Tree Dragons. Of these lizards, only the Eastern Three-lined Skink, Garden Skink and Blotched Blue-tongued Lizard were widespread and abundant (i.e. >10 records at >10 sites; Table 15).

Eastern Three-lined Skink

Male Eastern Three-lined Skink showing breeding colours. Photo M. Legg

Eastern Three-lined Skinks are one of the more common small reptiles at Point Nepean and were recorded at 13 sites, with 11 of the observations from pitfall traps and five skinks found under corrugated iron. Eastern Three-lined Skinks occupy a large number of habitat types across the site including Coastal Heath, Grassy Woodlands, Foredunes, Moonah and Coast Tea-tree/Moonah Woodlands. This species is a fast moving burrowing skink preferring sandy soils in which they burrow into during harsh times. During the breeding season the male portrays an orange throat.

After mating, three to eight eggs are laid in a clutch in a warm moist location under logs or amongst leaf-litter (Jenkins & Bartell 1980). Several breeding males were found during the survey (see below) as well as some juveniles confirming that this species does breed at Point Nepean.

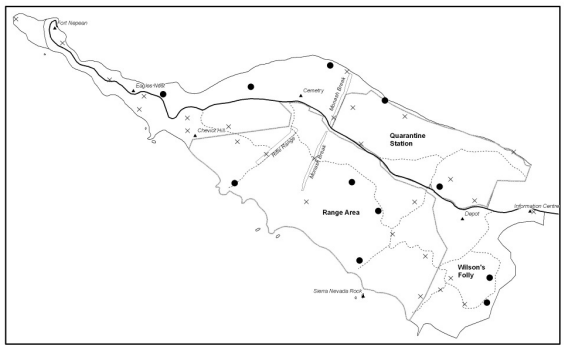


Eastern Three-lined Skink distribution (left) within the study area and eastern Three-lined Skink. Photo P. Bertuch.

Garden Skink

Garden Skinks were the most widespread reptile observed at the site (equal with the Blotched Blue-tongued Lizard). Garden Skinks were also found in a variety of habitat types.

The Garden Skink is a small terrestrial species (preferring leaf-litter or logs with small hollows) which was seen regularly along tracks and sampled under sheets of corrugated iron. Females lay two to five soft-shelled eggs, under logs or thick humus in early summer, which hatch approximately two months later (Jenkins & Bartell 1980).

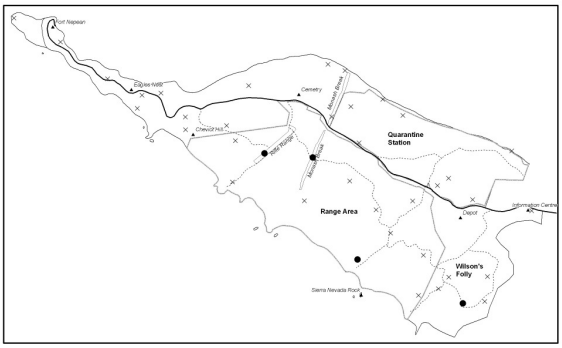


Garden Skink distribution (left) and Garden Skink (right). Photo M. Legg.

White's Skinks

White's Skinks were more restricted in their distribution than Eastern Three-lined or Garden Skinks being found only at four sites. Monash Break South (site 23) was particularly fruitful for White's Skink with seven captures. White's skinks showed a preference for relatively open habitats with native grasses in comparison to Eastern Three-lined and Garden Skinks. Three of the four sites this species was found at were in open habitats (i.e. cleared areas and Grassy Woodlands).

Due to the demise of the *Poa* grasslands through out the study area and the Nepean Peninsula (from weed invasion and urbanization) this lizard appears to be rare in its appropriate habitat.



White Skink distribution within the study area (left) and White Skink (right). Photo M. Legg.

Pale form of White's Skink. Photo M. Legg

White's Skinks typically have contrasting dark and light patterning on their dorsal surface with characteristic solid and dotted stripes extending from their neck to their vent. However a pale form White's Skink was also recorded during this survey which is light brown in colour and lacks the pronounced stripes on its dorsal surface.

Southern Grass Skink

The Southern Grass Skink appears to be rare within Point Nepean and was only sampled in Wilsons Folly. During the breeding season the male portrays a red lateral streak that runs through the shoulder, along the flanks. They also portray a salmon or creamy underside.

Southern Grass Skink. Photo © M. Legg.

This species displays a modification of the viviparous condition giving birth to live young (Jenkins & Bartell 1980). Mating occurs in mid to late summer. The female retains the sperm over autumn and winter, ovulating late in the following spring. The gestation period is about 10 to 12 weeks, and the birth occurs in late summer, approximately one year after copulation

Metallic Skink

The Metallic Skink is another rare species to the study area and was only found in the hilly areas of the Quarantine Station and in some spots along the Quarantine bay cliffs (sites 6 and 38). It appears to be absent from the rest of Point Nepean. This species has adapted to cold conditions and breeds in autumn.

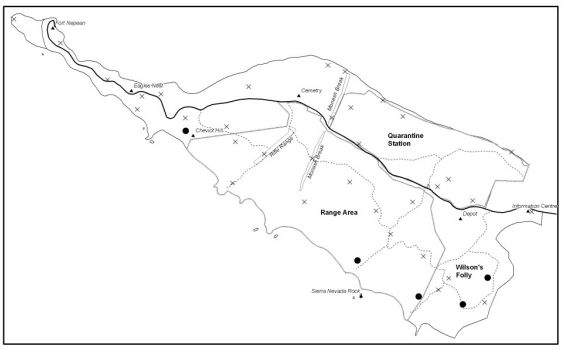
The female retains the sperm over winter and gives birth to between one and seven live young during late summer, almost one year after copulation. This species is truly viviparous.

Metallic Skink. Photo © M. Legg.

Tree Dragon

This semi arboreal dragon was found to be relatively common within Wilsons Folly and was observed at two other sites in Coastal Heathland/Headland Scrub along the Bass Strait Coast. This species is probably exposed to relatively high levels of predation by feral cats and to a lesser degree foxes. Individuals were seen running across tracks or sunning themselves on the lower branches of coast shrubs. Wilsons Folly was the only location in which juvenile Tree Dragons were observed, suggesting that this area is important breeding habitat for the species.

Female Tree Dragons lays up to eight eggs in a burrow or depression which she excavates beneath a log (Jenkins & Bartell 1980).



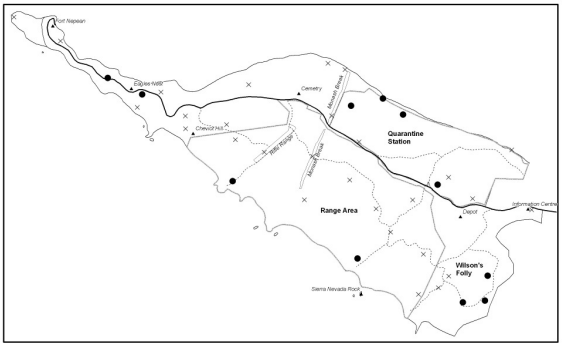
Tree Dragon distribution within the study area (left) and a juvenile Tree Dragon. Photo G. Ehmke

Blue-tongued Lizards

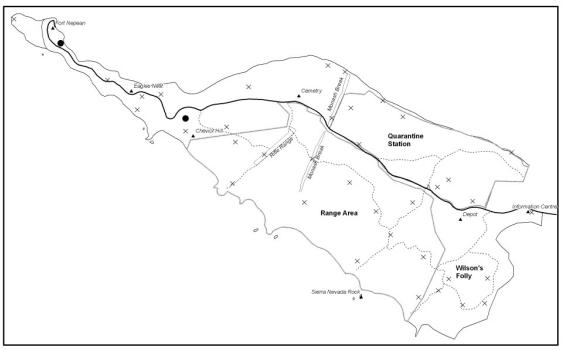
Both Blotched and Common Blue-tongued Lizards were found during spring and summer sunning themselves along tracks, in pitfall traps and under corrugated iron. The Common Blue-tongued Lizard appears to only inhabit the very point, along the Bass Strait cliffs. Blotched Blue-tongued Lizards in contrast appear to be more widespread and were recorded at 11 sites in pitfall traps, under corrugated iron and in cat traps. They were also observed

consistently along tracks and roads, including at least two incidences of road killed individuals. Blotched Blue-tongued Lizards were mainly coastal in their distribution and were rare in Moonah and Coast Tea-tree/Moonah Woodlands.

Both species of Blue-tongued Lizard give birth to live young numbering between ten and twenty individuals. They are omnivorous in their choice of food, mainly preying upon insects, snails and slugs, small invertebrates and a wide range of vegetable matter including coastal fruits. Blue-tongued Lizards probably play an important part in distributing and germinating indigenous and weedy fruits of the coastal scrub. They require intact understoreys with a mixture of graminoids and herb species, along with logs and even old building materials scattered on the ground in which to hide, breed and feed.



Distribution of Blotched Blue-tongued Lizard within the study area (left) and Blotched Blue-tongued Lizard (right). Photo. M. Legg.



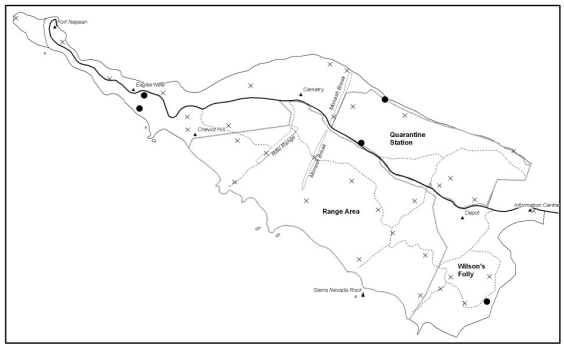
Common Blue-tongued Lizard distribution (left) and Common Blue-tongued Lizard (right). Photo M. Legg.

Snakes

Snakes were only occasionally encountered during surveys despite the relatively widespread use of corrugated iron. Only the Mainland Tiger Snake was observed at more than two sites (Table 15).

Mainland Tiger Snake

Mainland Tiger Snakes were the most commonly encountered snake within the study area (5 records at 5 sites; Table 15). Mainland Tiger Snakes are also relatively commonly seen in the study area by Parks Victoria staff and the general public (D. Stephenson, pers. comm.) and during this study were observed along tracks, roads, under tin and on the edges of bushes. It is likely that this snake is distributed in relatively low densities throughout the study area.



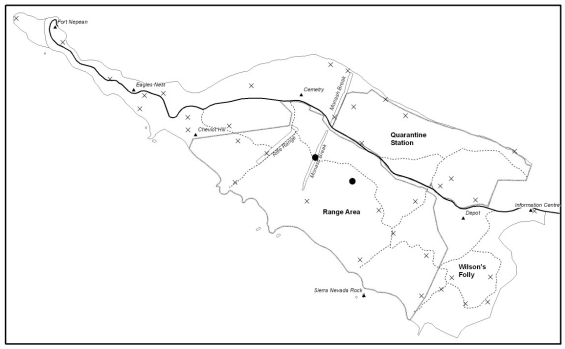
Mainland Tiger Snake distribution within the study area (left) and a juvenile Mainland Tiger Snake (right). M. Legg.

This species is diurnal in habit and feeds on a number of small rodents and frogs. More than 20 live young are produced in summer. Their bite is highly venomous to humans but Tiger Snakes are generally docile and only display aggressive behaviour when cornered or harassed (Jenkins & Bartell 1980). All specimens observed readily retreated when detected.

Adult Mainland Tiger Snake. Photo G. Ehmke.

White-lipped Snake

One specimen of White-lipped Snake was sampled under corrugated iron in Wilsons Folly and two others were seen incidentally (D. Stephenson, pers. comm.). The population of White-lipped Snakes at Point Nepean appears to be quite rare. This small snake mainly feeds on small skinks and requires dense understorey of tussock grasses and other graminoids to hunt its prey.



White-lipped Snake distribution (left). White-lipped Snake (right). Photo © M. Legg.

This snake is not dangerous to humans. The young are retained within the female until fully developed, eventually being dropped in mid-summer, the brood numbering three to four (Jenkins & Bartell 1980).

Eastern Brown Snake

Eastern Brown Snakes appear to be very rare within Point Nepean and are seldom observed elsewhere on the southern Mornington Peninsula having been recorded at only a handful of sites previously (Atlas of Victorian Wildlife records).

Eastern Brown Snakes are large aggressive snakes which feed on small mammals, lizards and sometimes frogs. This snake is venomous to humans. Eastern Brown Snakes are diurnal in habit and are oviparous, producing 20 or more soft-shelled eggs which are deposited under well-buried logs.

Lowland Copperhead

Only two Lowland Copperheads were observed during the sampling period (sites 25 and incidentally near site 29). The majority of habitat at Point Nepean doesn't suit this species. It is better suited to habitats such as the nearby Portsea Lagoon.

Lowland Copperhead, Photo © M. Legg.

Lowland Copperheads are venomous to humans but are docile snakes and are reluctant to bite or even display unless unduly provoked. During the breeding season the male portrays orange-red flanks, and a large number of live young are produced, with the average brood 20 or more.

Reptile captures comparison

Due to a number of limitations, principally substrate and UXO related (see methods section), pitfall traps were not established at all sites. Where conditions precluded the use of pitfall traps, corrugated iron was placed in open areas in an attempt to attract reptiles. While the differences in these two sampling techniques should be noted when considering results, the use of corrugated iron is a relatively effective alternative in revealing the presence of small reptiles (i.e. lizards and small snakes).

The number of reptiles recorded was generally greatest in open habitats such as Grassy Woodlands and cleared breaks, with Coastal Heath and Coast Headland Scrub also seemingly important reptile habitat (Fig. 3). Reptiles were comparatively scarce in 'closed' Coast Tea-tree and Moonah Woodlands, except for site six where Blotched Blue-tongued Lizards were recorded on four occasions (Fig. 3). Although invertebrates were not sampled as part of this study, incidental observations suggested that terrestrial invertebrates are far more common in open grassy habitats than in closed woodlands and thickets. Lack of terrestrial invertebrates (a key food source) and basking areas may account for the low reptile capture rates in closed woodland complexes.

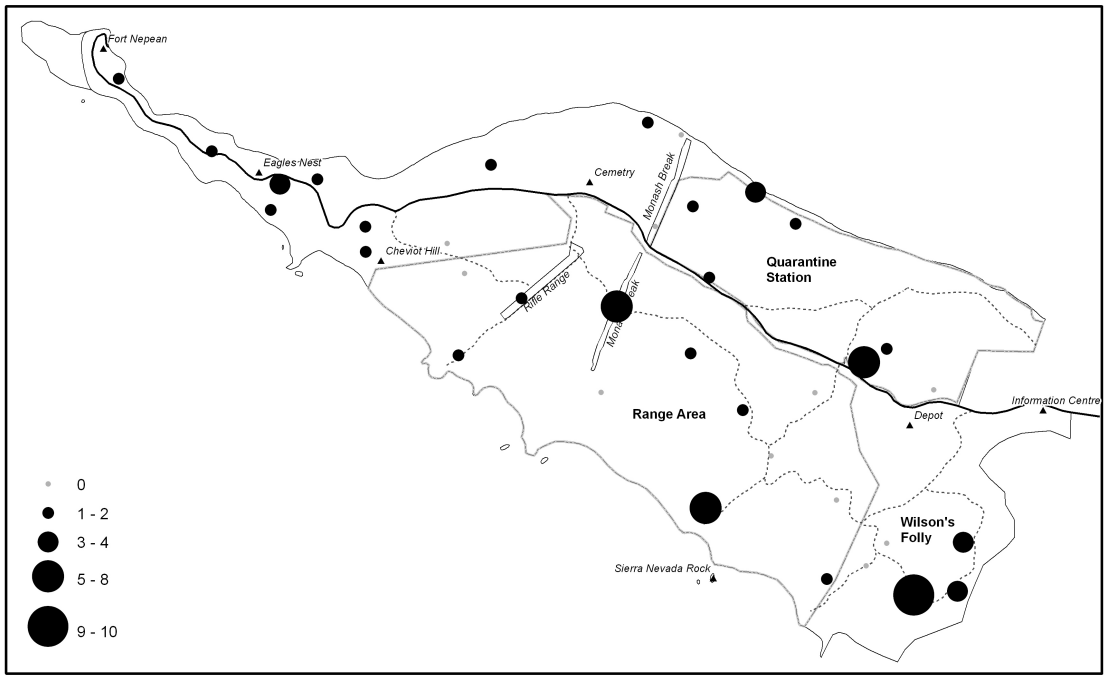


Figure 3. Number of lizard records per survey site

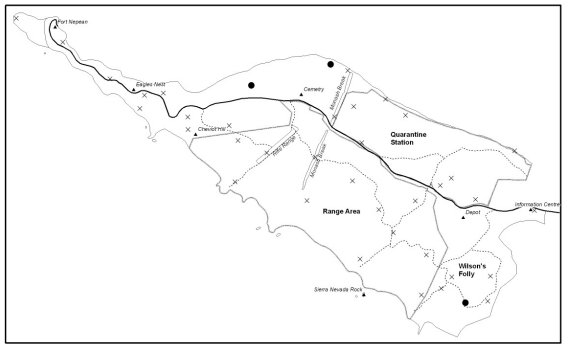
This includes Pitfall traps, corrugated iron and active searches.

Amphibians

Due to the dry nature of the area, only the Southern Bullfrog was observed. Specimens of this large burrowing frog were seen hopping along tracks in wet or prior to wet weather during spotlight walks. Individuals were also sampled in pitfall traps in Wilsons Folly and

along Coles Track. The nearest major breeding water body would be Portsea Lagoon. This species spends a majority of the year buried in the soil and surfaces only when penetrating rain awakens the individual.

The male's call is a short musical, explosive note producing a resonant 'bonk' and usually repeated every few seconds (Hero *et al.* 1991).



Southern Bullfrog (right) and distribution (left). Photo G. Ehmke.

5.4 Limitations

5.4.1 General Limitations

A variety of survey techniques were employed during this survey in order to maximise the probability of detecting rare and cryptic species across the survey area. However, due to UXO contamination and impenetrable substrate types, pitfall traps were not used at every site. Table 9 in the methods section outlines the sample techniques used at each site thus allowing these limitations to be taken into account when analysing data. Although alternative survey methods were employed to allow for limitations, the lack of pitfall trapping in some areas should be noted when interpreting results for small mammals and lizards. Results for medium to large mammals, large reptiles and birds, however, are not likely to be significantly influenced by the lack of pitfall trapping at some sites.

Another limitation of note is the variation in sampling timing over the study period. Due to logistical constraints, not all sites were able to be sampled simultaneously. Sampling was however, consistent within seasons which would limit major differences in species composition.

With the exception of Pearce Barracks, buildings were not sampled as part of this survey. Buildings at the former Quarantine Station may support populations of Agile Antechinus and/or White-footed Dunnarts.

Although a number of lawn areas were sampled in this study, the majority were not surveyed. The assumption is that these areas provide little faunal habitat other than for open-country birds such as Magpies. Research in similar areas (e.g. Scott *et al.* 1999) has

however revealed that some native mammals including Long-nosed Bandicoots do forage introduced grass habitats. Bandicoot diggings have been sighted around mown areas at nearby Police Point and along Defence Road and in the Quarantine Station in this study.

Intertidal and subtidal marine communities were not investigated as part of this study. Information on these communities is available elsewhere (reviewed in Plummer *et al*. 2003 p95).

5.4.2 Survey Methodologies

Although the use of hair tube sampling has been found to be relatively ineffective in identifying small mammals such as Antechinus (Catling *et al.* 1997; Cunningham *et al.* 2005), hair sampling is effective in the detection of medium sized, trap-shy mammal species such as Bandicoots and can also reveal the presence of larger species such as Wallabies and Foxes (Mills *et al.* 2002). Hair Tubes used here were large, and targeted medium sized mammals such as Bandicoots. Small mammals were targeted using Elliot and pitfall traps.

Seven mammal species were identified using hair analysis during this survey, including five Long-nosed Bandicoot, one White-footed Dunnart and six Red Fox records (Table 16). In comparison to hair sampling, cage and pitfall trapping were more effective in detecting Long-nosed Bandicoots and White-footed Dunnarts (Table 16). Hair sampling however yielded a similar number of results to Elliot trapping for Swamp Rats and Black Rats as well as providing numerous Black Wallaby records (Table 16). Although techniques such as cage trapping provide more information in terms of age, gender and condition of animals, hair sampling is significantly less invasive, and can be conducted year round, unlike trapping which should not be carried out during the breeding season of mammals such as Long-nosed Bandicoots due to their propensity to eject pouch young.

Elliot trapping yielded nearly twice as many House Mouse records as hair tubes, and over six times as many as pitfall traps (Table 16).

Table 16. Number of sites and sampling techniques where mammals were detected

Common Name	Hair	Cage	Elliot	Pitfall	Incidental	Cat	Fox
Long-nosed Bandicoot	5	9				1	
White-footed Dunnart	1		3	7			
Black Wallaby	10				13		
Swamp Rat	10	3	10				
*Black Rat	11	13	4				
*Cat (feral)					4	7	
*House Mouse	14		26	7			
*Red Fox	6						11

Comparison of sampling technique results for reptiles suggest that while the use of corrugated iron is effective for the relatively large Blue-tongued Lizards, pitfall trapping is

substantially more effective in detecting Eastern Three-lined and White's Skink as well as Tree Dragon's (Tree Dragons were captured a total of seven times in pitfalls and only once under corrugated iron) (Table 17). Pitfall traps were ineffective in detecting snakes (only one juvenile Mainland Tiger Snake was captured in a pitfall trap), and there was little difference in the effectiveness of pitfall traps versus corrugated iron for Southern Grass or Garden Skinks (Table 17).

Table 17. Number of sites at which reptiles were detected using different sampling techniques

Common Name	Pitfall	Corrugated iron	Incidental
Blotched Blue-tongued Lizard	1	11	
Common Blue-tongued Lizard		2	
Eastern Three-lined Skink	9	4	
Garden Skink	6	5	
Metallic Skink			2
Southern Grass Skink	1	1	
White's Skink	4		
Tree Dragon	2	1	1
White-lipped Snake		1	2
Eastern Brown Snake		1	
Lowland Copperhead			1
Mainland Tiger Snake	1	1	3

Overall, the comparison of survey methodologies highlights the need to employ a range of strategies in order to ensure detection of the full range of mammals and reptiles due to the rarity and cryptic nature of a number of species.

5.5 Discussion

5.5.1 Comparison of Existing Versus New Records

Although there are unconfirmed records of Agile Antechinus at Point Nepean (Marston 2002), no evidence of their existence was revealed during this survey. Agile Antechinus are locally common in parts of the Mornington Peninsula and have been recorded at over 30 other sites in the region (M. Legg, Mornington Peninsula Shire Wildlife Atlas, unpublished data), including similar habitats such as Moonah Woodlands at Cape Schanck (Koch 2005). It is unlikely that Agile Antechinus are limited by a lack of suitable breeding habitat at Point Nepean as Mature Moonah should provide adequate hollows for this semi-arboreal species. Possible explanations for the absence of Antechinus include; excessive competition from Black Rats or lack of prey species such as reptiles and invertebrates. It is however unclear whether Antechinus have previously inhabited the site and suffered a local extinction, or whether the species was in fact not indigenous to the site.

One historical record of Southern Brown Bandicoot at Point Nepean exists (cited in Tonkinson & Beardsell 1999). This record is said to have originated from an infra-red camera survey somewhere within the former Range Area in 1998 (D. Stephenson, pers. comm.). Details regarding this record however are not available, and given that no primary evidence could be found to substantiate the veracity of the record, it cannot be considered a confirmed record. This study employed considerable effort including cage trapping and hair sampling at over 35 sites as well as using remote camera without finding any evidence of Southern Brown Bandicoots.

Despite a broad overlap in geographic range in Victoria, Southern Brown and Long-nosed Bandicoots do not generally co-exist due to differences in habitat preferences (Opie *et al.* 1990). Although current research suggests that Southern Brown and Long-nosed Bandicoots do not generally co-exist, habitat loss, particularly when selective, can result in species being forced into sub-optimal habitats. Thus, it is possible that that Southern Brown Bandicoots have occurred at Point Nepean. The Southern Brown Bandicoot has been recorded on the Mornington Peninsula from the 1960's through to the late 1980's (AVW data), and the species is still extant the Cranbourne Royal Botanic Gardens and the Pines Flora and Fauna Reserve. Recent records have also confirmed the presence of Southern Brown Bandicoots at Warringine Park Bittern and Crib Point foreshore (M. Legg and P. Bertuch, unpublished data), however there are no records of the species from coastal habitats similar to that of Point Nepean elsewhere on the Mornington Peninsula.

Given Point Nepean's relatively small size, in the context of medium sized mammals such as Bandicoots, it is questionable whether the site could support viable populations of both Southern Brown and Long-nosed Bandicoots. Thus it is unlikely the Southern Brown Bandicoots occur at Point Nepean today.

Past records of species such as Eastern Curlew, Northern Giant-Petrel, White-fronted Tern and Fairy Tern likely represent vagrant occurrences at or around the study area at various times. The absence of largely sedentary species such as Bassian Thrush, which has been previously recorded, may represent local extinctions from the site. One past record of Marbled Gecko may also fall into this category, although this record may have been a misidentified juvenile Tree Dragon which are broadly similar in appearance to Marbled Geckos.

5.5.2 Significant fauna

Point Nepean's position at the tip of a relatively narrow peninsula (Point Nepean is less than 2km across at its widest point) means that the study area is particularly isolated and in a landscape context is more akin to a true island than a habitat isolet referred to in current landscape ecology paradigms (Forman 1995). Although it is possible that faunal movement could occur along the coastal strip of habitat of the Mornington Peninsula National Park, given the narrowness of this habitat and the high level of adjacent residential development, it is questionable whether this area would actually constitute a source of immigration into

Point Nepean. More likely is that Point Nepean functions as a source from which animals disperse, and habitat outside Point Nepean is akin to a habitat sink (With and King 2001)

The functional implication of this is that the study area is effectively isolated from other populations and there is a relatively low probability of immigration from other populations outside the study area. This means that native fauna within Point Nepean are less robust to stochastic threats such as uncontrolled fires and deterministic threats such as predation by introduced species. Therefore, it would be prudent to adopt a precautionary approach when assessing the population viability of conservation dependant species, as populations at Point Nepean may not be as robust as in other areas where viable sources of immigration exist (see section 5.5.5 – significant habitat for further discussion).

Hooded Plover

Hooded Plovers are known to have extremely low nesting success rates in Victoria (Weston 2003). Of 39 known nesting attempts on the Mornington Peninsula during the 2006-07 breeding season, only ten Hooded Plover Chicks fledged (G. Maguire, Birds Australia, pers. comm.). Along with predation of eggs and chicks by feral species such as foxes and cats, reptiles, birds of prey and gulls, the principal cause of the decline in Hooded Plover populations is human disturbance. Humans and dogs can cause nest failure directly by trampling eggs or chicks (Dowling & Weston 1999), and can also cause indirect nest failure by disturbing adult birds during incubation causing thermal stress to eggs or by distracting adult birds allowing predators access to eggs and chicks (Weston 2003). Much of the Bass coastline as well as areas some beach areas of Ticonderoga and Nepean Bays form important breeding and foraging habitat for Hooded Plovers (Map 10). Breeding habitat at Point Nepean is particularly critical due to the lack of human disturbance in comparison with the rest of the Hooded Plover habitats on the Mornington Peninsula.

Recommendations:

- Continue feral predator control programs
- Limit disturbance to breeding habitat (beaches, foredunes and offshore rocky islands)
- Where human access is likely, encourage co-existence between people and Hooded Plovers through interpretive signage and educational programs
- Conduct regular monitoring of nest locations
- Temporarily restrict beach access when birds are actively nesting.

Sooty Oystercatcher

Sooty Oystercatchers are extremely rare on most of the Mornington Peninsula coastline between London Bridge and Cape Schanck (Barrett *et al*. 2003). The fact that there are at least two resident breeding pairs within the study area indicates the high quality of intertidal rocky shore platforms at Point Nepean. Point Nepean is in fact probably the only place where this species breeds on the Mornington Peninsula. Most Sooty Oystercatchers in the region breed on Phillip Island.

The main threat to Sooty Oystercatchers stems from disturbance of nesting and to a lesser extent foraging activities. Although Sooty Oystercatchers nest on the ground, they place their nest, almost exclusively on offshore rocks, protecting them from land predators. Sooty Oystercatcher chicks are not fully precocial like Hooded Plovers, and once eggs hatch parents will feed chicks for a period of time allowing them to remain on rock isolets.

Recommendations:

- Maintain high quality intertidal rock shore platform habitat (i.e. feeding areas)
- Limit disturbance to breeding habitat (offshore rocky islands).

Ground-dwelling birds

Ground-dwelling birds are particularly susceptible to predation by feral species by virtue of the time they spend on the ground. These species are also prone to low breeding success caused by disturbance of nests. They are habitat specialists relying on high quality ground layer and subterranean feeding habitats.

Both the Brown Quail and Spotted Quail-thrush are considered near threatened in Victoria (DSE 2003), while the Painted Button-quail is considered regionally significant after significant declines in the Gippsland Plains Bioregion (Radford & Bennett 2005). All three of these species nest, forage and shelter on the ground, generally in habitats with grassy understoreys (Marchant *et al.* 1994).

None of these species were recorded more than once over the survey period, with all records being from within Wilsons Folly. This was despite considerable search effort, particularly within Wilsons Folly. Given the lack of records for these species, and the limited extent of their preferred habitat (i.e. Grassy Woodlands), these species probably exist only at very low densities within the site. In addition, these species are unlikely to occur nearby Point Nepean given urbanisation of surrounding areas and the relative unsuitability of Coastal Heathland and Coastal Dune Scrub habitats in the coastal section of the Mornington Peninsula National Park.

Although these species do not currently occur outside of Wilsons Folly, there is potential for their ranges to be expanded, at least into Harrisons Bowl, given suitable habitat restoration (i.e. encouragement of Grassy Woodland structure similar to that of Wilsons Folly).

Recommendations:

- Maintain and expand grassy woodland habitats where possible
- Continue feral predator control programs
- Limit disturbance to important habitat, particularly during breeding season.

Cormorants

Black-faced and Pied Cormorants are both listed as near threatened in Victoria (DSE 2003). Although neither of these species nests at Point Nepean, the site provides important roosting and feeding habitat for these and other cormorant species. Cormorants need to spend significant periods of time drying and preening their plumage, and thus depend on relatively undisturbed habitat for roosting during non-feeding periods. Disturbance to roost sites has the potential to cause considerable energetic stress to a significant number of birds.

Recommendation:

- Limit disturbance through access restrictions (largely already in place) to important roosting sites (see Map 10).

Black Falcon

Black Falcons are occasionally seen flying over coastal parts of the study area and are probably vagrant to the site. Southern Victoria is marginal for Black Falcons which are more common in inland Australia, however they are occasionally seen in coastal areas in southern Victoria hunting shorebirds and other prey.

Pacific Gull

Pacific Gulls are widespread, in relatively low densities, throughout both intertidal rocky shore platforms and sandy beaches at the site. Although Pacific (and Kelp) Gulls are robust to disturbance relative to many other species, surveys have revealed that Pacific Gulls tend to aggregate in areas such as Corsair Rock and Ticonderoga Bay beaches (see Map 10).

Recommendation:

- Limit disturbance through access restrictions (largely already in place) to important roosting sites (see Map 10).

Terns

Disturbance to breeding sites generally constitutes the greatest threat to colonially nesting birds such as Crested and Caspian Terns. Although disturbance to breeding is not an issue here given that neither of these species breeds at Point Nepean, a number of important roost sites, most notably Corsair Rock, are regularly used by both tern species. Disturbance to these sites by humans or water craft has the potential to affect terns during roosting and feeding.

Recommendation:

- Limit disturbance through access restrictions (largely already in place) to important roosting sites (see Map 10).

Powerful Owl

The one Powerful Owl recorded during a spotlight survey was probably vagrant to the site. This bird may have been attracted by the site by availability of arboreal prey (e.g. Common Ringtail Possums).

White-bellied Sea-Eagle

Four individual birds of varying age classes were observed flying overhead in autumn and spring during the study period. They did not appear to be actively foraging, and are probably vagrant to the site.

Albatross

Both Black-browed and Shy Albatross can be seen out to sea from Point Nepean. Neither of these species was observed foraging close to the shoreline and thus are considered vagrant.

White-throated Needletail

White-throated Needletails spend much of their time in flight seeking insect prey. Little is know of their utilisation of roosting habits. While no birds were seen in terrestrial habitat at Point Nepean, they are considered present at sites where they were seen actively feeding above.

Short-tailed Shearwater and White-faced Storm-Petrel

Although Short-tailed Shearwaters and White-faced Storm-Petrels are often seen from Point Nepean neither species was observed at the site itself and are therefore vagrant. However Short-tailed Shearwater were seen feeding in waters relatively close to Point Nepean, and it

is possible that these species do feed in the waters of the Port Phillip Heads Marine Park and Ticonderoga Bay Sanctuary. There is a breeding colony of approximately 100 pairs of White-faced Storm-Petrels on South Channel Fort.

White-footed Dunnart

Despite having a relatively widespread distribution throughout coastal habitats in Victoria, White-footed Dunnart populations are generally small and isolated, and consequently the species is now considered vulnerable in Victoria (DSE 2003). In the Gippsland Plains bioregion, White-footed Dunnarts have been previously recorded from Cape Liptrap, Shallow Inlet, Sandy Point (HMAS Cerberus Naval Base), Tootgarook Swamp, Lightwood Creek and Greens Bush (Morton *et al.* 1980; Schulz *et al.* 1987), Sorrento Back Beach, (AVW data) as well as Point Nepean (Mclean 1986). Within Point Nepean, White-footed Dunnarts have been previously recorded in Wilsons Folly, Cheviot Hill and east of Harrisons Bowl (Mclean 1986).

Records from this survey confirm that White-footed Dunnarts are still present in Wilsons Folly where they breed (as evidenced by the capture of a number of immature animals), and records from Harrisons Bowl, as well as a number of other sites along the south-western portion of the site indicate that much of Point Nepean, south of Defence Road is used by this species.

Surveys for White-footed Dunnarts were conducted in late winter in order to avoid pouch young mortality. This coincided with the pre-breeding period in which male White-footed Dunnarts disperse widely (sometimes in excess of one kilometre in one night) as they establish territories (Lunney & Leary 1989). Although the timing of surveys may have resulted in increased detection, it may have resulted in 'vagrant' records of male White-footed Dunnarts inhabiting 'sub-optimal' habitat during their dispersal phase. Lunney *et al* (1989) termed dispersing males 'explorer males' and found that males had a greater tendency to move through different habitat types during pre-breeding dispersal. The significant gender and age bias in results here may suggest that a large proportion of the individuals recorded may have been explorer males.

In coastal areas, White-footed Dunnarts have been shown to have a preference for relatively open habitats, and have most frequently been recorded in Tussock Grasslands and Sedgelands (Ahern 1974; Morton *et al.* 1980; Hutchings 1996; Twyford 1997). Research in non-coastal areas of New South Wales (Lunney *et al.* 1987; Lunney & Leary 1989; Lunney *et al.* 1989) emphasises similar habitat preferences, with White-footed Dunnarts found to prefer relatively open habitats. Similar relationships with vegetation structure have also been observed for Common Dunnarts (Monamy & Fox 2005).

Although Point Nepean is potentially large enough to support a viable population of White-footed Dunnarts, their specific habitat requirements suggest that the overall area of suitable habitat (i.e. Grassy Woodlands and Coastal Heathlands and Headland Scrub) is probably limited. Research suggests that resident White-footed Dunnarts (i.e. not explorer males)

consistently move around 100m per night (mean 79.5m for females and 104.9m for resident males) as they forage (Lunney & Leary 1989). Although the home ranges of males do seem to overlap, female home ranges do not, and therefore White-footed Dunnarts at Point Nepean are probably density-limited. Extrapolating from the results of Lunney & Leary (1989), it seems unlikely that White-footed Dunnart densities would be much higher than one individual per hectare at Point Nepean. Although no specific research on White-footed Dunnart densities has been conducted, Monamy & Fox (2005) found that Common Dunnarts exist at a maximum density of 3.75 individuals per hectare. Assuming White-footed Dunnarts exist at similar densities at Point Nepean (i.e. 1-4 individuals/ha) and are dependent on the limited amount of Grassy Woodland habitat for core, breeding habitat, it is questionable whether the overall population at the site is viable (at the 50/500 level; Soulé 1987)

There is also some evidence that White-footed Dunnarts are declining significantly at Point Nepean. Mclean (1986) reported 18 White-footed Dunnart captures at Cheviot Hill and seven at Wilsons Folly using pitfall traps over a total of 28 nights at each site. In comparison, only one White-footed Dunnart was recorded at Cheviot Hill, and two pitfall trap lines yielded only four captures in Wilsons Folly. The substantial increase in the number of sites surveyed, and improved survey techniques used in this study, suggests that the White-footed Dunnart population at Point Nepean may have significantly declined over the past 20 years.

It is unclear whether the apparent reduction in White-footed Dunnart numbers is a stochastic response to recent drought conditions, or whether the species is undergoing a decline as a result of deterministic, ongoing processes. Such on going threatening processes could include; competition from Black Rats and House Mice, predation by cats and/or foxes or limitation of suitable habitat. Further monitoring will be needed in order to determine this (see recommendations section).

Recommendations:

- Maintain and expand grassy woodland habitats where possible
- Continue feral predator control programs
- Limit disturbance to important habitat, particularly during the breeding season (July-September)
- Continue monitoring of known habitat and where possible establish relative abundance to assess population changes.

Long-nosed Bandicoot

Although relatively little is known of the conservation status of Long-nosed Bandicoot populations in Victoria (in part due to their highly cryptic nature), like most critical weight

range marsupials in south-eastern Australia this species has declined significantly in distribution and abundance since European Settlement, and is probably still declining today. In the areas where Long-nosed Bandicoots have been researched (mainly NSW), significant declines have been evident (Benson & Howell 1990; Higgs & Campbell 1993).

In general Long-nosed Bandicoots tend to be found in relatively wet habitats such as rainforest and riparian gullies in the Gippsland region (Opie *et al.* 1990; Claridge *et al.* 1991; Murray *et al.* 2006). However, Long-nosed Bandicoots have been recorded at a number of sites on the Mornington Peninsula as well as at other relatively dry habitats such as Narringal in south-western Victoria (Bennett 1990).

Incidental observations of Long-nosed Bandicoots within Point Nepean have been recorded consistently in the past (D. Stephenson, pers. comm.). Results from this survey confirm that a breeding population of Long-nosed Bandicoots is extant at the site.

Interpreting the within site distribution of Long-nosed Bandicoots is problematic given that bandicoots tend to have relatively large home ranges (Scott *et al.* 1999). In general, bandicoot forage diggings were most abundant in Grassy Woodland habitats (e.g. Wilsons Folly), Moonah Woodlands with open sedgy and/or grassy understoreys (e.g. around Happy Valley) and Coastal Heath and Dune Scrub communities with open understoreys. Forage diggings were comparatively rare in closed vegetation communities where Myrtle-leaf Milkwort or Coast Tea-tree was dominant and areas dominated by introduced grasses.

The distribution of Bandicoots within the site probably changes significantly with conditions and seasons in response to food availability. Mclean (1986) found that the abundance of invertebrates was low at the site in winter months. The diet of Long-nosed Bandicoots consists largely of subterranean invertebrates and insects for much of the year, however they tend to switch to fungus in Autumn and Winter (Claridge 1993; Scott *et al.* 1999; Thums *et al.* 2003). Research in south-eastern Australia has found that Long-nosed Bandicoot diet included substantial amounts of plant matter (30%), invertebrates (26%) and fungus (16%) (Claridge 1993).

Given that Long-nosed Bandicoots seem able to exploit a number of different food resources within Point Nepean, it is likely that shelter and breeding habitat are the factors limiting the size of Bandicoot populations.

In general Long-nosed Bandicoots have been found to select relatively open habitats (Scott *et al.* 1999; Chambers & Dickman 2002), although they also tended to remain relatively close to areas with more dense vegetative cover, for use as predator refuges (Chambers & Dickman 2002). Although much of the Moonah and Coast Tea-tree/Moonah Woodlands complexes extant at Point Nepean do not constitute such open habitats, Moonah Woodland complexes which are free of Myrtle-leaf Milkwort infestation and open enough to allow foraging by terrestrial mammals probably constitute important seasonal food resources for Long-nosed Bandicoots, in particularly through the provision of fungal resources.

Although Bandicoot forage diggings were relatively abundant and widespread across the study area (including at a number of sites where Bandicoots were not observed using other sampling techniques (i.e. cage traps or hair tubes), this does not necessarily suggest that Bandicoot densities are high. Forage diggings linger, particularly in dry periods, and there is no quantitative information on how many forage diggings an individual animal can make at once. The fact that Long-nosed Bandicoots have relatively large home ranges, 4.4ha for males and 1.7ha for females (Scott *et al.* 1999), in combination with the limited high quality habitat at Point Nepean suggests that the population density of this species is probably very low.

It has also been suggested that fungal eating marsupials such as Long-nosed Potoroos and Long-nosed Bandicoots may be important dispersal vectors of fungal spores (Claridge *et al.* 1992; Claridge 1993).

Recommendations:

- Maintain and expand grassy woodland habitat where possible
- Continue feral predator control programs
- Limit disturbance to important habitat, particularly during breeding season (which can be most of the year except for the coolest months)
- Continue monitoring of known habitat and where possible establish relative abundance to assess population changes.

Bats

Seven native bat species were recorded at Point Nepean. Some species such as Gould's Wattled Bat, Little, Large and Southern Forest Bats and Lesser Long-eared may breed at the site in Moonah Hollows, while other species such as Chocolate Wattled Bat and Eastern False Pipistrelle are probably migrants to the site. In general bats are more abundant in warmer months and are particularly active when invertebrate abundances are high. Old buildings and tree hollows are important resources for these species, however they also depend on healthy insect populations.

Recommendations:

- Maintain all hollow bearing Moonah and any other trees (live, dead and fallen) where possible
- Retain woody debris and leaf litter to encourage insect abundance
- Maintain habitat in buildings and structures where possible.

Reptiles

Species such as the Tree Dragon, Eastern Brown Snake, Southern Grass Skink and Metallic Skink seem to exist only in relatively low densities within Point Nepean. Degradation of habitat through weed invasion and inappropriate disturbance regimes, as well as predation from cats and foxes have probably contributed to the decline of these species.

Many reptiles, in particular species such as the Southern Grass Skink, prefer relatively open habitats where they are able to bask and more easily forage for invertebrate prey. Woody debris is also a key requirement of many reptiles which they use as breeding and foraging habitat, shelter from predators and as basking substrate.

Recommendations:

- Retain ground layer habitat such as woody debris and tussock forming grasses
- Maintain and expand grassy woodland habitats where possible.

5.5.3 Introduced Fauna

As is the case for much of the Mornington Peninsula, Red Foxes are widespread and abundant at Point Nepean. A population of Feral Cats is also extant at the site. Red Foxes and Feral Cats constitute two of the most serious threats to native fauna at Point Nepean. Predation by both species are listed as Potentially Threatening Processes under the *Flora and Fauna Guarantee Act 1988*.

Species particularly susceptible to predation by foxes and cats include terrestrial mammals, reptiles and ground dwelling/ground-foraging birds, although arboreal species are also predated upon by these species. Analysis of fox and cat scats confirmed that Common Ringtail Possums are preyed upon heavily by both foxes and cats, Swamp Rats were also preyed upon both feral predator species and Black Wallabies are predated upon by foxes. Long-nosed Bandicoot remains were recorded mainly in fox scats, although bandicoot hair was found in one cat scat. Although no White-footed Dunnart remains were recorded in scats, this species is likely highly vulnerable to predation by foxes and cats and its absence from scats may reflect its scarcity at the site.

The foot-hold fox trapping program in April and June 2006 yielded 30 fox captures across the site, after which a noticeable decline in fox prints on tracks and beaches was apparent (G. Ehmke and M. Legg pers. obs.). This decline was also noticed by the friends of the Hooded Plover group during their regular surveys along Point Nepean beaches (Dennis Bertotto pers. comm.). In comparison, the ongoing fox baiting program consistently yields 16-20 bait takes per year (D. Stephenson, pers. comm.). Given the propensity of foxes to cache food (and baits), the results achieved through foot-hold trapping almost certainly represents a significant improvement in the number of animals removed from Point Nepean over the fox baiting program. Subsequent to the foot-hold program, fox baiting was

conducted yielding substantially fewer takes than the average (D. Stephenson, pers. comm.). This suggests that the foot-hold trapping program had a significant effect on the fox population within the site.

Terrestrial mammals including White-footed Dunnarts, ground-dwelling birds and reptiles should benefit substantially from a reduction in feral predator numbers. Long-nosed Bandicoots, should actually respond particularly well to feral predator control given similar responses noted for other critical weight range mammals when feral predator numbers are reduced (e.g. Murray *et al.* 2006).

The main limitation of current feral species control at Point Nepean is that immigration of individuals into the site is not controlled, thus fox and cat populations can increase rapidly once control measures cease. Complete eradication of feral species within the study area would only be feasible if immigration into the site is eliminated. This is probably only possible through installation of a feral-proof fence across the neck of Point Nepean, an option which has been raised previously (Studley & Brinkman 2005). Predator-proof fences have been used effectively in a number of locations throughout Australia, including at the Cranbourne Royal Botanic Gardens, where a resident population of Southern Brown Bandicoots have thrived in recent years.

Despite the desirability of eradicating feral species from Point Nepean, there are disadvantages associated with feral-proof fencing. Fencing limits immigration into reserves thus isolating them from other native species populations. If a population within a reserve is dependant on immigration from outside, fencing may render such populations unviable. This isolation however may not have significant functional implications for populations at Point Nepean given that the study area probably does not receive significant immigration from outside the study area due to the lack of viable habitat for conservation dependent species outside the study area (there are generally not any records of conservation dependent species on the nearby on the Nepean Peninsula (Atlas of Australian Birds and Atlas of Victorian Wildlife data).

Fencing the site however would constitute a significant change in the ecology of the study area and may have unforseen influences on ecological processes within the study area. Thus, this option would require further investigation before being implemented.

While eradicating feral predators has obvious advantages, completely removing foxes and cats may not be necessary for native species to be effectively conserved. Given the results obtained last year, foot-hold trapping in combination with a more targeted baiting program may be sufficient to relieve predation pressure from susceptible native species and allow them to recover. The principal limitation of control measures is that recruitment from outside the site is likely to be ongoing. Therefore, control methods would also need to be ongoing to match this level of recruitment if predation by feral species is to be effectively limited. Feral species control could be significantly assisted if control measures were implemented in areas adjacent to the study area. Reducing feral species densities in areas such as the Portsea Golf Course and the coastal section of the Mornington Peninsula

National Park as well as on other private land near Point Nepean would significantly aid in reducing recruitment of these species into the study area. In other situations such measures are often considered unfeasible because many reserves are essentially 'islands' surrounded on all sides by sources of feral species immigration. This however is not the case with Point Nepean as immigration can only occur through a relatively narrow stretch of land. Therefore a feral species control program outside the study area may substantially benefit native fauna within Point Nepean. In addition, if such programs are successful enough, some native species may begin to utilise areas outside Point Nepean thus bolstering their population viability (the golf course and Mornington Peninsula National Park are obvious examples of potentially usable habitat for terrestrial mammals).

European Rabbits were observed opportunistically at a number of sites within the study area. In general, the density of this species seemed to be relatively low, which is probably a reflection of the relatively low productivity and lack of water at Point Nepean. The low numbers of rabbits may also be due to the recent drought. Although "Reduction in biomass and biodiversity of native vegetation through grazing by the rabbit *Oryctolagus corniculus"* is listed a potentially threatening process under the *FFG Act 1988*, the extant population within the study area is small and seemingly in decline. Therefore, control of this species is a low priority relative to the need for management of other feral species (i.e. Red Fox, Feral Cat, Black Rat and House Mouse). There is however, a possibility that rabbit numbers may increase at the site, particularly if predator numbers fall substantially.

With the exception of the Common Blackbird which was found throughout the site, Common Starlings which were found in and around buildings in the Quarantine Station and Spotted Turtle-dove which were common around the point area, relatively few introduced bird species inhabit the study area. Common Mynas were not detected, possibly due to the lack of tree hollows, and Rock Doves were also absent (although Rock Dove remains were present at Peregrine Falcon feeding platforms). Although not an introduced species, the absence of Noisy Miners is noteworthy given their well known hyper-aggressiveness toward native passerines (Grey *et al.* 1998).

The abundance of Common Blackbirds throughout the site probably has a significant affect on the overall function of ecosystems at Point Nepean, given their role as key dispersal vectors for weeds such as Italian Buckthorn.

Recommendations:

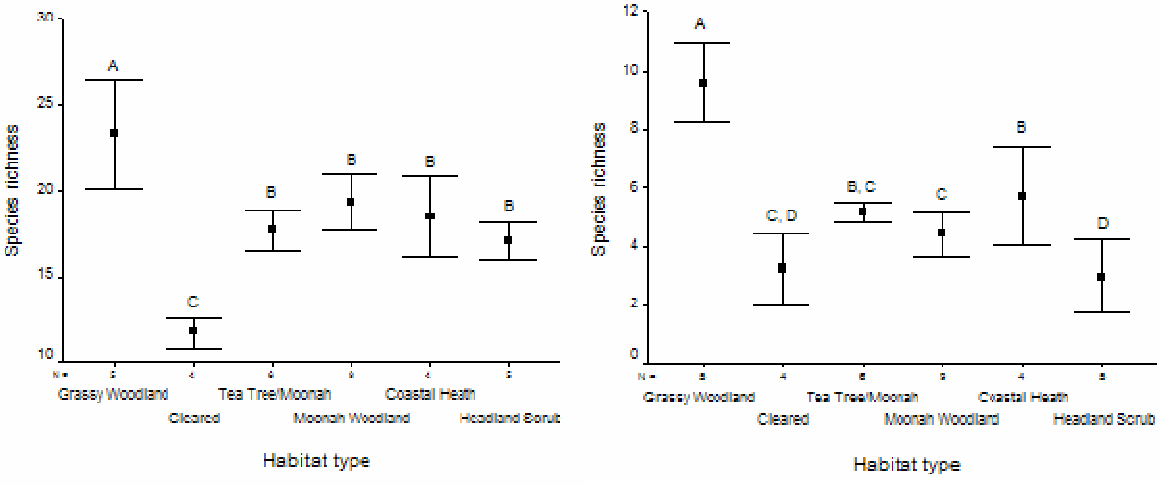
- Continue foot-hold trapping, den fumigation programs and establish permanent baiting stations
- Continue cat trapping
- Rabbit populations should be monitored and control measures implemented if the population increases
- Conduct regular rat trapping (cage and Elliot traps)

- Monitor effectiveness of the different control methods and manage adaptively
- Conduct review of predator-proof fencing feasibility and desirability.

5.5.4 Relative Faunal Values of Habitat Types

Overall species richness in different habitat types

Based on habitat classifications (see methods section), species richness was compared using one-way analysis of variance (ANOVA) to assess the conservation significance of different habitat types. There was a significant difference in the total number of vertebrate species (birds, mammals and reptiles combined) between habitat types (richness; $F_{5,27}=11.881$, $p<0.001$). The letters above the error bars on the graph highlight statistically different habitat types. Species richness was highest in Grassy Woodlands and lowest in cleared habitats, while Moonah Woodlands, Coast Tea-tree/Moonah Woodlands, Coastal Heath and Headland Scrub habitats were similar to one another (Fig. 4a). Assessment of habitat significance using all species can be misleading given the potential presence of a number of common species in some habitat types (i.e. a habitat with a high richness of common species may be considered as important as one with a high richness of threatened species). Thus, the species richness analysis was repeated using only significant species (i.e. those of conservation concern). The pattern for significant species only was similar to that apparent for overall species richness (log richness; $F_{5,27}=12.191$, $p<0.001$; Fig. 4b). The richness of significant species was again significantly higher in Grassy Woodlands than in other habitat types.



a (left graph) b (right graph)

Figure 4. Richness of all native and significant species in habitat types

Richness (Mean ± 1.96 S.E.) of (a) all native vertebrate species, and (b) significant species only in different habitat types. Off transect records and introduced species were excluded from this analysis. Site nine was also excluded due to its proximity to site six. Letters above error bars represent homogeneous sub-groups as revealed by SNK <0.05.

Avifaunal community composition in different habitat types

Given the relatively large number of bird species at Point Nepean community, compositional analyses were used to quantify the overall avifaunal composition at selected sites. A full list of bird species along with estimated relative abundance at each site is presented in the Appendices. This species list formed the basis for the compositional analyses which were calculated using Multidimensional Scaling (MDS) plot of a Bray Curtis similarity matrix (Clarke 1993) on presence/absence data. The resultant plot essentially analyses species present or absent from each site comparing the composition for each individual site with each other site in the dataset resulting in a two-dimensional plot whereby sites with similar overall bird communities are placed closer to one another than sites with dissimilar compositions. Species detected "off site" were excluded from compositional analyses (see appendices).

The MDS analysis revealed a broad divide in the bird community composition between sites located on the left side of the plot, compared with sites with positive MDS 1 values located on the right side of the plot (Fig. 5). This broad divide in bird communities corresponds with differences in structural vegetation characteristics, namely sites on the left of the plot are Coastal Heathland and Headland Communities (characterised by relatively low vegetation structure, <2m), while sites on the right represent woodland habitats (characterised by higher vegetation structure, >2m; Fig. 5).

Coastal Heathland and Headland communities were distinguished from other communities by birds such as Singing Honeyeater, Nankeen Kestrel, White-throated Needletail, Peregrine Falcon and Welcome Swallow (Fig. 5). Woodland complexes on the other hand were distinguished from Coastal Heathland and Headland Communities birds such as Spiny-cheeked Honeyeater, Brown Goshawk, Swamp Harrier, Grey Fantail, Spotted Pardalote, Eastern Yellow Robin, Red-browed Finch and Bronzewings (Fig. 5).

In addition to the main distinction between Coast Heathland/Costal Headland Scrub habitats and Woodland complexes evident along the MDS 1 axis, differences between avifaunal communities were also apparent within these two broad groupings. Grassy Woodland communities were significantly different from Moonah Woodland communities and do not overlap on the MDS plot (Fig. 5). Grassy Woodlands supported ground-dwelling species such as Brown Quail, Spotted Quail-thrush, Red-browed Finch and Brush Bronzewing as well as having more Crescent Honeyeaters and Swamp Harriers than Moonah Woodlands. Moonah Woodlands in comparison were characterised by Spiny-cheeked Honeyeater, Brown Goshawk, Grey Shrike Thrush and Spotted Pardalote (Fig. 5). The bird composition of Coast Tea-tree/Moonah Woodlands shared similarities with Grassy Woodland and 'true' Moonah Woodlands as indicated by the high degree of overlap evident on the MDS plot. Coast Tea-tree/Moonah Woodlands were dominated by a few species such as Grey Fantail, Brown Thornbill and Mistletoe birds (Fig. 5).

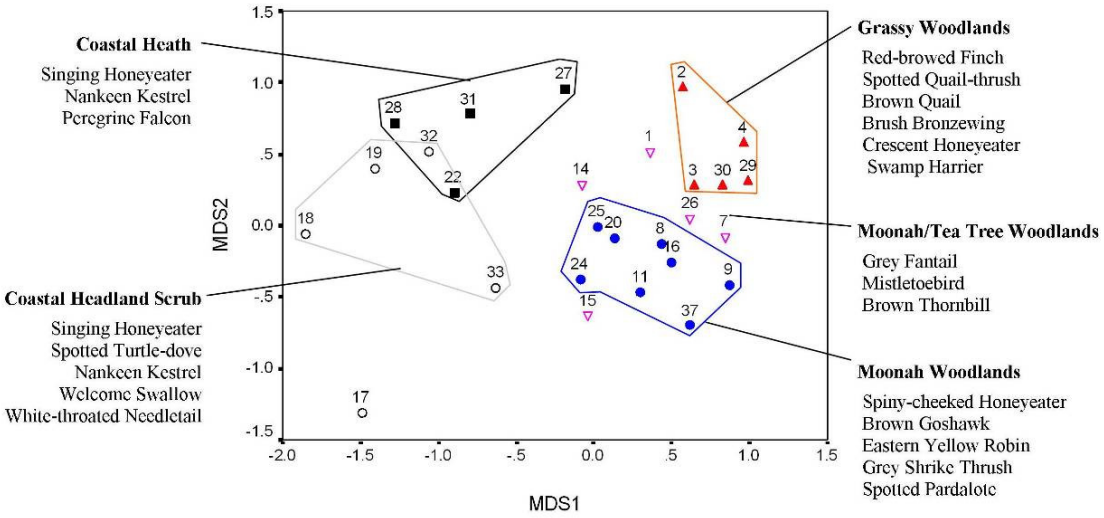


Figure 5. Multidimensional Scaling (MDS) plot of avifaunal composition.

In a previous study, Yeoman and Mac Nally (2005) found that Coastal Moonah Woodlands on the Mornington and Bellarine Peninsulas had distinct avifaunal communities when compared to other habitats and were characterised by White-browed Scrubwren, Silvereye, Brown Thornbill, Grey Fantail, Red Wattlebird and Spiny-cheeked Honeyeater. Results here broadly correspond with this study.

It should be noted that these analyses could be affected by spatial autocorrelation given the clustered distribution of sites, i.e. Grassy Woodlands were only extant in Wilsons Folly and Harrisons Bowl and Headland Scrub sites were all located in west of Cheviot Hill. However, the differences in species richness and avifaunal composition do highlight the particular conservation significance of Grassy Woodland habitats. These results also suggest that the initial delineation of habitat types (see section 5.2.2) effectively reflects underlying faunal habitat preferences. These habitat types should provide a strong basis for management of faunal species populations within the site.

Habitat Type Descriptions

Grassy Woodland

Grassy Woodland habitat at Point Nepean was found to support relatively diverse assemblages of mammals, reptiles and birds. Grassy Woodlands were characterised by terrestrial species such as White-footed Dunnart, Long-nosed Bandicoot, Tree Dragon, Southern Grass Skink, Brown Quail, Spotted Quail-thrush, and Painted Button-quail. Grassy Woodlands also constituted important foraging habitat for a number of raptors.

Although not directly sampled as part of this study, invertebrate diversity and abundances in pitfall traps was noticeably higher in grassy woodland habitats than in 'closed' woodland complexes. This was also highlighted by Mclean (1986).

Naturally treeless Grassy Bowls present around Harrisons Bowl constitute potentially important habitat for terrestrial mammals and reptiles. One immature Long-nosed Bandicoot was trapped in a grassy bowl indicating that this species as well as White-footed Dunnarts may nest in these areas.

Recommendation:

- Expand and maintain grassy understorey habitats in appropriate selected areas (e.g. Wilsons Folly, Harrisons Bowl and Wombat Flat) and facilitate faunal movement between these habitats where possible.

Moonah Woodland and Coast Tea-tree/Moonah Woodland complexes

As revealed by the overall species richness and avifaunal community composition analyses, woodland complexes, comprising various configurations dominated by Moonah and/or Coast Tea-tree had relatively similar faunal assemblages (Figs. 4 & 5). These "woodland complexes" support a relatively generalist faunal assemblage in comparison with Grassy Woodland habitats (Fig. 4 & 5). In particular, woodland complexes dominated by Coast Tea Tree appear not to constitute suitable habitat for most native terrestrial mammals, reptiles or ground-dwelling/ground foraging birds (Figs. 4 & 5). Birds typical of woodland complexes include Grey Fantail, Spiny-cheeked Honeyeater, Eastern Yellow Robin, Brown Goshawk and Grey Shrike-thrush. Reptiles are rare in woodland complexes, as are native terrestrial mammals such as White-footed Dunnart, Long-nosed Bandicoot or Swamp Rats. Common Ringtail Possums however are most abundant woodland complexes.

Despite relatively low faunal diversity and abundance, there was evidence that terrestrial fauna do utilise woodland complexes with more open canopies not dominated by Coast Tea Tree or Myrtle-leaf Milkwort. Bandicoot forage diggings are often evident in these habitats, particularly where a graminoid understorey persists. One White-footed Dunnart was also found in Moonah Woodland in Happy Valley (site 16), which is a site that possesses a relatively open canopy with grass and sedge cover apparent in the understorey. More open woodland complexes probably also provide important foraging habitat for Bandicoots, in particular during autumn-winter when Bandicoots forage for fungus.

Recommendation:

- Control key weed species, in particular Myrtle-leaf Milkwort and encourage native understorey vegetation.

- Control excessive dominance of Coast Tea-tree and encourage open woodland structure (similar to Happy Valley) in selected areas.

Coastal Heath and Coastal Headland Scrub

Coastal Heath and Coastal Headland Scrub habitats at Point Nepean support distinct faunal assemblages. Birds such as Singing Honeyeater, Nankeen Kestrel, and Peregrine Falcon are found along coastal areas of the study area with far greater regularity than in woodland complexes.

Coastal Headland Scrub habitats are quite species poor, particularly for significant species (Fig. 4) in comparison to other habitat types in the study area. This probably results from the high exposure to wind and salt spray. Coastal Headland Scrub habitats support a somewhat similar avifaunal assemblage to Coastal Heathlands (see Fig. 5), although species such as White-throated Needletail, Welcome Swallow and Spotted Turtle-Dove distinguish these two coastal habitat types. It should be noted that all of the Coastal Headland Scrub sites in this study were located towards Point Nepean, in areas with high human visitation and numerous buildings. This may be responsible for the relatively high abundance of species such as Spotted Turtle-Dove and Welcome Swallow. Coastal Headland Scrub is also a potentially important habitat for White-footed Dunnarts which were found at Cheviot Hill in this, as well as previous surveys (Mclean 1986).

Recommendations:

- Conduct weed control and eradication programs.

Cleared Habitats

Although cleared areas have generally been found to disadvantage small mammals such as native rats and Antechinus (Goldingay & Whelan 1997), results in this survey suggest despite heavy modification, cleared habitats provide important foraging resources for a range of terrestrial fauna. The number of reptile captures in cleared areas was high relative to closed woodland complexes, probably due to the relative abundance of invertebrate prey and basking opportunities inherent to these sites. It should be noted however that traps in cleared areas were located amongst native grasses rather than in Buffalo Grass or other introduced grasses. Cleared habitats are also important foraging habitat for Flame Robins, Crimson and Eastern Rosellas, Black Wallabies and raptors.

Recommendations:

- Maintain cleared treeless areas as foraging habitat for Black Wallabies, reptiles and raptors.

- Encourage native species where possible.

Foredunes

Although supporting relatively few species in comparison with other habitat types across the study area, foredunes are important basking habitat for reptiles and provide critical nesting and sheltering habitat for Hooded Plovers.

Recommendations:

- Control and monitor access to key beach-nesting bird breeding locations (see Map 10 and fauna monitoring recommendations).

- Install interpretive signage and conduct education programs highlighting the significance of coastal habitats and encourage appropriate use.

Man-made structures

Point Nepean has a number of man-made structures, some of which constitute habitat for native fauna. Peregrine Falcons commonly use the Monash Navigation light as a roost site, and also use some of the old wooden structures on the Bass Coast Cliffs as feeding platforms. Welcome Swallows breed in the buildings in the former Range Area and Quarantine Station and bats roost in forts. Man made structures also provide habitat for introduced species such as Black Rats and House Mice.

Peregrine Falcons roosting on Monash Light (left, photo M. Legg) and Point Nepean Forts (right, photo G. Ehmke).

5.5.5 Significant Habitat

Map 9 shows highly significant terrestrial faunal habitat at Point Nepean (see Map 10 for designation of significant coastal habitat). Significant habitats were defined based on overall survey results and represent areas critical to significant species and/or areas of high faunal diversity. Key characteristics of each significant area are listed on the map, and more details can be found in the habitat descriptions above. Significant habitats shaded green denote areas of high conservation significance in their current state. This is the case with all significant terrestrial habitats highlighted with the exception of the 'Harrisons Bowl' area (which includes some surrounding areas) which is highlighted in brown. This area contains patches of highly significant faunal habitat such as grassy bowls and Grassy Woodlands, while also containing highly degraded habitat such as monocultures of Coast Tee Tree and introduced grasses. The whole Harrisons Bowl area mapped is however considered significant faunal habitat because of its highly significant potential habitat value. Harrisons Bowl has the potential to be restored to a Grassy Woodland structure similar to that of Wilsons Folly. Because of its position in the overall landscape (i.e. near Wilsons Folly, away from significant human disturbance and in the centre of the study area), Harrisons Bowl has

the potential to receive immigration of terrestrial mammals, reptiles and ground-dwelling/foraging birds from Wilsons Folly and may significantly bolster faunal populations reliant on this limited habitat type.

It is important to note that the habitat areas highlighted are considered significant relative to other habitats within the site. From a regional perspective, all native habitats (as well as some non-native habitats) at Point Nepean are significant given the loss, fragmentation and degradation of native habitat in the region.

There is often a tendency to consider entire reserves as unilaterally suitable habitat for all species within them. Demographic isolation can however exist within reserves due to the specific habitat preferences of specialist species (e.g. Radford & Bennett 2004). Results from this survey indicate that species such as White-footed Dunnart, Long-nosed Bandicoot, Spotted Quail-thrush, Brown Quail and Southern Grass Skink may be functionally isolated in Grassy Woodlands habitats within the study area. This, in combination with limited availability of key food, shelter and nesting resources suggests that the current area of Grassy Woodland habitat may be insufficient to sustain populations of some species in the long-term term.

Recommendations:

- Further research involving Population Viability Analyses (PVA) should be undertaken to provide a robust estimate of the amount of different habitats required for particular species to be viable in the long-term.
- This can then be used to inform habitat restoration programs.

Coastal Habitats

Point Nepean is the only area on the Mornington Peninsula that possesses a significant amount of beach and intertidal rocky shore platform habitat that is free of significant human disturbance. Intertidal Rock Platforms are mainly present along the Bass Coast and constitute important feeding habitat for a number of resident shorebirds, supratidal rocks provide breeding habitat for Sooty Oystercatchers and form high tide roosts for cormorants and other shorebirds. Species such as Pacific Gulls, Kelp Gulls and Hooded Plovers also roost and feed on beach habitats, and Hooded Plovers consistently breed at a number of locations around Point Nepean (Map 10). Coastal Cliffs also constitute breeding habitat for Peregrine Falcons.

In addition to providing significant habitat for non-marine vertebrate species, the Port Phillip Heads Marine Park and Ticonderoga Bay Sanctuary constitute highly significant intertidal and sub-tidal marine habitats. Marine mammals including Southern Right and Humpback Whales, Common Dolphins, Australian Fur Seals as well as Little Penguins all feed or rest in waters around Point Nepean. Although not surveyed as part of this research, intertidal rock platforms and sub-tidal reefs also support highly diverse macroalgal

assemblages, invertebrate communities and fish populations (O'Hara 2000). A key threat to intertidal marine communities is trampling by humans (Povey & Keogh 1991).

Soldier Crab on Corsair Beach. Photo G. Ehmke.

Recommendations:

- Exclude access to intertidal rocky shore platforms on the Bass Straight and Port Phillip Bay Coastline.
- Exclude access to rocky islands (e.g. Corsair and Sierra Nevada Rock).
- Control (including temporary and permanent exclusion zones) and monitor access to key beach-nesting bird breeding locations (see Map 10 and fauna monitoring recommendations).
- Install interpretive signage and conduct education programs highlighting the significance of coastal habitats and encourage appropriate use where access is provided.

5.5.6 Fire

Fire is set to play a key role in the future management of Point Nepean in issues such as UXO remediation, weed management, vegetation restoration and faunal species management. Inappropriate fire regimes can have severe impacts on native wildlife (particularly on rare species and habitat specialists), and successional dynamics can be a key in determining the distribution and viability of native fauna (e.g. Bandicoots). Fire affects fauna through processes such as (Sutherland & Dickman 1999; Gill & Bradstock 2003):

- increased predation
- loss of shelter and nest resources
- changes to food availability (increases for some species and decreases for others)
- altered movement patterns

- change competitive interactions.

These processes can lead to significant changes to faunal composition. In general faunal populations can (Whelan *et al.* 2002):

1. remain unchanged
2. decline then recover
3. decline to local extinction
4. increase then decline.

Long-nosed Bandicoots, White-footed Dunnarts and Swamp Rats as well as ground-dwelling/ground-foraging birds will probably show a 'decline then recover' response to fire, initially being disadvantaged by decreased vegetation cover, increased exposure to predation and lack of food in post-fire environments. These species should however recover with time since fire as vegetation cover increases. Possums, reptiles and birds such as wrens, thornbills and other woodland species are likely to take longer to recover as they depend on higher vegetation complexity structure and woody debris. Fire often results in a loss of woody debris which is a key habitat resource for many species (Mac Nally *et al.* 2001; Mac Nally *et al.* 2002), and may need to be actively replaced in some areas.

House Mouse numbers have been found to increase substantially immediately post-fire in coastal environments (Fox 1982; Wilson & Moloney 1985), and birds of prey and snakes may also benefit from the open structure of post-fire environments. Post-fire environments are also likely to benefit foxes and cats, increasing their opportunities to hunt terrestrial prey.

Research into the successional relationship of Bandicoots with time since fire has involved mainly Southern Brown Bandicoots, and although there is considerable debate as to bandicoot successional dynamics, evidence generally suggests that Bandicoots prefer mid successional stages (5-7 years) post fire (Stoddart & Braithwaite 1979; Catling & Newsome 1981; Paull 1995).

White-footed Dunnarts have been found to do well in relatively young post-fire environments in New South Wales (Lunney & Ashby 1987; Lunney & Leary 1989), but seem unable to exploit environments immediately post fire (Wilson & Moloney 1985), probably needing at least some ground layer and understorey vegetation cover. This would likely take two or three years to re-establish.

Current fire management in Wilsons Folly seems to have advantaged terrestrial mammals, reptiles and ground-dwelling birds. Implementing similar management practices in other suitable areas such as around Harrisons Bowl seems likely to benefit these species.

The majority of areas designated for UXO remediation are Coast Tea-tree dominated woodland complexes with relatively generalist faunal assemblages. This in combination

with the relative abundance of similar habitat that exists around proposed burn areas means that long-term, localised extinctions from areas subject to burning are unlikely. Key foraging areas such as grassy bowls which are limited in extent, should however be protected from disturbance associated with UXO remediation and/or burning operations. A number of terrestrial species were found in Grassy Woodlands/grassy bowls in these areas including immature Long-nosed Bandicoots, suggesting that Bandicoots and other terrestrial species may breed in these habitats.

5.5.7 UXO Remediation

Given the relatively severe nature of proposed UXO remediation works (i.e. selective biomass reduction, vegetation removal and burning), there are likely to be significant, direct, short-term impacts on some species.

Vegetation clearance may have acute short term impacts on some resident species such as possums and breeding birds. However, few reptiles or native terrestrial mammals were found in areas designated for UXO remediation, thus impacts on populations of these species should be limited. Overall, while there is likely to be some mortality involved with vegetation clearance and fires, population level impacts should be limited as long as clearance is conducted outside breeding periods and spatial and temporal planning is adequate (e.g. provision of refuge areas, staging works and conducting works outside breeding periods).

Grassy bowls were found to be important foraging and nesting areas for Long-nosed Bandicoots and White-footed Dunnarts. Research in other areas has emphasised the importance of mosaics of open habitat with woodland/scrub areas adjacent which these species use as predator refuges (Chambers & Dickman 2002). UXO remediation therefore has the potential expose some species to increased predation from foxes and cats.

5.5.8 Habitat Rehabilitation

In general terms, increasing habitat diversity and the amount of particularly important habitat types within Point Nepean is likely to benefit faunal diversity. In particular, increasing the area of Grassy Woodlands should bolster a number of species populations which may not currently be viable (e.g. Long-nosed Bandicoot, White-footed Dunnart, ground-dwelling birds and some reptiles).

Currently there is only around 20ha of Grassy Woodland habitat at Point Nepean (i.e. Wilsons Folly and a few small patches around Harrisons Bowl). If the lack of Grassy Woodlands is limiting the abundance of some species, 20ha is unlikely to be sufficient to sustain populations in the long term. Grassy Woodland habitat could be substantially increased to approximately 50ha if areas around Harrisons Bowl were manipulated to this end.

In addition to restoring key habitat such as true Grassy Woodlands, increasing supplementary habitat such as 'open' (i.e. ≤50% canopy cover) Moonah Woodlands with grassy/sedgy understoreys is also likely to benefit terrestrial fauna. Of the Moonah Woodland habitats sampled, faunal activity was clearly highest around Happy Valley and other 'open' woodland complexes. Achieving such habitat quality in other Moonah Woodlands seems feasible given the success of habitat management at Happy Valley.

Lower lying Coastal Grassy Woodlands are thought to have existed on the Port Phillip Bay side of the study area between the Observatory Point and Quarantine Station (known as "Wombat Flat"). These areas of Grassy Woodland are thought to have had a predominantly She-oak and wattle canopy structure have largely been destroyed at the site, as is the case with similar habitats over the vast majority of the Port Phillip Bay Coastline in the region. Fauna which depended on these habitats such as Common Wombats have also disappeared from Point Nepean. Restoring areas around Wombat Flat, west of the Quarantine Station would significantly add to the habitat diversity in the area. This is likely to significantly benefit fauna as the area is currently highly degraded, and supports few faunal values.

5.5.9 Access and Human Utilisation

Point Nepean experiences high levels of human visitation, and fauna are therefore predisposed to high levels of disturbance associated with that visitation. Currently, public access is relatively restricted and key habitat areas such as Wilsons Folly and coastal areas have remained relatively free of direct human disturbance. With the decommissioning of the former Range Area and handover of the Quarantine Station, there are opportunities to increase public access to a number of areas. While increased visitor access would offer advantages in terms of fostering greater appreciation of the parks natural values, much of the conservation value of the study area stems from a lack of consistent human utilisation. Bass Straight coast intertidal rock platform communities for example are significantly healthier than those just outside the study area at London Bridge (pers. obs.) where shore platforms experience significant amounts of trampling which is known to significantly degrade intertidal macroalgal and invertebrate communities (Povey & Keogh 1991).

Human access has the potential to affect terrestrial mammals, reptiles and birds, in particular ground-dwelling species, shorebirds and resident breeding birds. Direct consequences of human disturbance include trampling of nest and shelter sites and degradation of ground layer habitat. Although largely indirect, behavioural responses to increased human utilisation of the site may also be significant. Indirect impacts of human disturbance can include disruption to feeding and foraging activity, nesting and movement patterns as well as exposing cryptic species to extra predation pressure. These impacts are likely to be species-specific with more generalist species probably able to cope relatively well with increased pressure, while habitat specialists and cryptic species may be more significantly impacted.

Current track networks at Point Nepean are broadly sufficient in protecting most significant faunal habitat. However, a number of new tracks have been proposed which, if instigated would potentially introduce human disturbance to a number of new areas. Allowing access along existing tracks in some parts of the study area such as areas around the Rifle Range in the former Range Area may not have significant impacts for fauna, however, others areas such as Wilsons Folly may be highly susceptible to detrimental effects associated with human disturbance. People have a propensity to leave formal tracks and intrude into off limits areas, particularly in open habitats, significantly reducing the effective habitat area for specialist species (Antos *et al.* 2007). Unauthorised intrusions into Wilsons Folly are likely if existing tracks around the perimeter are opened. This would have considerable impacts on a number of significant species, particularly during breeding periods. Direct impacts could include trampling of ground-nesting bird eggs and young, destruction of White-footed Dunnart and Long-nosed Bandicoot nests and significant habitat degradation through trampling and weed spread. Disturbance could also disrupt foraging activities and potentially expose sensitive species to increased predation. Allowing unrestricted access into Wilsons Folly would also significantly increase the risk of deliberately lit wildfires given its highly flammable grassy understorey.

Given the high significance and sensitivity of coastal habitats around Point Nepean, increased access along coastal areas would also result in significant impacts on shorebirds and coastal birds. Areas of significant coastal habitat are outlined in Map 10. Human disturbance in any of these areas is highly undesirable. Some control is needed where access is already provided.

The Quarantine Station area will be the focus of much increased human activity consisting of both regular access and major events. The main threats to fauna from these activities stem from potential intrusions from designated activity areas (i.e. recreation and education areas shown in the Management Plan) to adjacent areas of high conservation significance. Given the number of people potentially using the recreation and education zone (i.e. many thousands), impacts on other areas of the study area, particularly adjacent areas, have the potential to be highly significant. Many, if not all, of the impacts associated with high levels of human visitation can potentially be mitigated through thoughtful and sensitive management, however integrated management recognising the potentially synergistic effect of different access regimes will probably be needed.

Increased traffic along Defence Road may make dispersal more difficult for some species further fragmenting habitat. There may also be an increase in mortality of a number of species, particularly wallabies, echidnas and reptiles associated with increased traffic.

In addition to access from landward locations, some of the Point Nepean coastline is highly accessible by water. Unauthorised watercraft (e.g. Jet-Skis) were observed landing on beaches between Observatory Point and the Quarantine Station as well as on the beaches near Sierra Nevada rocks on multiple occasions during the course of the study. Such intrusions constitute potentially significant impacts for sensitive coastal species such as roosting cormorants and terns and beach-nesting shorebirds.

6. RELEVANT POLICY AND LEGISLATION

6.1 Regional

6.1.1 Port Phillip and Westernport Regional Catchment Strategy

The *Port Phillip and Western Port Regional Catchment Strategy* (Port Phillip and Westernport CMA 2004) is a broad policy document providing strategic direction in land, water and biodiversity management with the aim of increasing the protection of bays and waterways. Point Nepean falls within the region covered by this plan.

Point Nepean National Park represents a unique 'catchment asset' within the region by providing substantial habitat for flora and fauna of regional, state and national significance. Some of the least developed coastal zones within Port Phillip Bay and along the Bass Strait Coast. The study area also supports the most substantial tract of remnant Coastal Moonah Woodland which is listed as a threatened community under Victoria's *FFG Act 1988*.

According to Figure 28 of the strategy the vegetation of Point Nepean is a medium priority for protection and enhancement.

6.1.2 Port Phillip and Westernport Vegetation Management Plan

The Port Phillip and Western Port Native Vegetation Plan (Port Phillip and Western Port CMA 2006) establishes a strategic and coordinated approach to native vegetation within the CMA area. Its primary function is to provide a regional context to native vegetation management issues and compliment the DSE's *Victoria's Native Vegetation Management: A Framework for Action* (DNRE 2002).

The transfer of land from Commonwealth to Victorian Government management under the National Parks Act 1975 is consistent with the strategic aims of the *Vegetation Management Plan*. In fact it is likely to be one of very few opportunities to expand the National Park estate within the CMA.

The Port Phillip and Westernport CMA have recommended that the conservation status of Coastal Alkaline Scrub (EVC 858) be considered endangered within the Port Phillip and Westernport Region. It is currently listed as depleted by DSE (2007 online).

Generally, the current process of UXO remediation with corresponding resources for follow up vegetation management and enhancement are consistent with the strategic directions of the Port Phillip and Westernport Vegetation Management Plan.

6.2 State

6.2.1 Victoria's Native Vegetation Management Framework

The objective of the Native Vegetation Management Framework is the retention and management of native vegetation (DNRE 2002:13). According to the DSE (2002:14) the goal of native vegetation management in Victoria is to achieve:

A reversal, across the entire landscape, of the long-term decline in the extent and quality of native vegetation, leading to a Net Gain.

Four individual actions to achieve the above goal are outlined in the DNRE's (2002:14) Framework. These are:

- *active improvement of the quality of existing vegetation;*
- *avoidance or minimisation of further permanent losses through clearing;*
- *strategic increase in the cover of native vegetation through biodiverse revegetation; and*
- *the flexibility that is required to support landholders as they move towards more sustainable land use.*

To achieve the most strategic outcome for native vegetation across Victoria the DNRE's (2002) Framework embraces a system of classification determining both the land protection and conservation significance of any given site. The determination of conservation significance through both background information and field assessments sets in motion a commensurate management response. The Net Gain methodology is intended to provide a systematic approach that ensures the conservation of the majority of remnant vegetation across Victoria. The DNRE (2002:23) has established a three step approach to use when applying the Nat Gain process. These steps are:

- *To avoid adverse impacts, particularly through vegetation clearance.*
- *If impacts cannot be avoided, to minimise impacts through appropriate consideration in planning processes and expert input to project design or management.*
- *Identify appropriate offset options.*

Upon receiving planning applications to clear vegetation responsible authorities make their assessments relative to the conservation significance of the site. If all the preliminary processes have been correctly applied approval may be granted.

The outcome of the Net Gain process is intended to ensure that the most significant vegetation incurs no losses (exceptions do apply) while less significant vegetation is adequately managed through commensurate offsets based on the level of significance. During the process it must be assured that every effort has been made to avoid remnant vegetation at the outset and if clearance is unavoidable impacts have been minimised to avoid the most significant vegetation and reduce the amount of overall vegetation cleared.

The application of this policy within the context of Point Nepean National Park relates to proposal for various infrastructure upgrades. There may be impacts on native vegetation as a result of these upgrades. However, the policy does not apply to Commonwealth Land. UXO remediation, which involves substantial vegetation modification, is a unique circumstance and it is unclear how the Native Vegetation Management Framework would respond. Especially since there is substantial investment in vegetation maintenance as a result.

6.2.2 National Parks Act 1975

An area listed under the National Parks Act is primarily established for conservation of the natural environmental values including flora and fauna. In addition sites of archaeological, ecological and geological, historical or other areas of scientific interest are also protected under this act.

In order to meet the requirements of the National Parks Act there must be ongoing commitments for the control or eradication of pest plants and animals, protection of ecological and evolutionary processes, protection of indigenous species while accommodating the public and facilitating enjoyment and education.

In allowing access to the former firing range and other areas that have previously been inaccessible to the public the objectives of the National Parks Act should be carefully considered. This is particularly relevant with regard to the impact of increased public visitation and subsequent impacts on fauna.

6.2.3 Flora and Fauna Guarantee Act 1988

The Flora and Fauna Guarantee Act 1988 (FFG Act) was legislated to ensure the continued survival of all Victorian species of flora and fauna and all Victorian communities of plants and animals. The Act builds on broader national and international policy, including principles of conservation and biodiversity. A key component of the FFG Act is to ensure the sustainable use of flora and fauna resources whether they are threatened or not.

The FFG Act lists:

- Threatened species of flora and fauna;
- Threatened communities of flora and fauna;

- Protected flora; and
- Potentially threatening processes.

All four components of the FFG Act are relevant to the study site.

Threatened Species

There are eight species of flora and fauna that are listed under the FFG Act as threatened. These species were accepted for listing under the FFG Act by the Scientific Advisory Committee (SAC) because they met one or more criteria that demonstrated they were in a *demonstrable state of decline likely to result in extinction* (wording used by SAC when making a final recommendation). There are two species (with potential for a third) of flora found within Point Nepean National Park listed under the FFG Act. Five birds and one mammal recorded during this survey are also listed under the FFG Act.

Threatened Communities

Coastal Moonah Woodland is listed as threatened under the FFG Act. As previously discussed this community is part of the Coastal Alkaline Woodland EVC. Any works undertaken within the National Park including UXO remediation and proposed infrastructure upgrades that may have an impact upon this community are likely to require permit approval by DSE.

Protected Flora

Protected Flora species include all species listed as threatened, all species that belong to communities listed as threatened (such as Coastal Moonah Woodland) and plants requiring protection for other reasons.

Plants requiring protection for other reasons are listed to regulate exploitation including removal from the wild for cultivation and the cut-flower industry. Among others, the list includes all members of Asteraceae (daisies), all members of Epacridaceae (heaths), all members of Orchidaceae (orchids) and all Acacia's (excluding Silver, Early Black, Lightwood, Blackwood and Hedge Wattles).

DSE regulate the issuing of permits relating to any proposed activities of works that my impact upon protected species. Again UXO remediation and any proposed infrastructure upgrades within the National Park are likely to require DSE approval where they affect Coastal Moonah Woodland.

Potentially Threatening Processes

Schedule three of the FFG Act lists numerous Potentially Threatening Processes. These processes have been identified as a threat to the survival of one or more species of flora or fauna or a community. A number of threatening processes operate across Victoria and across all land tenures while some are specific to a defined locality.

A number of the Potentially Threatening Processes are, or could be, operating within Point Nepean National Park. These include:

- Collection of native orchids,
- Habitat fragmentation as a threatening process in Victoria,
- Inappropriate fire regimes causing disruption to sustainable ecosystem processes and resultant loss of biodiversity,
- Predation of native wildlife by the cat *Felis catus*,
- Predation of native wildlife by the introduced Red Fox *Vulpes vulpes*,
- Reduction in biomass and biodiversity of native vegetation through grazing by the rabbit *Oryctolagus corniculus,*
- The introduction and spread of the Large Earth Bumblebee *Bombus terrestris* into Victorian terrestrial environments,
- Spread of *Pittosporum undulatum* in areas outside its natural range,
- The invasion of native vegetation by environmental weeds,
- Use of Phytophthora-infected gravel in construction of roads, bridges and reservoirs.

6.2.4 Catchment and Land Protection Act

The study site supports a number of weeds that are declared noxious under the Catchment and Land Protection Act 1994 (CLP Act). Plants occurring on this list are known to or have the potential to result in detrimental environmental or economic impact.

Under the CLP Act declared noxious weeds are categorised into four groups depending on their known and potential impact and specific circumstances for each region. These categories are:

- State Prohibited Weeds (S);
- Regionally Prohibited Weeds (P);

- Regionally Controlled Weeds (C); and
- Restricted Weeds

State Prohibited Weeds are either currently absent in Victoria or are restricted enough to be eradicated. The Victorian Government is responsible for their control.

Regionally Prohibited Weeds in the Port Phillip East Catchment area are not necessarily widespread but have the potential to become widespread. It is expected that weeds that meet this criteria can be eradicated from the region. Regionally Controlled weeds are usually widespread but important to prevent further spread.

Restricted Weeds occur in other states and are considered to be a serious threat to primary production, Crown land, the environment and or community health if they were traded in Victoria. No weeds are currently listed as Restricted Weeds.

6.3 National

6.3.1 Environment Protection & Biodiversity Conservation Act 1999

The EPBC Act is the principle piece of federal legislation that aims to guide a variety of planning processes or other actions with regard to any matters listed under the act. Under the Act species and communities can be listed as threatened. Fauna can also be listed as migratory.

Within Point Nepean National Park there is one species of plant (Leafy Greenhood) that is listed as Vulnerable under the EPBC Act. One species of bird, the Shy Albatross, was observed flying over or offshore from the study site. This species is listed as Vulnerable under the EPBC Act.

Some species of birds are also listed as Migratory under the EPBC Act. Migratory listings under the EPBC Act include all species listed under the following international conventions:

- China-Australia Migratory Bird Agreement;
- Japan-Australia Migratory Bird Agreement; and
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).

Coastal Alkaline Scrub (EVC 858) has been nominated for listing as a threatened community under the EPBC Act. A decision on the nomination is yet to be reached by the Department of Environment and Water Resources (DEWR).

Under the EPBC Act, Parks Victoria will be required to make a referral to DEWR if any current, proposed or future activities are expected to have a significant impact on listed matters. The Minister then decides which assessment and reporting option is applied. The Minister may approve a 'controlled action' allowing the activities, however conditions may apply to the controlled action.

The Leafy Greenhood population also coincides with a historically significant site. In the event of restoration works that will have an impact on any vegetation abutting the historical structures there is the potential that there may be an impact upon the Leafy Greenhood. In such an event there will be a requirement to demonstrate that the historical restoration works have taken into account the Leafy Greenhood population. This information is required by DEWR in the referral process. Similarly, the establishment of an ex-situ population of the Leafy Greenhood will also require approval from DEWR.

The Shy Albatross and other Migratory species are transient species and not likely to suffer from any proposed actions within Point Nepean National Park.

If Coastal Moonah Woodland is listed by DEWR as a threatened community under the EPBC Act Parks Victoria may be required to provide a referral for the UXO remediation works.

7. DISCUSSION

7.1 Closed Scrub or Open Woodland

There exists a level of uncertainty and potential disagreement among land managers, ecologists and biologists over exactly how to approach the concept of 'restoration' within the study area. Archaeological evidence, apparent population declines of state and regionally significant fauna and the general habitat requirements of many other species of fauna have lead to the suggestion that Coast Tea-tree has invaded the study area from is narrow coastal niche. However, the counter claim to this is that it is part of the natural succession of vegetation within the study area and it will eventually give rise to a more open community dominated by other longer-lived species.

As outlined in the earlier sections of this report there has been substantial disturbance for well over 100 years throughout much of the study area. These disturbances have without doubt influenced the composition of vegetation we see today. Therefore, all that we are left with to base future management decisions on is the existing vegetation condition, ambiguous historical anecdotes, Aboriginal archaeological sites and the ongoing interpretation of flora and fauna surveys and research.

7.1.1 Pre-European Vegetation Structure

The original pre European condition of native vegetation and habitat conditions at Point Nepean remains equivocal, as is the case with many other ecosystems and landscapes across Australia. Anecdotal historical accounts in the form of diary entries, survey's reports or early illustrative maps provide some clues but these sources are not beyond ambiguity.

Based on the variety of accounts discussed in earlier sections of this report we can be fairly certain that there was a dense scrub along the southern ocean side. The current extent of the Coastal Headland Scrub, which is characterised as much by environmental conditions as by its constituent flora, is probably similar to its pre European extent. However, the natural (pre-European) floristic progression from Coastal Headland Scrub into the extensive Coastal Alkaline Scrub is not likely to be something that is easily understood.

There are a number of Boonwurrung archaeological sites that are now densely covered with Coast Tea-tree (D. Stephenson pers. comm.). In addition the number of artefacts and archaeological sites is apparently indicative of more permanent and ongoing management of the study area and surrounding environment. Although fire is likely to have been used in grassy habitats we have virtually no substantial information on the composition and structure of pre-European vegetation. Therefore, it is not possible to draw parallels with planned burns in the study area in a modern context to the nature of fire used by the Boonwurrung.

7.1.2 Previous Studies and Ongoing Research

In 1927 (Pescott) it was reported in the *Victorian Naturalist* that Coast Tea-tree was dying off around Port Phillip Bay. It was, in fact, thought to be disappearing. However, similar die-offs have been observed more recently (authors' obs). Which lends weight to the theory that Coast Tea-tree is a species that dominates a particular successional phase of coastal vegetation communities including the Coastal Alkaline Scrub EVC.

Willis (1948) discusses field observations of Moonah across its natural range in south eastern Australia. However, there is not a great deal of information on the structure of plant communities or discussion of any association with Coast Tea-tree.

Turner *et al.* (1961) discusses dune succession on Sunday Island at Corner Inlet. Although little inference can be made, they identified Coast Tea-tree as occupying some sites where other woodland species such as eucalypts should have occurred. At the time of their research grazing had been occurring on the island for at least ten years. This may have altered the natural distribution of some species.

In a study of dune vegetation ecology at Gunnamatta Beach, Sacheti and Scott (1986) investigated the succession of plant associations. It seems as though their study was undertaken within either Coastal Headland Scrub and/ or Coastal Dune Scrub so does not provide any insights on the management of Coastal Alkaline Scrub within the hinterland of the Point Nepean study area. They did note, however, the grass and herb diversity decreases with the maturity of Coast Tea-tree (although this is true to a point, grass and herb diversity has been observed to increase in senescent or over mature Coast Tea-tree).

In 1977 Hazard and Parsons studied the coastal scrub and woodland of Westernport Bay. Their research identified a link between the loss of mature Coast Banksia through fire and the competition Banksia recruitment faces from Coast Tea-tree. However, their study was undertaken 32 years after a fire and they noted that there were instances of persistent Banksia becoming emergent over Coast Tea-tree. They also concluded that fire is a causal agent in the spread of Coast Tea-tree into adjacent vegetation. According to Hazard and Parsons (1977) Coast Tea-tree can spread up to 65 metres from a seed source following fire. They noted that frequent fires are likely to encourage dense stands of Coast Tea-tree leading to the displacement of other species.

Recently, Hazard and Parsons' (1977) research was revisited. Gent and Morgan (2007) assessed the changes in vegetation structure at roughly the same sites that Hazard and Parsons studied over 30 years ago and their findings are significant for this study. The Gent and Morgan (2007) study provides some insights into the successional pathways of coastal vegetation that have been burnt in the past but have remained unburnt for a long period. Hazard and Parsons (1977) found that Coast Banksia Woodland was invaded by Coast Tea-tree following fire, Coast Banksia recruitment was rare and that Coast Beard-heath was actively recruiting in the absence of fire. Without fire, Hazard and Parson predicted that the Coast Banksia would eventually collapse allowing Coast Tea-tree invasion which would then give rise to Coast Beard-heath. However, Gent and Morgan (2007) have found that while the densities of Coast Banksia have declined the surviving tree are bigger and there is little evidence to suggest other tree or shrub species are displacing them. Based on the

absence of Banksia seedlings, described as a recruitment bottle, and the lack of invasion of other species, Gent and Morgan (2007) suggest that their long unburnt study site is increasingly resembling a grassy woodland. Understanding succession, is obviously of critical importance to the future management of the study area given that it is a management goal to provide more open grassy habitat for a number of significant fauna species.

Recent research by Hughes (2001) on fire in Wilsons Folly suggests that the vegetation there is in varying states of succession. This implies that the grassland is not over the entire Wilsons folly area is an expression of anthropogenic influence. It is probable that what we have defined as Calcareous Swale Grassland in other parts of Point Nepean occurred in Wilsons Folly in low lying areas. However, the maintenance of a treeless grassland up to the ridgelines is unnatural. Hughes (2001) suggests regrowth of various ages are expressions of Coastal Alkaline Scrub at different stages of succession. This could be the case throughout much of the Coastal Alkaline Scrub within the National Park.

7.1.3 Overview

If natural succession of scrub transforms into woodland is operating within the study area, then is it just a matter of waiting? The intervening period of low quality habitat for significant species, fragmentation and disturbance within the surrounding landscape and the ongoing implications of weed management suggest that waiting for the natural succession of Coast Tea-tree is not a management option that can be adopted across the study area. Further research is obviously of great importance, particularly given the status threatened status of Coastal Moonah Woodland and its place within the Coastal Alkaline Scrub EVC.

The table below is an attempt to encapsulate the issues and discuss each issue according what is known, unknown or equivocal and in need of further research.

Table 18. Issues Surrounding the Management of Scrub and Woodland

Issue or Hypothesis	Status	Comment
Most of the study area was previously an open woodland (apart from obviously unsuitable habitats).	Equivocal	There are a variety of sources suggesting that wooded vegetation with grassy and open understorey vegetation was once much more widespread on the Mornington peninsula, However, localities and descriptions can be ambiguous.
Coast Tea-tree has invaded inland from its Coastal Dune Scrub and Headland Scrub habitats	Equivocal	Coast Tea-tree is listed by DSE as a characteristic species of the Coastal Alkaline Scrub EVC which predominantly occurs throughout the Nepean Peninsula. It is therefore considered indigenous throughout the study area.
Coast Tea-tree has increased in abundance in recent history.	Probably	In response to a cessation of Boonwurrung land use (speculative) and the beginning of European land use practices. Archaeological studies identified middens in thickets of

Issue or Hypothesis	Status	Comment
		Coastal Tea-tree.
The growth and closed scrub behaviour of Coast Tea-tree reduces habitat quality for many species of fauna particularly ground dwelling mammals	Unequivocal	This has been demonstrated by research undertaken for this project. Closed Coast Tea-tree scrub prevents the establishment of a grassy tussock structure in the understorey which can be considered as a key stone habitat for species such as the White-footed Dunnart and the Long-nosed Bandicoot.
The growth and closed scrub behaviour of Coast Tea-tree reduces the diversity of understorey flora.	Equivocal	This depends upon the age of the Coast Tea-tree. Very young cohorts following disturbance will limit light and resources available to ground flora. However, with age, the cohort self-thins and eventually becomes senescent. Numerous small herbs and grasses flourish under Coast Tea-tree. Research is ongoing.
Coast Tea-tree should be controlled in post burn management of UXO and other areas.	Yes and No	Coast Tea-tree should be removed from Calcareous Swale Grassland in order to maintain this EVC and critical habitat for fauna. There is also a case for the control of Coast Tea-tree on the adjacent slopes of swale grasslands in what might theoretically be Coastal Alkaline Scrub based on the need to increase fauna habitat for significant species such as the Long-nosed Bandicoot, White-footed Dunnart and the Spotted-quail-thrush. However, it is still considered indigenous.
Closed thickets of Coast Tea-tree scrub are a an expression of plant community succession in a dynamic ecosystem.	Equivocal	Coast Tea-tree may be seen as a long-lived primary coloniser in disturbed coastal environments particularly on old dunes and sandy soils. The cumulative impacts of disturbance since European arrival may have resulted in the increased abundance.

The uncertainty of the pre-European structure of what is called Coastal Alkaline Scrub is not likely to be quickly resolved. Originally this EVC (858) was called Calcarenite Dune Woodland. Although further research is required to understand the dynamics of this threatened community it has been made clear during this research that there are a number of significant species of fauna that are dependent on open grassy habitats. A habitat type that may have only developed in long unburnt sites following successional pathways over many decades. As identified in section 5.5.4 and 5.5.5 of this report, restoring open grassy habitats in woodland or grassland structure is a management priority that can not necessarily wait this long.

8. RECOMMENDATIONS

The *Point Nepean National Park Draft Management Plan* (Parks Victoria and PNCT 2005) and the *Point Nepean Public Issues Paper* (Studley & Brinkman 2005) identified a number of potential management scenarios which may have implications for flora and fauna conservation. These include increased recreational access, feral predator control (including the possibility of predator proof fencing), unexploded ordinance remediation works and development of the former Quarantine station.

In addition to specific proposed management scenarios, a number of ongoing processes and management priorities affect flora and fauna. Recommendations below address both ongoing and proposed management of the park.

8.1 Flora and Vegetation Communities

8.1.1 Coast Tea-tree

Further Research

Coast Tea-tree is indigenous to the study area. The naturalness of its current abundance however is equivocal. Ongoing research by ARI into the ecology of Moonah Woodlands could be complemented by further research on Coast Tea-tree and its response to various forms of treatment that may include a do nothing approach. In some areas within its natural range it has invaded adjacent communities primarily because of altered fire regimes (Blood 2001).

Further research is also required to determine if the current extent of Coast Tea-tree is a succession phase of an ecosystem that has been highly disturbed. Is continued disturbance setting the whole succession process back to year zero? The current UXO remediation program provides an opportunity for this monitoring to occur.

Management

Coast Tea-tree should be treated as indigenous. However, as indicated by the fauna research from this study, this species is causing the reduction of important habitat for a number of vertebrate species. The extent of Coastal Alkaline Scrub relative to Calcareous Swale Grassland is such that the active management of the latter by removing Coast Tea-tree is not likely to have any impact on the status of the former EVC within the study area.

Active control of Coast Tea-tree within existing or former Calcareous Swale Grassland is recommended. However, previous studies have identified fire as an agent of Coast Tea-tree recruitment and dispersal (Burrell 1981). Following spring flowering and seed development over summer, an autumn burn will result in the release of seed and subsequent recruitment.

8.1.2 Drooping Sheoak

Further Research

Drooping Sheoak was once a much more abundant component of the landscape. There is some uncertainty regarding the ability of the existing population to recover to anything similar to pre-European levels.

Further research is needed on a variety of recruitment strategies within the park. Natural regeneration may not be sufficient for the species to recover. Browsing by mammals may be causing high seedling mortality and seed production may be low.

Management

The species should be actively managed throughout the National Park. Individuals of dubious provenance should be considered for replacement. Specific areas should be established for replanting while monitoring of other areas for natural regeneration should be established. Natural regeneration should be protected from browsing.

8.1.3 Coastal Moonah Woodland

Further Research

Further research is greatly needed on unravelling the response of this community to previous and ongoing disturbances.

- The role of ants in this community and the potential impact of argentine ants;
- Allelopathic properties of Moonah leaf litter or roots;
- Age of Moonah.

Management

Areas with relatively high understorey species compositions should be specifically targeted for sensitive weed control. These areas could be established as benchmark sites for this community and their maintenance is guaranteed in perpetuity.

Broad acre weed management options should continue to be investigated.

8.1.4 Damp-sands Herb-rich Woodland

Further Research

The existence of this community within the study area is in contrast of the popular belief that eucalypts were always naturally absent from the Nepean Peninsula. Although relatively small in extent this vegetation community may have been maintained by a particular fire regime. Coast Manna-gum and Black Wattle regenerate well after fire and 25 years is considered the natural fire frequency interval. Further research could be undertaken into describing the edaphic conditions that give rise to this community rather than the dominant Coastal Alkaline Scrub.

Management

This EVC should be mosaic burnt every 25 years, with a control area never burnt but weed management undertaken. A burn may also reveal further species of dormant vascular flora that will remain undetected until fire stimulates growth. However, any burn will require substantial commitment for weed control. It would also have to be particularly sensitive so as not to cause loss of recruiting seed banks that in the case of some species may be quite limited.

8.1.5 Calcareous Swale Grassland

Further Research

The Grassy Bowls of the study area are key habitats for a number of significant species of fauna. Therefore, the maintenance and improvement of this EVC within the study area is a high management priority. More detailed vegetation studies could be undertaken to determine the floristic composition and environmental conditions that have allowed this EVC to persist.

Management

Introduced grasses, shrubs and to a lesser extent trees threaten this community. Introduced grasses such as Rat-tail Grass **Sporobolus africanus,* Buffalo Grass, Kikuyu and other species occur in disturbed sites within the EVC particularly along access tracks. Vehicles and slashing machinery using these tracks should be clean before entering intact areas within the park. Slashing along internal access tracks should not occur after slashing the grass along Defence Road (with many introduced grass species) without appropriate wash-down procedures.

8.1.6 Orchids

Further Research

Three to four species of orchids were not identified to the species level in this survey. This includes a *Caladenia* sp., *Corybas* sp., *Pterostylis* sp. and a *Microtis* sp. The locations of all these unidentified orchid species is contained within the floristic data generated as a result of this survey.

The Helmet-orchid, *Corybas* sp. (potentially *C.* sp. aff. *diemenicus*) is a priority for identification as it may be Nationally significant. It is recommended that this be searched for and identified, in situ, in 2007. It was observed flowering in late June 2006.

Monitoring should occur to see if the natural pollinators for the Leafy Greenhood are still present.

Management

The Leafy Greenhood location must remain confidential to prevent theft which is a very real risk given the uniqueness of Point Nepean population. However, there must be a balanced approached in informing people involved in park management to ensure inadvertent damage is not done to the population through a lack of knowledge.

An ex situ population of Leafy Greenhood must be established. This could be done through vegetative and seed. Hand pollination should be considered. It is likely that the population can be effectively managed by individuals already managing other leafy Greenhood sites on the Mornington Peninsula.

Reintroduction of this species into other sites within the study area should be approached with caution. Liaison with individuals who posses invaluable practical knowledge of this species on the Mornington Peninsula will be necessary. Further management details are contained within the confidential Leafy Greenhood Memorandum of Advice.

8.1.7 Significant Flora

Significant flora discussed here includes all species listed in Table 4 (p.39) which have a conservation status ranging from poorly known (k) to endangered (e). This section provides an overview of threats and management responses for significant flora. Further research and general management principles are also provided.

Further Research

Further research is required on the extent and abundance of some species within the study area. Marine species occurring on the inter-tidal zones are little known. In addition, the more cryptic

species such as Coast Colobanth could be more abundant and their extent within the study area is not likely to be represented by the single or few records from this survey

Populations of the Rare/Coast Bitter-bush are directly affected by past, present and future management practices. The UXO remediation and ecological restoration processes have the potential to directly influence the population numbers of the two forms of this taxa. Hughes (2001) recommended further research into this species' response to fire. Population studies over several years, concurrent with landscape level management and UXO remediation, would enable better evaluation of its ecology and may enable predictive responses to different forms of landscape management. The study area provides one of the best opportunities for population ecology studies of this species in Victoria. This is also the case for regionally significant species.

Management

Species specific management is outlined in the table below. However, common to all species is the management need to not cause the loss or damage to any significant species when undertaking management, restoration or infrastructure works within the study area. If new walking trails and visitor facilities are proposed the sites where they occur should be surveyed for these species at appropriate times of year.

Table 19. Significant Species Management Recommendations

Species	Threats	Management
Coast Wirilda *Acacia ulicifolia*	No particular threat. The species is naturally rare but relatively common in Coastal Alkaline Scrub	No specific management necessary. However, fire in quick succession may deplete seed bank. Even though it can occasionally reproduce from root stock a second burn amongst a cohort responding to an initial burn before it has reached reproductive maturity and produced seed will reduce abundance.
Coast and Rare Bitter Bush *Adriana quadripartita*	Browsing and excessive disturbance associated with maintenance. Potential misidentification as an introduced species.	Both forms of this species are disturbance dependant and regenerate after fire. Avoid burning areas at to short an interval to allow for seed bank to establish. Its reliance on wind pollination requires population numbers to be maintained to ensure there are adequate gender ratios. Hughes (2001) recommended further research and monitoring which is reiterated here.
Sea Nymph *Amphibolis antarctica*	Unknown	Suitable habitat should be surveyed to identify further occurrences.
Coast Fescue *Austrofestuca littoralis*	Displacement by introduced species. Off target damage during Marram Grass control.	Monitor populations. Control Marram and Sea Wheat-grass if necessary.
Late Helmet Orchid (potential) *Corybas sp.*	Insect damage, herbivores, track maintenance, herbicide, soil disturbance.	Confirm species as priority (flowers mid to late July). The single plant observed during this study occurs 30cm from a maintenance track. If Late Helmet Orchid the FFG Action statement prepared for the species should be consulted.

Species	Threats	Management
Coast Colobanth *Colobanthus apetalus* var. *apetalus*	Displacement by introduced species. Off target damage during weed control works. Destruction of plant during track maintenance.	This species is tiny and could easily be overlooked during track maintenance and weed control works. This species and similar small herbs and graminoids are almost always neglected during weed control that relies on mulching, in which case they are smothered. Coast Colobanth and other small ground flora should be given due consideration in restoration works; avoid herbicide use in some sites and avoid burying with mulch. However, these species are just as likely to be lost to the smothering effect of introduced species especially grasses.
Austral Trefoil *Lotus australis*	Competition with Marram Grass.	Avoid off target damage to this species if works are undertaken to control Marram Grass or Sea-wheat Grass.
Peninsula Daisy-bush *Olearia* sp. 2	Displacement by introduced species. Other threats unclear.	This species should be considered for cultivation and use in plantings associated with park infrastructure. Further research is required to identify appropriate management.
Dune and Fluffy-fruit Wood-sorrel *Oxalis rubens and O. thompsoniae*	Potential displacement by introduced species. Other threats unclear.	Unclear.
Dune Poa *Poa poiformis* var. *ramifer*	Potential displacement by introduced species. Other threats unclear.	Unclear.
Leafy Greenhood *Pterostylis cucullata*	Illicit collection, introduced species, accidental damage from other works. See MoA.	Keep location confidential but ensure that Parks Victoria or PNCT staff or volunteers do not inadvertently damage this population, through lack of communication, during maintenance and management works. Refer to Memorandum of Advice
Coast Bush-pea *Pultenaea canaliculata*	Potential displacement by introduced species. Other threats unclear.	Little direct management is necessary. If introduced species are observed to be directly competing they should be controlled or removed.
Beaded Glasswort *Sarcocornia sp.*	Unclear.	Identify species.
Coast Twin-leaf *Zygophyllum billardierei*	Other than competition with introduced species there are no particular threats.	Avoid off target damage to this species when controlling weeds. No direct management is necessary.

8.1.8 Other Flora Species

Further Research

Dianella sp aff. *revoluta* (Coastal) may be more widespread within Point Nepean National Park. This species is regionally significant because it has appeared in less than 5% of quadrat records for the

Gippsland Plains. However, many records for this taxa could be recorded as Black -anther Flax-lily *Dianella revoluta* prior to the revision of many *Dianella* species occurred.

Management

Winged Spyridium occurs at only one locality within the National Park. As discussed previously this species is not found at any other locality east of Port Phillip Bay and is of high regional significance. Walking tracks and other visitor infrastructure need to be carefully placed to avoid any impacts this species.

8.1.9 Vegetation Communities

Further Research

There are eight EVCs known for Point Nepean National Park as a result of this study. There is still a level of complexity within the number of sub-community expressions that has not been fully explored. Previous research (Parr-Smith and Smith 1978) is now out dated. Vegetation is dynamic and there are various phases of succession that a single community will go through. Given the study areas disturbance history it is reasonable to assume that what appear to be different communities are the same communities but at differing periods of maturity.

Further research is required on the recovery dynamics of EVCs, particularly Coastal Alkaline Scrub and the Moonah Woodland community within this EVC.

Management

EVCs that are restricted in extent and distribution should be actively managed for environmental weeds. Consideration should also be given to small localised burns at different times of the year with follow-up weed control.

8.1.10 Cemetery

Further Research

The cemetery is a unique site within the National Park in that it is both disturbed, is a culturally significant site and also of important botanical significance. The diversity of indigenous herbs and grasses is generally higher within this site than within scrub or woodland communities elsewhere within the park.

Weeds are present including Buffalo Grass which could adversely affect the diversity of native species if management regimes change. Continual monitoring every few years may be necessary to ensure the current status quo of indigenous cover is not reduced.

Management

Management of the cemetery should be initially to maintain the status-quo in indigenous cover and diversity. Within this framework trials could be undertaken to change mowing regimes. Mowing should generally occur after grasses and other herbs including lilies and orchids have set seed.

8.1.11 Slashed Breaks

Further Research

The Monash Break and the formal rifle range provide open habitat in terrain that is otherwise covered by dense woody vegetation. There has been some expression that these breaks in vegetation should be rehabilitated. However, they offer a different habitat to the otherwise fairly ubiquitous Coastal Alkaline Scrub and support flora and fauna uncommon in that EVC.

There are some sections that are dominated by exotic species and these may be slowly advancing along the breaks under favourable conditions. Consideration should be given to monitoring any long term changes in abundance of exotic species.

Management

Both the Rifle and Monash breaks provide practical fire breaks and maintenance of them for such purposes is preferable than establishing new firebreaks in the event of an uncontrolled wildfire emergency. There is not expected to be significant benefits for the movement of fauna through restoring canopy connectivity.

To maintain current levels of diversity both the Rifle Range and Monash breaks should be maintained in their current form. Invasive exotic species could be gradually controlled and allow for their replacement of native species. Selective mowing may be one option but would require a skilled contractor using, ideally a flayal mower. These areas should not be slashed too low. Preferably they should be slashed at the height of native grasses (~60cm) to maintain habitat utility for reptiles such as skinks.

8.1.12 Phytophthora

Further Research

Tests should be undertaken at several locations around the study area. Preferably these should be near vehicle access tracks, walking trails or areas where there is likely to be soil disturbance and the potential for dispersal on machinery or boots.

Management

To ensure Phytophthora is not brought onto the site or existing infestations (if they occur) are not spread further within the site the following steps should be taken:

- Conduct tests in key areas where Phytophthora is likely to occur within the study site;
- Ensure environmental hygiene standards and procedures are followed for machinery and vehicles during any planned works; and
- Define sites within the study area where preventative Phytophthora hygiene should occur (e.g. construction of walking trails).

8.2 Fauna

8.2.1 Former Range Area

UXO Remediation Works

- Limit vegetation clearance and burning to autumn to avoid breeding periods.
- Consider spring burns in some areas to limit the recruitment of Coast Tea-tree. Faunal breeding periods would however have to be carefully considered.
- Adopt a staged approach whereby only relatively small areas of vegetation (10-20ha) are cleared at any one time.
- Ensure adequate refuge areas exist for fauna. Adopting a staged approach to remediation works should largely achieve this providing spatial planning is sufficient (e.g. retain some woodland patches adjacent cleared/burnt areas and remaining grassy bowls).
- Identify possums in dreys during vegetation removal works, and leave habitat trees until animals abandon relocate.
- Use selective herbicides or hand cutting and removal to avoid damage to ground layer habitat (e.g. grasses and sedges).
- Protect grassy bowl areas (Calcareous Swale Grassland) from undesirable disturbance (e.g. machine disturbance and too frequent fire).
- Limit human disturbance in sensitive post-fire environments.
- Replace woody debris where appropriate.
- Continual monitoring that combine vegetation quality and habitat recovery.

Habitat Restoration

- Actively manage Calcareous Swale Grassland grassy bowl habitats.
- Encourage 'open' (i.e. <50% canopy cover) woodland habitats with graminoids understorey interspersed with grassy bowls.
- Retain representative samples of all habitat types that currently occur within the study area.

- Control Coast Tea-tree in selected areas to prevent dominance in priority faunal habitats.
- Control key weed species, in particular Myrtle-leaf Milkwort.
- Conduct post UXO remediation monitoring (see below).
- Remove rubbish such as old tyre dumps and other refuse which could be used by introduced species.
- Areas with relatively high understorey floristic diversity should be specifically targeted for sensitive weed control. These areas could be established as benchmark sites for this community to be maintained in perpetuity.

8.2.2 Wilsons Folly

- Encourage an open woodland vegetation structure.
- Continue the control of Coast Tea-tree.
- Continue the control of Myrtle-leaf Milkwort
- Limit further spread of exotic species from vehicle tracks surrounding the Wilsons Folly.
- Address erosion on management tracks.
- Allow the natural recruitment of woody species such as Drooping Sheoak, Coast Banksia, Wirilda and Coast Beard-heath in appropriate zones (e.g. Banksia in the lowers sections and Sheoak on higher ridges and slopes) within the Folly but monitor impact on understorey habitat.
- Implement a fire regime that accommodates the above mentioned woody species and the viability of the flora and fauna communities within the Folly.
- Maintain woody debris for fauna habitat including the White-footed Dunnart and Tree Dragon.
- Continue to monitor the successional dynamics of the vegetation, changes to habitat quality and structure and fauna populations within the Folly.
- Fill in water reservoir north east of the access track into Wilsons Folly as it appears to have no functional value and may be hazardous for fauna and personnel.

8.2.3 Quarantine Station

Visitor Access

- Continue public access restrictions from Coles Track to Ticonderoga Bay beach east of Observatory Point.
- Restrict access to Ticonderoga Bay west of Jarman Oval from the Quarantine Station.
- Erect permanent interpretative signage at Observatory Point and any other beach access points alerting people to the importance of beach-nesting shorebird habitat.
- Strictly prohibit access to significant fauna habitat (including beaches) around the Quarantine Station especially during festivals and other events.

Habitat Restoration

- Restoration/rehabilitation of habitat at 'Wombat Flat'
    - Aim to increase vegetation and habitat diversity.
    - Undertake weed control where practical and there will be realised ecological returns informed by specific ecological management plans.
    - Mowing some areas may encourage native grasses and trigger the germination of woody species.

8.2.4 Cleared Areas

- Rifle range, Monash break
    - Maintain treeless, cleared areas as foraging habitats for Black Wallabies, reptiles and raptors.
    - Encourage the development of a grassland structure in lower elevated areas. Manage these areas through suggested slashing and mowing regimes (see above vegetation discussion). Including slashing at the height of native grasses (~60cm) to maintain habitat utility for reptiles such as skinks.
    - Selective weed control on exotic grasses and exotic shrubs such as Italian buckthorn.

8.2.5 Access

- Access to Wilsons Folly should be strictly controlled given its importance as faunal habitat and the restricted distribution of grassy woodlands in the study area. Given the likely high usage, the proposed link track to London Bridge may have serious implications for a number of significant faunal species resident within Wilsons Folly. In particular, 'off track' intrusions need to be prevented if the track proceeds as outlined in the Management Plan (Parks Victoria 2007).
- Place interpretative signage along all access points around Wilsons Folly alerting people to the significance and threats associated with the area.
- Monitor compliance with regulations and assess the level of any intrusions into off-limits areas. Consider installing boardwalks with handrails to limit intrusions if the levels of intrusion are deemed unacceptably high.
- Place signage at shoreline access points highlighting significant shorebird nesting habitat, outlining access regulations and providing interpretative information regarding significant shorebird and coastal birds.
- The proposed tracks from Happy Valley to the Rifle Range to Defence Road and the 'Hinterland Experience' track could proceed without significantly affecting faunal values.
- Enforce restrictions on boats and jet skis landing on Nepean and Ticonderoga beaches, particularly during the Hooded Plover breeding season.
- Prohibit access to the Hooded Plover breeding area east of Observatory Point during the breeding season.
- Leave existing fences around the former Range Area to limit unauthorised intrusions, but ensure that adequate culverts are in place to allow faunal movement.

- Limit traffic along Defence Road and install speed humps to increase compliance with speed limits.
- Prohibit large volumes of traffic entering the park (i.e. past the current Visitor Centre) during dawn and dusk faunal activity periods.
- Exclude public access to 'Boonwurrung Track' and other access routes to the Bass Coastline.
- Formulate specific management strategies for major events in consultation with experts, and monitor potential impacts.
- Formulate specific integrated management plan for access, encompassing the Quarantine Station and "main park" areas. Monitor potential impacts and adapt management accordingly.

8.2.6 Introduced species

- Continue fox foot-hold trapping and establish permanent trapping sites.
- Establish permanent fox baiting stations.
- Continue cat trapping with foot-hold and cage traps.
- Work with the Mornington Peninsula Shire and private landholders to implement a fox foot-hold trapping and feral cat trapping program with the aim of reducing feral predator densities in areas adjacent to the park and consequently limiting recruitment into the park.
- Conduct a feasibility study into the option of feral-proof fencing.

8.2.7 Significant species management overview

Table 20. Fauna Management Recommendations

Species	Threats	Management
Hooded Plover	- Disturbance from humans - Nest predation (from feral predators, birds and reptiles)	- Continue and review feral control programs - Limit disturbance to breeding habitat (beaches, foredunes and offshore rocky islands) - Encourage co-existence between people and Hooded Plovers through interpretive signage and educational programs - Conduct regular monitoring of nest locations (through existing programs in the region) - Temporarily restrict beach access when birds are actively nesting
Sooty Oystercatcher	- Disturbance from humans	- Maintain high quality intertidal rock shore platform habitat (i.e. feeding areas) - Limit disturbance to breeding habitat (offshore rocky islands)
Ground-dwelling birds	- Disturbance to nesting sites and breeding activities from humans - Predation from feral species Lack of suitable habitat - Weed invasion	- Maintain and expand Grassy Woodland habitats where possible - Continue feral predator control programs - Limit disturbance to important habitat, particularly during breeding season
Cormorants, Terns and	- Disturbance to roosting	- Limit disturbance through access restrictions (largely

Species	Threats	Management
Pacific Gull	sites	already in place) to important roosting sites
White-footed Dunnart and Long-nosed Bandicoot	- Disturbance to nesting sites and breeding activities from humans - Predation from feral species - Lack and fragmentation of suitable habitat - Weed invasion - Competition from introduced species (e.g. Black Rats)	- Maintain and expand grassy woodland habitats where possible - Continue feral predator control programs - Limit disturbance to important habitat, particularly during the breeding season - Continue monitoring of known habitat and where possible establish relative abundance to assess population changes (see monitoring recommendations for further details).
Bats	- Lack of suitable roosting nesting habitat (i.e. hollows and buildings)	- Maintain hollow bearing Moonah and any other trees (live, dead and fallen) where possible - Retain woody debris and leaf litter to encourage insect abundance - Maintain habitat in buildings and structures where possible
Reptiles	- Predation from feral species - Lack of suitable habitat - Mortality from vehicular collisions	- Retain ground layer habitat such as woody debris and tussock forming grasses - Maintain and expand grassy woodland habitats where possible - Limit vehicular access and install speed humps

8.2.8 Research needs and suggested future monitoring actions

Future monitoring needs will depend largely on the specific management issues of interest. The following recommendations are devised with the intention of addressing the following questions:

- What is the impact of human utilisation of the site (in particular increased visitor access) on fauna populations?
- What is the long-term viability of significant faunal populations?
- What habitat types are important to sustain significant species populations?
- Are significant species expanding or contracting their ranges within the study area.

General research needs

- Population Viability Analysis (PVA) could provide insights into the long-term viability of significant species (e.g. Long-nosed Bandicoot and White-footed Dunnart).
- Regular post remediation works monitoring could provide insights into the pace at which fauna re-colonise areas after fire/vegetation removal.
    - Seasonal bird surveys would allow analysis of temporal trends in bird community compositions and could be related to vegetation variables such as structure and cover of key species.

  - Periodic surveys for terrestrial mammals and reptiles could assess the value of remediate areas as habitat for particularly sensitive species.
- Periodic site-wide surveys could also provide insights into long-term trends in faunal composition across the study area as a whole.

Where possible existing sites and comparable methods should be used to those used in this study. This way future results can be compared directly and changes identified. Sites should be carefully chosen at the outset of monitoring and fixed for the duration of monitoring.

The frequency at which surveys should be conducted will depend on specific questions. Site-wide surveys should only be needed periodically whereas monitoring of UXO remediation works, habitat restoration or post-fire monitoring needs to be more frequent.

Records of all significant species should be kept and submitted to relevant databases. Breeding records are particularly important, and details should be kept wherever possible. Some specific databases exist for breeding information (e.g. Birds Australia, Nest Record Scheme; www.birdsaustralia.com.au/NRS), and existing methodologies from these schemes should be used where possible. While a database of incidental observations will be important, many species are unlikely to be observed with sufficient regularity to yield useful information for management through incidental observations alone. Specific methodologies for such rare and/or cryptic species are outlined below along with general recommendations for fauna monitoring.

Birds

Given the strong seasonal patterns evident for many birds sampling for birds in general needs to be stratified seasonally. Sampling would need to be conducted at least twice in a year, and preferably four times in a year to accurately assess bird communities at the site for a given year. Consistent methodologies should be used across the site (e.g. 20min 2ha atlas surveys; Barrett *et al.* (2003) for terrestrial surveys).

Shorebirds

Continue monitoring of key shorebird breeding sites (i.e. Hooded Plover and Sooty Oystercatcher) with the aim of assessing the relationship between human impacts and breeding success. Existing research programs exist in the region and could be incorporated (Birds Australia, Promoting co-existence between recreationalists and beach-nesting birds and Birds Australia Nest Record Scheme).

Ground-dwelling birds

Given their highly cryptic nature, incidental surveys for ground-dwelling birds are not likely to be effective. Targeted surveys (possibly involving call playback methods*) are likely to be more effective in monitoring the status and distribution of these species.

* Call playback surveys need to be conducted under strict guidelines as these methods can significantly affect behavioural patterns.

Terrestrial mammals

With the exception of Short-beaked Echidna and Black Wallabies, most terrestrial mammals will require specific sampling methodologies. This study has revealed broad habitat preferences of Long-nosed Bandicoot, White-footed Dunnart, Swamp Rat, Black Rat and House Mouse through the use of a variety of sampling techniques. These methods could be repeated in order to assess changes in faunal composition at the site over time.

In particular methods could be repeated at areas of particular interest such as UXO contaminated areas and areas subject to active management (e.g. restoration and revegetation) to establish the response of fauna to management.

The viability of native faunal populations was not directly addressed through this research. For sensitive species such as Long-nosed Bandicoot and White-footed Dunnart, establishing population numbers would be necessary to effectively assess their long-term viability. This could be addressed through home range analysis (e.g. Hutchings 1996; Monamy & Fox 2005; Scott *et al.* 1999) and would probably need to involve radio-tracking.

Reptiles

Most reptiles, particularly small lizards, require specific sampling methods such as pitfall trapping to establish even presence/absence of these species. Periodic sampling for skinks is suggested as they can be good indicators of habitat quality due to their dependence on understorey habitat such as woody debris and tussock grasses.

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APPENDIX 1. Methodology for defining significance

Plant Communities

Level of Significance	Method of Assessment
Nationally Significant	Communities listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Communities listed as Threatened under Schedule 2 of Victoria's Flora and Fauna Guarantee Act 1988 that are endemic to Victoria.
State Significance	Communities listed as Threatened under Schedule 2 of Victoria's Flora and Fauna Guarantee Act 1988 that are found in other states but are best represented within Victoria and not already listed in the above categories. Communities listed as endangered, vulnerable or rare throughout all Victorian Bioregions according to DSE 2003.
Regional Significance	Communities considered depleted, naturally restricted across Victoria and within the subject bioregion.
High Local Significance	Communities considered to be locally depleted not listed in any of the above categories.

Flora

Level of Significance	Method of Assessment
Nationally Significant	Species listed under the Environment Protection and Biodiversity Conservation Act 1999. Species listed as endangered, vulnerable, rare or poorly known in Australia in either Cross *et al.*. 2001, Ross and Walsh 2003 or Briggs and Leigh 1996
State Significance	Species listed as Threatened under Schedule 2 of Victoria's Flora and Fauna Guarantee Act 1988 not already listed in the above categories. Species listed as endangered, vulnerable, rare or poorly known in Victoria in either DSE 2003 or Ross and Walsh 2003.
Regional Significance	Species considered rare or uncommon within the bioregion by the authors with consideration given to previous studies.
High Local Significance	Species considered rare or uncommon within the local area by the authors with consideration given to previous studies.

Fauna

Level of Significance	Method of Assessment
International Significance	Migratory species protected under international treaties (JAMBA, CAMBA and Bonn) and listed under the Environment Protection and Biodiversity Conservation Act 1999 or the IUCN Red Data lists as threatened .
National Significance	Species listed under the EPBC Act 1999 not listed in the above category.
State Significance	Species listed as Threatened under Schedule 2 of Victoria's Flora and Fauna Guarantee Act 1988 not already listed in the above categories. Species listed as critically endangered, endangered, vulnerable, data deficient or near threatened in Victoria by DSE 2003.
Regional Significance	Species not listed in the above categories that have a limited range in Victoria, or have undergone noted declines.

Site

Level of Significance	Considerations
Nationally Significant	If the site supports significant[1] or important[1] habitat for a taxon of National or International Significance as defined in the above lists.
State Significance	If the site supports significant[1] or important[1] habitat for a taxon of State Significance as defined in the above lists.
Regional Significance	If the site makes a significant contribution to the conservation significant taxa within the bioregion but does not fit into the above categories.

1: Significant or important habitat is defined by the taxon's dependence on the site for forage or breeding habitat.

APPENDIX 2. Vascular plant taxa recorded during this survey.

This list was originally generated using Viridans software. All quadrat data, incidental records and one defined area species list from this study were entered into Practical Ecology's version of FIS. A data subset was then generated of all records from this survey to create this vascular species list (the only nonvascular plant is weft-moss). However, this list was revised in September 2007 to accommodate nomenclature changes published in the 2007 Census (Walsh and Stajsic 2007).

Conservation Status Codes:

*	Introduced species	e	Endangered in Victoria
k	Poorly known in Victoria	L	Listed under the Victorian FFG Act
v	Vulnerable in Victoria	VU	Vulnerable under the Commonwealth EPBC Act
r	Rare in Victoria	#	Naturalised Victorian native

MOSSES		
Thuidiaceae		
	Thuidiopsis furfurosa	Golden Weft-moss
FERNS AND ALLIES		
Dennstaedtiaceae		
	Pteridium esculentum	Austral Bracken
CONIFERS		
Cupressaceae		
*	*Cupressus macrocarpa*	Monterey Cypress
Pinaceae		
*	*Pinus radiata*	Radiata Pine
MONOCOTYLEDONS		
Agavaceae		
*	*Agave americana*	Century Plant
Aloeaceae		
*	*Aloe spp.*	Aloe
Cymodoceaceae		
k	*Amphibolis antarctica*	Sea Nymph
Cyperaceae		
	Carex breviculmis	Common Grass-sedge
	Ficinia nodosa	Knobby Club-sedge
	Lepidosperma gladiatum	Coast Sword-sedge
	Schoenus nitens	Shiny Bog-sedge
Iridaceae		
*	*Freesia spp.*	Freesia
*	*Romulea spp.*	Onion Grass
Juncaceae		
	Luzula meridionalis	Common Woodrush
	Luzula meridionalis var. densiflora	Common Woodrush
	Luzula spp.	Woodrush
Liliaceae		
*	*Agapanthus praecox subsp. orientalis*	Agapanthus
*	*Allium spp.*	Garlic
*	*Asparagus asparagoides*	Bridal Creeper
*	*Asparagus scandens*	Asparagus Fern

	*	*Asphodelus fistulosus*	Onion Weed
		Dianella brevicaulis	Small-flower Flax-lily
		Dianella revoluta s.l.	Black-anther Flax-lily
		Dianella sp. aff. revoluta (Coastal)	Coast Flax-lily
		Hypoxis glabella s.l.	Yellow star
		Hypoxis spp.	Hypoxis
	*	*Narcissus spp.*	Narcissus
		Thysanotus patersonii	Twining Fringe-lily
		Wurmbea latifolia subsp. vanessae	Broad-leaf Early Nancy

Orchidaceae

		Caladenia latifolia	Pink Fairies
		Caladenia spp.	Caladenia
		Corybas diemenicus	Veined Helmet-orchid
		Corybas incurvus	Slaty Helmet-orchid
		Corybas spp.	Helmet Orchid
		Cyrtostylis reniformis	Small Gnat-orchid
		Cyrtostylis robusta	Large Gnat-orchid
		Microtis spp.	Onion Orchid
		Microtis unifolia	Common Onion-orchid
L	VU v	*Pterostylis cucullata subsp. cucullata*	Leafy Greenhood
		Pterostylis pedunculata	Maroonhood
		Pterostylis spp.	Greenhood

Poaceae

	*	*Aira cupaniana*	Quicksilver Grass
	*	*Aira spp.*	Hair Grass
	*	*Ammophila arenaria*	Marram Grass
	*	*Anthoxanthum odoratum*	Sweet Vernal-grass
		Austrodanthonia caespitosa	Common Wallaby-grass
		Austrodanthonia racemosa var. racemosa	Stiped Wallaby-grass
		Austrodanthonia setacea	Bristly Wallaby-grass
		Austrodanthonia spp.	Wallaby Grass
r		*Austrofestuca littoralis*	Coast Fescue
		Austrostipa flavescens	Coast Spear-grass
		Austrostipa spp.	Spear Grass
		Austrostipa stipoides	Prickly Spear-grass
	*	*Avena barbata*	Bearded Oat
	*	*Avena spp.*	Oat
	*	*Avena sterilis*	Sterile Oat
	*	*Briza maxima*	Large Quaking-grass
	*	*Briza minor*	Lesser Quaking-grass
	*	*Bromus diandrus*	Great Brome
	*	*Bromus hordeaceus subsp. hordeaceus*	Soft Brome
		Bromus spp.	Brome
	*	*Catapodium rigidum*	Fern Grass
	*	*Cynodon dactylon var. dactylon*	Couch
	*	*Cynosurus echinatus*	Rough Dog's-tail
		Dichelachne crinita	Long-hair Plume-grass
		Distichlis distichophylla	Australian Salt-grass
	*	*Ehrharta erecta*	Panic Veldt-grass
	*	*Ehrharta longiflora*	Annual Veldt-grass
		Elymus scaber var. scaber	Common Wheat-grass
	*	*Festuca arundinacea*	Tall Fescue
	*	*Hainardia cylindrica*	Common Barb-grass
	*	*Holcus lanatus*	Yorkshire Fog
	*	*Hordeum leporinum*	Barley-grass
		Lachnagrostis billardierei s.l.	Coast Blown-grass

	Lachnagrostis billardierei subsp. billardierei	Coast Blown-grass
*	*Lagurus ovatus*	Hare's-tail Grass
*	*Lolium loliaceum*	Stiff Rye-grass
*	*Lolium spp.*	Rye Grass
	Microlaena stipoides var. stipoides	Weeping Grass
*	*Nassella trichotoma*	Serrated Tussock
*	*Parapholis incurva*	Coast Barb-grass
*	*Pennisetum clandestinum*	Kikuyu
*	*Phalaris spp.*	Canary Grass
*	*Poa bulbosa*	Bulbous Meadow-grass
	Poa labillardierei var. labillardierei	Common Tussock-grass
	Poa morrisii	Soft Tussock-grass
	Poa poiformis var. poiformis	Coast Tussock-grass
r	*Poa poiformis var. ramifer*	Dune Poa
	Poa rodwayi	Velvet Tussock-grass
	Poa spp.	Tussock Grass
*	*Psilurus incurvus*	Bristle-tail Grass
*	*Rostraria cristata*	Annual Cat's-tail
	Spinifex sericeus	Hairy Spinifex
*	*Sporobolus africanus*	Rat-tail Grass
*	*Stenotaphrum secundatum*	Buffalo Grass
	Themeda triandra	Kangaroo Grass
*	*Thinopyrum junceiforme*	Sea Wheat-grass
*	*Vulpia spp.*	Fescue
Xanthorrhoeaceae		
	Lomandra filiformis	Wattle Mat-rush
	Lomandra longifolia subsp. longifolia	Spiny-headed Mat-rush
DICOTYLEDONS		
Aizoaceae		
	Carpobrotus rossii	Karkalla
	Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower
	Tetragonia implexicoma	Bower Spinach
	Tetragonia tetragonioides	New Zealand Spinach
Amaranthaceae		
	Hemichroa pentandra	Trailing Hemichroa
Apiaceae		
	Apium annuum	Annual Celery
	Apium prostratum subsp. prostratum var. prostratum	Sea Celery
	Daucus glochidiatus	Australian Carrot
	Hydrocotyle laxiflora	Stinking Pennywort
Apocynaceae		
	Alyxia buxifolia	Sea Box
*	*Vinca major*	Blue Periwinkle
Araliaceae		
*	*Hedera helix*	English Ivy
Asteraceae		
	Actites megalocarpa	Dune Thistle
	Apalochlamys spectabilis	Showy Cassinia
*	*Arctotheca calendula*	Cape Weed
*	*Artemisia spp.*	Wormwood
*	*Carduus tenuiflorus*	Winged Thistle
*	*Centaurea melitensis*	Malta Thistle
*	*Chrysanthemoides monilifera*	Boneseed
*	*Cirsium vulgare*	Spear Thistle
*	*Conyza spp.*	Fleabane

*	*Crepis capillaris*	Smooth Hawksbeard
	Euchiton spp.	Cudweed
*	*Gazania spp.*	Gazania
	Helichrysum leucopsideum	Satin Everlasting
	Helichrysum luteoalbum	Jersey Cudweed
*	*Hypochoeris glabra*	Smooth Cat's-ear
*	*Hypochoeris radicata*	Cat's Ear
	Lagenophora stipitata	Common Bottle-daisy
*	*Leontodon taraxacoides subsp. taraxacoides*	Hairy Hawkbit
	Leucophyta brownii	Cushion Bush
	Olearia axillaris	Coast Daisy-Bush
	Olearia glutinosa	Sticky Daisy-bush
r	*Olearia sp. 2*	Peninsula Daisy-bush
	Ozothamnus turbinatus	Coast Everlasting
	Picris angustifolia subsp. angustifolia	Coast Picris
*	*Senecio elegans*	Purple Groundsel
	Senecio hispidulus s.l.	Rough Fireweed
	Senecio odoratus var. odoratus	Scented Groundsel
	Senecio pinnatifolius s.l.	Variable Groundsel
	Senecio spathulatus s.l.	Dune Groundsel
	Senecio spp.	Groundsel
*	*Sonchus asper s.l.*	Rough Sow-thistle
*	*Sonchus oleraceus*	Common Sow-thistle
	Sonchus spp.	Sow Thistle
*	*Taraxacum officinale spp. agg.*	Garden Dandelion
	Taraxacum spp. ?	Dandelion
Boraginaceae		
*	*Anchusa arvensis*	Bugloss
	Cynoglossum australe	Australian Hound's-tongue
	Myosotis australis	Austral Forget-me-not
Brassicaceae		
*	*Cakile maritima ssp. maritima*	Sea Rocket
*	*Cakile spp.*	Sea Rocket
*	*Cardamine hirsuta s.l.*	Common Bitter-cress
*	*Diplotaxis tenuifolia*	Sand Rocket
	Hymenolobus procumbens	Oval Purse
Caryophyllaceae		
	Caryophyllaceae spp.	Chickweed
*	*Cerastium glomeratum s.l.*	Common Mouse-ear Chickweed
*	*Cerastium spp.*	Mouse-ear Chickweed
r	*Colobanthus apetalus var.apetalus*	Coast Colobanth
*	*Minuartia mediterranea*	Fine-leaved Sandwort
*	*Petrorhagia dubia*	Velvety Pink
*	*Petrorhagia spp.*	Pink
*	*Polycarpon tetraphyllum*	Four-leaved Allseed
*	*Silene nocturna*	Mediterranean Catchfly
*	*Silene vulgaris*	Bladder Campion
	Stellaria pungens	Prickly Starwort
Casuarinaceae		
	Allocasuarina verticillata	Drooping Sheoak
Chenopodiaceae		
	Atriplex cinerea	Coast Saltbush
	Enchylaena tomentosa var. tomentosa	Ruby Saltbush
	Rhagodia candolleana subsp. candolleana	Seaberry Saltbush
k	*Sarcocornia quinqueflora subsp. tasmanica*	Beaded Glasswort
	Sarcocornia quinqueflora subsp. quinqueflora.	Beaded Glasswort

		Threlkeldia diffusa	Coast Bonefruit
Convolvulaceae			
		Convolvulus sp.	Pink Bindweed
		Dichondra repens	Kidney-weed
Crassulaceae			
		Crassula peduncularis	Purple Crassula
		Crassula sieberiana	Sieber Crassula
Dilleniaceae			
		Hibbertia sericea s.l.	Silky Guinea-flower
Epacridaceae			
		Leucopogon parviflorus	Coast Beard-heath
Euphorbiaceae			
	v	*Adriana quadripartita (pubescent form)*	Coast Bitter-bush
L	*e*	*Adriana quadripartita s.s. (glabrous form)*	Rare Bitter-bush
		Beyeria lechenaultii	Pale Turpentine Bush
	*	*Euphorbia paralias*	Sea Spurge
	*	*Euphorbia peplus*	Petty Spurge
Fabaceae			
	*	*Dipogon lignosus*	Common Dipogon
		Kennedia prostrata	Running Postman
	k	*Lotus australis var. australis*	Austral Trefoil
	*	*Lotus spp. (naturalised)*	Trefoil
	*	*Medicago polymorpha*	Burr Medic
	*	*Medicago spp.*	Medic
	*	*Melilotus indicus*	Sweet Melilot
	r	*Pultenaea canaliculata*	Coast Bush-pea
		Pultenaea tenuifolia	Slender Bush-pea
		Swainsona lessertiifolia	Coast Swainson-pea
	*	*Trifolium dubium*	Suckling Clover
	*	*Vicia sativa*	Common Vetch
Fumariaceae			
	*	*Fumaria muralis subsp. muralis*	Wall Fumitory
	*	*Fumaria spp.*	Fumitory
Gentianaceae			
	*	*Centaurium spp.*	Centaury
	*	*Centaurium tenuiflorum*	Slender Centaury
	*	*Cicendia filiformis*	Slender Cicendia
Geraniaceae			
	*	*Geranium molle*	Dovesfoot
		Geranium spp.	Crane's Bill
		Pelargonium australe	Austral Stork's-bill
Goodeniaceae			
		Scaevola albida	Small-fruit Fan-flower
		Scaevola spp.	Fan Flower
Lamiaceae			
		Ajuga australis	Austral Bugle
	*	*Marrubium vulgare*	Horehound
Lauraceae			
		Cassytha pubescens	Downy Dodder-laurel
Loranthaceae			
		Amyema miquelii	Box Mistletoe
		Amyema pendula	Drooping Mistletoe
		Amyema preissii	Wire-leaf Mistletoe
Malvaceae			

*	*Malva dendromorpha*	Tree Mallow
	Malva spp.	Mallow
Mimosaceae		
	Acacia longifolia subsp. sophorae	Coast Wattle
	Acacia mearnsii	Black Wattle
	Acacia paradoxa	Hedge Wattle
r	*Acacia uncifolia*	Coast Wirilda
Moraceae		
*	*Ficus spp.*	Fig
Myoporaceae		
	Myoporum insulare	Common Boobialla
Myrtaceae		
*	*Agonis flexuosa*	Willow Myrtle
#	*Eucalyptus botryoides*	Southern Mahogany
	Eucalyptus viminalis subsp. pryoriana	Coast Manna-gum
	Leptospermum laevigatum	Coast Tea-tree
	Melaleuca lanceolata	Moonah
Oleaceae		
*	*Fraxinus spp.*	Ash
Orobanchaceae		
*	*Orobanche minor*	Lesser Broomrape
Oxalidaceae		
*	*Oxalis pes-caprae*	Soursob
r	*Oxalis rubens*	Dune Wood-sorrel
	Oxalis spp.	Wood Sorrel
*	*Oxalis spp. (naturalised)*	Wood Sorrel
Pittosporaceae		
	Bursaria spinosa subsp. spinosa	Sweet Bursaria
#	*Pittosporum undulatum*	Sweet Pittosporum
Plantaginaceae		
*	*Plantago coronopus*	Buck's-horn Plantain
	Plantago gaudichaudii	Narrow Plantain
	Plantago hispida	Hairy Plantain
*	*Plantago lanceolata*	Ribwort
Polygalaceae		
	Comesperma volubile	Love Creeper
*	*Polygala myrtifolia*	Myrtle-leaf Milkwort
Polygonaceae		
	Muehlenbeckia australis	Climbing Lignum
Primulaceae		
*	*Anagallis arvensis*	Pimpernel
Proteaceae		
	Banksia integrifolia subsp. integrifolia	Coast Banksia
	Hakea spp.	Hakea
Ranunculaceae		
	Clematis microphylla	Small-leaved Clematis
	Clematis microphylla var. microphylla ?	Small-leaved Clematis
	Ranunculus sessiliflorus	Annual Buttercup
	Ranunculus spp.	Buttercup
Rhamnaceae		
	Pomaderris paniculosa	Scurfy Pomaderris
	Pomaderris paniculosa subsp. paralia	Coast Pomaderris
*	*Rhamnus alaternus*	Italian Buckthorn
	Spyridium vexilliferum var. vexilliferum	Winged Spyridium

Rosaceae		
	Acaena novae-zelandiae	Bidgee-widgee
Rubiaceae		
*	*Coprosma repens*	Mirror Bush
	Galium australe	Tangled Bedstraw
*	*Galium murale*	Small Goosegrass
	Galium spp.	Bedstraw
*	*Sherardia arvensis*	Field Madder
Rutaceae		
	Correa alba var. alba	White Correa
	Correa reflexa	Common Correa
Santalaceae		
	Exocarpos cupressiformis	Cherry Ballart
Sapindaceae		
	Dodonaea viscosa subsp. spatulata	Sticky Hop-bush
Scrophulariaceae		
*	*Veronica arvensis*	Wall Speedwell
	Veronica calycina	Hairy Speedwell
	Veronica gracilis	Slender Speedwell
Solanaceae		
*	*Lycium ferocissimum*	African Box-thorn
*	*Solanum douglasii*	Douglas' Nightshade
	Solanum laciniatum	Large Kangaroo Apple
*	*Solanum linnaeanum*	Apple of Sodom
*	*Solanum nigrum*	Black Nightshade
Stackhousiaceae		
	Stackhousia monogyna	Creamy Stackhousia
Thymelaeaceae		
	Pimelea serpyllifolia subsp. serpyllifolia	Thyme Rice-flower
Urticaceae		
	Parietaria debilis s.l.	Shade Pellitory
Violaceae		
	Viola hederacea	Ivy-leaf Violet
	Viola spp.	Violet
Zygophyllaceae		
r	*Zygophyllum billardierei*	Coast Twin-leaf

APPENDIX 3. Total flora species recorded from this and previous surveys

This list was originally generated using Viridans software following the input of field data from this project. A data subset was generated of all records from all records to create this species list. However, this list was revised in September 2007 to accommodate nomenclature changes published in the 2007 Census (Walsh and Stajsic 2007).

Conservation Status Codes:

*	Introduced species	e	Endangered in Victoria
k	Poorly known in Victoria	L	Listed under the Victorian FFG Act
v	Vulnerable in Victoria	VU	Vulnerable under the Commonwealth EPBC Act
r	Rare in Victoria	#	Naturalised Victorian native

MOSSES	
Pottiaceae	
Gymnostomum calcareum	Lime Cave-moss
Thuidiaceae	
Thuidiopsis furfurosa	Golden Weft-moss
FERNS AND ALLIES	
Dennstaedtiaceae	
Pteridium esculentum	Austral Bracken
CONIFERS	
Cupressaceae	
* *Cupressus macrocarpa*	Monterey Cypress
Pinaceae	
* *Pinus radiata*	Radiata Pine
MONOCOTYLEDONS	
Agavaceae	
* *Agave americana*	Century Plant
Aloeaceae	
* *Aloe spp.*	Aloe
Cymodoceaceae	
k *Amphibolis antarctica*	Sea Nymph
Cyperaceae	
Carex breviculmis	Common Grass-sedge
Ficinia nodosa	Knobby Club-sedge
Lepidosperma gladiatum	Coast Sword-sedge
Schoenus nitens	Shiny Bog-sedge
Iridaceae	
* *Freesia spp.*	Freesia
* *Romulea spp.*	Onion Grass
Juncaceae	
Luzula meridionalis	Common Woodrush
Luzula meridionalis var. densiflora	Common Woodrush
Luzula spp.	Woodrush
Liliaceae	
* *Agapanthus praecox subsp. orientalis*	Agapanthus
* *Allium spp.*	Garlic
* *Asparagus asparagoides*	Bridal Creeper
* *Asparagus scandens*	Asparagus Fern
* *Asphodelus fistulosus*	Onion Weed
Dianella brevicaulis	Small-flower Flax-lily

	Dianella revoluta s.l.	Black-anther Flax-lily
	Dianella sp. aff. revoluta (Coastal)	Coast Flax-lily
	Hypoxis glabella s.l.	Yellow star
	Hypoxis spp.	Hypoxis
*	*Narcissus spp.*	Narcissus
	Thysanotus patersonii	Twining Fringe-lily
	Wurmbea latifolia subsp. vanessae	Broad-leaf Early Nancy

Orchidaceae

	Caladenia latifolia	Pink Fairies
	Caladenia spp.	Caladenia
	Chiloglottis valida	Common Bird-orchid
	Corybas diemenicus	Veined Helmet-orchid
	Corybas incurvus	Slaty Helmet-orchid
	Corybas spp.	Helmet Orchid
	Cyrtostylis reniformis	Small Gnat-orchid
	Cyrtostylis robusta	Large Gnat-orchid
	Cyrtostylis spp.	Gnat Orchid
	Microtis spp.	Onion Orchid
	Microtis unifolia	Common Onion-orchid
L VU v	*Pterostylis cucullata*	Leafy Greenhood
	Pterostylis pedunculata	Maroonhood
	Pterostylis spp.	Greenhood

Poaceae

*	*Aira cupaniana*	Quicksilver Grass
*	*Aira spp.*	Hair Grass
*	*Ammophila arenaria*	Marram Grass
*	*Anthoxanthum odoratum*	Sweet Vernal-grass
	Austrodanthonia caespitosa	Common Wallaby-grass
	Austrodanthonia racemosa var. racemosa	Stiped Wallaby-grass
	Austrodanthonia setacea	Bristly Wallaby-grass
	Austrodanthonia spp.	Wallaby Grass
r	*Austrofestuca littoralis*	Coast Fescue
	Austrostipa flavescens	Coast Spear-grass
	Austrostipa rudis	Veined Spear-grass
	Austrostipa spp.	Spear Grass
	Austrostipa stipoides	Prickly Spear-grass
*	*Avena barbata*	Bearded Oat
*	*Avena spp.*	Oat
*	*Avena sterilis*	Sterile Oat
*	*Briza maxima*	Large Quaking-grass
*	*Briza minor*	Lesser Quaking-grass
*	*Bromus catharticus*	Prairie Grass
*	*Bromus diandrus*	Great Brome
*	*Bromus hordeaceus subsp. hordeaceus*	Soft Brome
	Bromus spp.	Brome
*	*Catapodium marinum*	Stiff Sand-grass
*	*Catapodium rigidum*	Fern Grass
*	*Cynodon dactylon var. dactylon*	Couch
*	*Cynosurus echinatus*	Rough Dog's-tail
*	*Dactylis glomerata*	Cocksfoot
	Dichelachne crinita	Long-hair Plume-grass
	Distichlis distichophylla	Australian Salt-grass
*	*Ehrharta erecta*	Panic Veldt-grass
*	*Ehrharta longiflora*	Annual Veldt-grass
	Elymus scaber var. scaber	Common Wheat-grass

	* *Festuca arundinacea*	Tall Fescue
	* *Hainardia cylindrica*	Common Barb-grass
	* *Holcus lanatus*	Yorkshire Fog
	* *Hordeum leporinum*	Barley-grass
	Lachnagrostis billardierei s.l.	Coast Blown-grass
	Lachnagrostis billardierei subsp. billardierei	Coast Blown-grass
	* *Lagurus ovatus*	Hare's-tail Grass
	* *Lolium loliaceum*	Stiff Rye-grass
	* *Lolium spp.*	Rye Grass
	Microlaena stipoides var. stipoides	Weeping Grass
	* *Nassella trichotoma*	Serrated Tussock
	* *Parapholis incurva*	Coast Barb-grass
	* *Paspalum dilatatum*	Paspalum
	* *Pennisetum clandestinum*	Kikuyu
	* *Phalaris aquatica*	Toowoomba Canary-grass
	* *Phalaris spp.*	Canary Grass
	* *Poa bulbosa*	Bulbous Meadow-grass
	Poa labillardierei	Common Tussock-grass
	Poa labillardierei var. labillardierei	Common Tussock-grass
	Poa morrisii	Soft Tussock-grass
	Poa poiformis	Coast Tussock-grass
	Poa poiformis var. poiformis	Coast Tussock-grass
r	*Poa poiformis var. ramifer*	Dune Poa
	Poa rodwayi	Velvet Tussock-grass
	Poa spp.	Tussock Grass
	* *Psilurus incurvus*	Bristle-tail Grass
	* *Rostraria cristata*	Annual Cat's-tail
	Spinifex sericeus	Hairy Spinifex
	* *Sporobolus africanus*	Rat-tail Grass
	* *Stenotaphrum secundatum*	Buffalo Grass
	Themeda triandra	Kangaroo Grass
	* *Thinopyrum junceiforme*	Sea Wheat-grass
	* *Vulpia bromoides*	Squirrel-tail Fescue
	* *Vulpia myuros f. myuros*	Rat's-tail Fescue
	* *Vulpia spp.*	Fescue
Xanthorrhoeaceae		
	Lomandra filiformis	Wattle Mat-rush
	Lomandra longifolia	Spiny-headed Mat-rush
DICOTYLEDONS		
Aizoaceae		
	* *Carpobrotus aequilaterus*	Angled Pigface
	Carpobrotus rossii	Karkalla
	Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower
	Tetragonia implexicoma	Bower Spinach
	Tetragonia spp.	Native Spinach
	Tetragonia tetragonioides	New Zealand Spinach
Amaranthaceae		
	Hemichroa pentandra	Trailing Hemichroa
Apiaceae		
	* *Ammi majus*	Bishop's Weed
	Apium annuum	Annual Celery
	Apium prostratum subsp. prostratum	Sea Celery
	Daucus glochidiatus	Australian Carrot
	Hydrocotyle laxiflora	Stinking Pennywort
	Lilaeopsis polyantha	Australian Lilaeopsis
Apocynaceae		

	Alyxia buxifolia	Sea Box
*	*Vinca major*	Blue Periwinkle
Araliaceae		
*	*Hedera helix*	English Ivy
Asteraceae		
	Actites megalocarpa	Dune Thistle
	Apalochlamys spectabilis	Showy Cassinia
*	*Arctotheca calendula*	Cape Weed
*	*Artemisia spp.*	Wormwood
*	*Carduus pycnocephalus*	Slender Thistle
*	*Carduus tenuiflorus*	Winged Thistle
*	*Centaurea melitensis*	Malta Thistle
*	*Chrysanthemoides monilifera*	Boneseed
*	*Cirsium vulgare*	Spear Thistle
*	*Conyza bonariensis*	Flaxleaf Fleabane
*	*Conyza spp.*	Fleabane
*	*Conyza sumatrensis*	Tall Fleabane
*	*Crepis capillaris*	Smooth Hawksbeard
	Euchiton spp.	Cudweed
*	*Gazania spp.*	Gazania
	Helichrysum leucopsideum	Satin Everlasting
	Helichrysum luteoalbum	Jersey Cudweed
*	*Hypochoeris glabra*	Smooth Cat's-ear
*	*Hypochoeris radicata*	Cat's Ear
	Lagenophora stipitata	Common Bottle-daisy
*	*Leontodon taraxacoides subsp. taraxacoides*	Hairy Hawkbit
	Leucophyta brownii	Cushion Bush
	Olearia axillaris	Coast Daisy-Bush
	Olearia glutinosa	Sticky Daisy-bush
r	*Olearia sp. 2*	Peninsula Daisy-bush
	Ozothamnus turbinatus	Coast Everlasting
	Picris angustifolia subsp. angustifolia	Coast Picris
	Senecio biserratus	Jagged Fireweed
*	*Senecio elegans*	Purple Groundsel
	Senecio hispidulus s.l.	Rough Fireweed
	Senecio odoratus var. odoratus	Scented Groundsel
	Senecio pinnatifolius	Variable Groundsel
	Senecio spathulatus s.l.	Dune Groundsel
	Senecio spp.	Groundsel
*	*Sonchus asper s.l.*	Rough Sow-thistle
*	*Sonchus oleraceus*	Common Sow-thistle
	Sonchus spp.	Sow Thistle
*	*Taraxacum officinale spp. agg.*	Garden Dandelion
	Taraxacum spp.	Dandelion
Boraginaceae		
*	*Anchusa arvensis*	Bugloss
	Cynoglossum australe	Australian Hound's-tongue
	Myosotis australis	Austral Forget-me-not
Brassicaceae		
*	*Cakile maritima ssp. maritima*	Sea Rocket
*	*Cakile spp.*	Sea Rocket
*	*Cardamine hirsuta s.l.*	Common Bitter-cress
*	*Diplotaxis muralis*	Wall Rocket
*	*Diplotaxis tenuifolia*	Sand Rocket
*	*Hirschfeldia incana*	Buchan Weed
	Hymenolobus procumbens	Oval Purse

Caryophyllaceae			
		Caryophyllaceae spp.	Chickweed
	*	*Cerastium diffusum*	Sea Mouse-ear Chickweed
	*	*Cerastium glomeratum s.l.*	Common Mouse-ear Chickweed
	*	*Cerastium spp.*	Mouse-ear Chickweed
	r	*Colobanthus apetalus var. apetalus*	Coast Colobanth
	*	*Minuartia mediterranea*	Fine-leaved Sandwort
	*	*Petrorhagia dubia*	Velvety Pink
	*	*Petrorhagia spp.*	Pink
	*	*Polycarpon tetraphyllum*	Four-leaved Allseed
	*	*Silene nocturna*	Mediterranean Catchfly
	*	*Silene vulgaris*	Bladder Campion
		Stellaria pungens	Prickly Starwort
Casuarinaceae			
		Allocasuarina verticillata	Drooping Sheoak
Chenopodiaceae			
		Atriplex cinerea	Coast Saltbush
		Enchylaena tomentosa var. tomentosa	Ruby Saltbush
		Rhagodia candolleana subsp. candolleana	Seaberry Saltbush
	k	*Sarcocornia quinqueflora subsp. tasmanica*	Beaded Glasswort
		Sarcocornia spp.	Glasswort
		Threlkeldia diffusa	Coast Bonefruit
Convolvulaceae			
		Convolvulus spp.	Pink Bindweed
		Dichondra repens	Kidney-weed
Crassulaceae			
		Crassula peduncularis	Purple Crassula
		Crassula sieberiana s.l.	Sieber Crassula
Dilleniaceae			
		Hibbertia sericea s.l.	Silky Guinea-flower
Epacridaceae			
		Leucopogon parviflorus	Coast Beard-heath
		Leucopogon virgatus	Common Beard-heath
Ericaceae			
	*	*Arbutus unedo*	Irish Strawberry Tree
Euphorbiaceae			
	v	*Adriana quadripartita*	Coast Bitter-bush
	v	*Adriana quadripartita (pubescent form)*	Coast Bitter-bush
L	e	*Adriana quadripartita s.s. (glabrous form)*	Rare Bitter-bush
		Beyeria lechenaultii	Pale Turpentine Bush
	*	*Euphorbia paralias*	Sea Spurge
	*	*Euphorbia peplus*	Petty Spurge
Fabaceae			
	*	*Dipogon lignosus*	Common Dipogon
		Kennedia prostrata	Running Postman
	k	*Lotus australis var. australis*	Austral Trefoil
	*	*Lotus spp. (naturalised)*	Trefoil
	*	*Medicago polymorpha*	Burr Medic
	*	*Medicago spp.*	Medic
	*	*Melilotus indicus*	Sweet Melilot
	r	*Pultenaea canaliculata*	Coast Bush-pea
		Pultenaea tenuifolia	Slender Bush-pea
		Swainsona lessertiifolia	Coast Swainson-pea
	*	*Trifolium dubium*	Suckling Clover
	*	*Trifolium glomeratum*	Cluster Clover
	*	*Vicia sativa*	Common Vetch

Fumariaceae		
	* *Fumaria muralis subsp. muralis*	Wall Fumitory
	* *Fumaria spp.*	Fumitory
Gentianaceae		
	* *Centaurium spp.*	Centaury
	* *Centaurium tenuiflorum*	Slender Centaury
	* *Cicendia filiformis*	Slender Cicendia
Geraniaceae		
	* *Geranium molle*	Dovesfoot
	Geranium spp.	Crane's Bill
	Pelargonium australe	Austral Stork's-bill
Goodeniaceae		
	Scaevola albida	Small-fruit Fan-flower
	Scaevola spp.	Fan Flower
Lamiaceae		
	Ajuga australis	Austral Bugle
	* *Marrubium vulgare*	Horehound
Lauraceae		
	Cassytha pubescens	Downy Dodder-laurel
Loranthaceae		
	Amyema miquelii	Box Mistletoe
	Amyema pendula	Drooping Mistletoe
	Amyema preissii	Wire-leaf Mistletoe
Malvaceae		
	* *Malva dendromorpha*	Tree Mallow
	Malva spp.	Mallow
Mimosaceae		
	Acacia longifolia subsp. sophorae	Coast Wattle
	Acacia mearnsii	Black Wattle
	Acacia paradoxa	Hedge Wattle
	# *Acacia retinodes*	Wirilda
r	*Acacia uncifolia*	Coast Wirilda
Moraceae		
	Ficus spp.	Fig
Myoporaceae		
	Myoporum insulare	Common Boobialla
Myrtaceae		
	* *Agonis flexuosa*	Willow Myrtle
	# *Eucalyptus botryoides*	Southern Mahogany
	Eucalyptus viminalis subsp. pryoriana	Coast Manna-gum
	Leptospermum laevigatum	Coast Tea-tree
	Melaleuca lanceolata	Moonah
Oleaceae		
	* *Fraxinus spp.*	Ash
Orobanchaceae		
	* *Orobanche minor*	Lesser Broomrape
Oxalidaceae		
	* *Oxalis pes-caprae*	Soursob
r	*Oxalis rubens*	Dune Wood-sorrel
	Oxalis spp.	Wood Sorrel
	* *Oxalis spp. (naturalised)*	Wood Sorrel
k	*Oxalis thompsoniae*	Fluffy-fruit Wood-sorrel
Pittosporaceae		
	Bursaria spinosa subsp. spinosa	Sweet Bursaria
	# *Pittosporum undulatum*	Sweet Pittosporum
Plantaginaceae		

* *Plantago coronopus*	Buck's-horn Plantain
Plantago gaudichaudii	Narrow Plantain
Plantago hispida	Hairy Plantain
* *Plantago lanceolata*	Ribwort
Polygalaceae	
Comesperma volubile	Love Creeper
* *Polygala myrtifolia*	Myrtle-leaf Milkwort
Polygonaceae	
Muehlenbeckia australis	Climbing Lignum
Primulaceae	
* *Anagallis arvensis*	Pimpernel
Proteaceae	
Banksia integrifolia subsp. integrifolia	Coast Banksia
Hakea spp.	Hakea
Ranunculaceae	
Clematis microphylla	Small-leaved Clematis
Ranunculus sessiliflorus	Annual Buttercup
Ranunculus spp.	Buttercup
Rhamnaceae	
Pomaderris paniculosa	Scurfy Pomaderris
Pomaderris paniculosa subsp. paralia	Coast Pomaderris
* *Rhamnus alaternus*	Italian Buckthorn
Spyridium vexilliferum var. vexilliferum	Winged Spyridium
Rosaceae	
Acaena novae-zelandiae	Bidgee-widgee
Rubiaceae	
* *Coprosma repens*	Mirror Bush
Galium australe	Tangled Bedstraw
Galium migrans	Wandering Bedstraw
* *Galium murale*	Small Goosegrass
Galium spp.	Bedstraw
* *Sherardia arvensis*	Field Madder
Rutaceae	
Correa alba	White Correa
Correa reflexa	Common Correa
Santalaceae	
Exocarpos cupressiformis	Cherry Ballart
Sapindaceae	
Dodonaea viscosa subsp. spatulata	Sticky Hop-bush
Scrophulariaceae	
* *Veronica arvensis*	Wall Speedwell
Veronica calycina	Hairy Speedwell
Veronica gracilis	Slender Speedwell
Solanaceae	
* *Lycium ferocissimum*	African Box-thorn
* *Solanum douglasii*	Douglas' Nightshade
Solanum laciniatum	Large Kangaroo Apple
* *Solanum linnaeanum*	Apple of Sodom
* *Solanum nigrum*	Black Nightshade
Stackhousiaceae	
Stackhousia monogyna	Creamy Stackhousia
Thymelaeaceae	
Pimelea serpyllifolia subsp. serpyllifolia	Thyme Rice-flower
Pimelea spp.	Rice Flower
Urticaceae	
Parietaria debilis s.l.	Shade Pellitory

Violaceae		
	Viola hederacea	Ivy-leaf Violet
	Viola spp.	Violet
Zygophyllaceae		
r	*Zygophyllum billardierei*	Coast Twin-leaf

Data From: Flora Information System (Practical Ecology's version), Biodiversity and Natural Resources, DSE - May 2005 - © Viridans Biological Databases. Note: format and nomenclature changes have been made to the data output.

APPENDIX 4. Regionally significant species

Scientific Name	Common Name
Actites megalocarpa	Dune Thistle
Ajuga australis	Austral Bugle
Alyxia buxifolia	Sea Box
Amyema miquelii	Box Mistletoe
Amyema preissii	Wire-leaf Mistletoe
Apalochlamys spectabilis	Showy Cassinia
Apium annuum	Annual Celery
Apium prostratum subsp. *prostratum*	Sea Celery
Austrodanthonia penicillata	Slender Wallaby-grass
Austrostipa flavescens	Coast Spear-grass
Austrostipa stipoides	Prickly Spear-grass
Beyeria lechenaultii	Pale Turpentine Bush
Caladenia latifolia	Pink Fairies
Carpobrotus rossii	Karkalla
Convolvulus spp.	Pink Bindweed
Corybas dilatatus	Veined Helmet-orchid
Corybas incurvus	Slaty Helmet-orchid
Crassula peduncularis	Purple Crassula
Crassula sieberiana s.l.	Sieber Crassula
Cynoglossum australe	Australian Hound's-tongue
Cyrtostylis reniformis	Small Gnat-orchid
Cyrtostylis robusta	Large Gnat-orchid
Daucus carota	Carrot
Dianella sp. aff. *revoluta* (Coastal)	Coast Flax-lily
Dichelachne crinita	Long-hair Plume-grass
Dodonaea viscosa subsp. *spatulata*	Sticky Hop-bush
Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush
Galium australe	Tangled Bedstraw
Galium migrans	Wandering Bedstraw
Helichrysum leucopsideum	Satin Everlasting
Hemichroa pentandra	Trailing Hemichroa
Lachnagrostis billardierei s.l.	Coast Blown-grass
Lachnagrostis billardierei subsp. *billardierei*	Coast Blown-grass

Scientific Name	Common Name
Lepidosperma gladiatum	Coast Sword-sedge
Leucophyta brownii	Cushion Bush
Melaleuca lanceolata	Moonah
Microtis unifolia	Common Onion-orchid
Muehlenbeckia australis	Climbing Lignum
Myosotis australis	Austral Forget-me-not
Olearia axillaris	Coast Daisy-Bush
Olearia glutinosa	Sticky Daisy-bush
Ozothamnus turbinatus	Coast Everlasting
Parietaria debilis	Shade Pellitory
Pelargonium australe	Austral Stork's-bill
Picris angustifolia subsp. *angustifolia*	Coast Picris
Pimelea serpyllifolia subsp. *serpyllifolia*	Thyme Rice-flower
Plantago hispida	Hairy Plantain
Pomaderris paniculosa subsp. *paralia*	Coast Pomaderris
Pterostylis pedunculata	Maroonhood
Pultenaea tenuifolia	Slender Bush-pea
Ranunculus sessiliflorus	Annual Buttercup
Scaevola albida	Small-fruit Fan-flower
Schoenus nitens	Shiny Bog-sedge
Senecio biserratus	Jagged Fireweed
Senecio odoratus var. *odoratus*	Scented Groundsel
Senecio spathulatus s.l.	Dune Groundsel
Spinifex sericeus	Hairy Spinifex
Spyridium vexilliferum var. *vexilliferum*	Winged Spyridium
Stackhousia monogyna	Creamy Stackhousia
Swainsona lessertiifolia	Coast Swainson-pea
Threlkeldia diffusa	Coast Bonefruit
Thysanotus patersonii	Twining Fringe-lily
Veronica calycina	Hairy Speedwell
Wurmbea latifolia subsp. *vanessae*	Broad-leaf Early Nancy

APPENDIX 5. Pre-burn vegetation monitoring sites

Quadrat E01859 (mapped as no. 59) **Date:** 1 March 2007
Location: 38° 19'05.4" 144° 41'22.4" **Altitude**: 15m **Recorders:** GW ID **Vegetation**: Coastal Alkaline Scrub

Cover	Status	Scientific Name	Common Name
+	r	*Acacia uncifolia*	Coast Wirilda
1	*	*Aira cupaniana*	Quicksilver Grass
+	*	*Asparagus asparagoides*	Bridal Creeper
1	*	*Catapodium rigidum*	Fern Grass
+	*	*Centaurium sp.*	Centaury
+		*Clematis microphylla*	Small-leaved Clematis
+		*Dianella brevicaulis*	Small-flower Flax-lily
+		*Elymus scaber*	Common Wheat grass
+		*Ficinia nodosa*	Knobby Club-sedge
+	*	*Hypochaeris glabra*	Smooth Cat's ear
+	*	*Lagurus ovatus*	Hare's Tail
+	*	*Leontodon taraxacoides subsp. taraxacoides*	Hairy Hawkbit
+		*Lepidosperma gladiatum*	Coast Sword-sedge
+		*Leptospermum laevigatum*	Coast Tea-tree
+		*Leucopogon parviflorus*	Coast Beard-heath
+		*Pimelea serpyllifolia subsp. serpyllifolia*	Thyme Rice-flower
2		*Poa labillardierei*	Common Tussock-grass
+	*	*Polygala myrtifolia*	Myrtle-leaf Milkwort
+		*Rhagodia candolleana subsp. candolleana*	Seaberry Saltbush
1	*	*Silene nocturna ?*	Mediterranean Catchfly
1		*Swainsona lessertiifolia*	Coast Swainson-pea
1		*Vulpia sp.*	
+		*1 unknown*	

Quadrat E01860 (mapped as no. 60) **Date:** 1 March 2007
Location: 38° 19'07.2" 144° 41'21.4" **Altitude**: ?28m **Recorders:** GW ID **Vegetation**: Coastal Alkaline Scrub

Cover	Status	Scientific Name	Common Name
+	r	*Acacia uncifolia*	Coast Wirilda
1		*Alyxia buxifolia*	Sea Box
+		*Austrostipa flavescens*	Coast Spear-grass
+	*	*Chrysanthemoides monilifera*	Boneseed
+		*Clematis microphylla*	Small-leaved Clematis
+		*Dianella brevicaulis*	Small-flower Flax-lily
+		*Dichondra repens*	Kidney-weed
+		*Lepidosperma gladiatum*	Coast Sword-sedge
3		*Leptospermum laevigatum*	Coast Tea-tree
2		*Leucopogon parviflorus*	Coast Beard-heath
+		*Pimelea serpyllifolia subsp. serpyllifolia*	Thyme Rice-flower
2	*	*Polygala myrtifolia*	Myrtle-leaf Milkwort
+		*Rhagodia candolleana subsp. candolleana*	Seaberry Saltbush
+	*	*Rhamnus alaternus*	Italian Buckthorn
+		*Senecio odoratus var. odoratus*	Scented Groundsel
+	*	*Sonchus oleraceus*	Common Sow-thistle
+		*Swainsona lessertiifolia*	Coast Swainson-pea
1		*Tetragonia implexicoma*	Bower Spinach

Quadrat E01861 (mapped as no. 61) **Date**: 1 March 2007
Location: 38° 19'10.9" 144° 41'16" **Altitude**: 8m **Recorders:** GW ID **Vegetation**: Coastal Alkaline Scrub

Cover	Status	Scientific Name	Common Name
+	r	*Acacia uncifolia*	Coast Wirilda
1		*Ajuga australis*	Austral Bugle
1		*Alyxia buxifolia*	Sea Box
1		*Austrostipa flavescens*	Coast Spear-grass
1		*Carex breviculmis*	Short-stem Sedge
+		*Clematis microphylla*	Small-leaved Clematis
+		*Comesperma volubile*	Love Creeper
+		*Dianella brevicaulis*	Small-flower Flax-lily
+		*Dichondra repens*	Kidney-weed
1		*Ficinia nodosa*	Knobby Club-sedge
1		*Hydrocotyle laxiflora*	Stinking pennywort
+		*Kennedia prostrata*	Running Postman
1		*Lagenophora stipitata*	Common Bottle-daisy
3		*Leptospermum laevigatum*	Coast Tea-tree
2		*Leucopogon parviflorus*	Coast Beard-heath
+		*Pimelea spp.*	Rice Flower
+	#	*Pittosporum undulatum*	Sweet Pittosporum
1		*Poa labillardierei*	Common Tussock-grass
1		*Schoenus nitens*	Shiny Bog-sedge
+		*Swainsona lessertiifolia*	Coast Swainson-pea

APPENDIX 6. Vegetation community groupings from two way table

The following Large Group outputs from Viridans Software are derived from the 62 quadrats undertaken during this survey. Initial observations of these groupings and the consideration of the location of quadrats within the study area suggest that groups 1 to 5 are expressions of varying successional phases of the Coastal Alkaline Scrub EVC. Further research is required to test this hypothesis. The final group (6) does not seem analogous to any particular EVC.

Large Group 1: Coast Wirilda Dominant

Freq	c/a		Scientific Name	Common Name
100	1	*	*Vulpia spp.*	Fescue
100	1		*Swainsona lessertiifolia*	Coast Swainson-pea
100	2		*Poa labillardierei*	Common Tussock-grass
100	+	*	*Catapodium rigidum*	Fern Grass
100	1	r	*Acacia uncifolia*	Coast Wirilda
092	1		*Austrostipa flavescens*	Coast Spear-grass
092	+	*	*Asparagus asparagoides*	Bridal Creeper
092	1	*	*Aira spp.*	Hair Grass
083	1		*Senecio odoratus var. odoratus*	Scented Groundsel
083	+		*Rhagodia candolleana subsp. candolleana*	Seaberry Saltbush
083	1	*	*Polygala myrtifolia var. myrtifolia*	Myrtle-leaf Milkwort
083	1		*Leucopogon parviflorus*	Coast Beard-heath
083	2		*Leptospermum laevigatum*	Coast Tea-tree
083	1		*Dichondra repens*	Kidney-weed
083	+		*Austrodanthonia spp.*	Wallaby Grass
075	1	*	*Rostraria cristata*	Annual Cat's-tail
075	+		*Pimelea serpyllifolia subsp. serpyllifolia*	Thyme Rice-flower
075	1		*Lepidosperma gladiatum*	Coast Sword-sedge
075	+		*Dianella brevicaulis*	Small-flower Flax-lily
075	+		*Clematis microphylla*	Small-leaved Clematis
075	1	*	*Centaurium spp.*	Centaury

Number of Quadrats in Group : 12 **Number of Character Species in Group :** 21
Mean (median) spp. no. and range : 32 (32) : (22-38) **Mean altitude and range :** 42 (15-55)
Mean non-native number and range : 35% (9 - 45) **Mean non-native cover and range :** 32% (20-47)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 66%
Total number of species in group : 79 **Total number of non-native species in group :** 29
Total regional rare species in group : 2 **Total national rare species in group :** 0

Large Group 2: Coast Tea-tree Dominant (a)

Freq	c/a		Scientific Name	Common Name
100	2		*Leptospermum laevigatum*	Coast Tea-tree
090	1		*Leucopogon parviflorus*	Coast Beard-heath
080	+	*	*Rhamnus alaternus*	Italian Buckthorn
080	1	*	*Polygala myrtifolia var. myrtifolia*	Myrtle-leaf Milkwort
080	+		*Austrostipa flavescens*	Coast Spear-grass
080	2	r	*Acacia uncifolia*	Coast Wirilda
070	2		*Poa labillardierei*	Common Tussock-grass
070	1		*Lepidosperma gladiatum*	Coast Sword-sedge
070	1		*Hydrocotyle laxiflora*	Stinking Pennywort
070	+		*Clematis microphylla*	Small-leaved Clematis
070	1		*Austrodanthonia spp.*	Wallaby Grass
070	1	*	*Asparagus asparagoides*	Bridal Creeper
070	+		*Alyxia buxifolia*	Sea Box

Number of Quadrats in Group : 10 **Number of Character Species in Group :** 13
Mean (median) spp. no. and range : 22 (21) : (14-32) **Mean altitude and range :** 34 (8-65)
Mean non-native number and range : 21% (0 - 36) **Mean non-native cover and range :** 19% (0-42)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 58%
Total number of species in group : 63 **Total number of non-native species in group :** 15
Total regional rare species in group : 1 **Total national rare species in group :** 0

Large Group 3: Moonah Dominant

Freq	c/a		Scientific Name	Common Name
100	2	*	*Polygala myrtifolia var. myrtifolia*	Myrtle-leaf Milkwort
092	1		*Rhagodia candolleana subsp. candolleana*	Seaberry Saltbush
092	2		*Melaleuca lanceolata subsp. lanceolata*	Moonah
092	1	*	*Asparagus asparagoides*	Bridal Creeper
083	1	*	*Rhamnus alaternus*	Italian Buckthorn
083	1		*Austrodanthonia spp.*	Wallaby Grass
075	1		*Tetragonia implexicoma*	Bower Spinach
075	1		*Poa labillardierei*	Common Tussock-grass
075	+		*Clematis microphylla*	Small-leaved Clematis

Number of Quadrats in Group : 12 **Number of Character Species in Group :** 9
Mean (median) spp. no. and range : 24 (25) : (14-35) **Mean altitude and range :** 29 (10-46)
Mean non-native number and range : 33% (5 - 43) **Mean non-native cover and range :** 34% (21-51)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 37%
Total number of species in group : 75 **Total number of non-native species in group :** 23
Total regional rare species in group : 1 **Total national rare species in group :** 0

Large Group 4: Coast Tea-tree Dominant (b)

Freq	c/a		Scientific Name	Common Name
100	+		*Senecio odoratus var. odoratus*	Scented Groundsel
100	2	#	*Leptospermum laevigatum*	Coast Tea-tree
100	1	*	*Aira spp.*	Hair Grass
088	+	*	*Vulpia spp.*	Fescue
088	+		*Swainsona lessertiifolia*	Coast Swainson-pea
088	+	*	*Rostraria cristata*	Annual Cat's-tail
088	4		*Poa labillardierei*	Common Tussock-grass
088	+	*	*Hypochoeris glabra*	Smooth Cat's-ear
088	+		*Dichondra repens*	Kidney-weed
088	+		*Clematis microphylla*	Small-leaved Clematis
075	+		*Pimelea serpyllifolia subsp. serpyllifolia*	Thyme Rice-flower
075	+		*Lepidosperma gladiatum*	Coast Sword-sedge
075	+		*Daucus glochidiatus*	Australian Carrot
075	+	*	*Centaurium spp.*	Centaury

Number of Quadrats in Group : 8 **Number of Character Species in Group :** 14
Mean (median) spp. no. and range : 22 (21) : (19-27) **Mean altitude and range :** 28 (15.5-41)
Mean non-native number and range : 38% (6 - 48) **Mean non-native cover and range :** 29% (20-40)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 64%
Total number of species in group : 55 **Total number of non-native species in group :** 22
Total regional rare species in group : 2 **Total national rare species in group :** 0

Large Group 5: Coast Tea-tree Dominant (c)

Freq	c/a		Scientific Name	Common Name
100	1	*	*Sporobolus africanus*	Rat-tail Grass
100	1	#	*Leptospermum laevigatum*	Coast Tea-tree
100	1		*Austrodanthonia spp.*	Wallaby Grass
083	1	*	*Vulpia spp.*	Fescue
083	2	*	*Stenotaphrum secundatum*	Buffalo Grass
083	+	*	*Minuartia mediterranea*	Fine-leaved Sandwort
083	2		*Hibbertia sericea s.l.*	Silky Guinea-flower
083	1		*Dichondra repens*	Kidney-weed
083	+	*	*Cerastium spp.*	Mouse-ear Chickweed

Number of Quadrats in Group : 6 **Number of Character Species in Group :** 9
Mean (median) spp. no. and range : 27 (24) : (21-45) **Mean altitude and range :** 16 (9-31)
Mean non-native number and range : 51% (9 - 68) **Mean non-native cover and range :** 48% (30-72)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 33%
Total number of species in group : 72 **Total number of non-native species in group :** 36
Total regional rare species in group : 2 **Total national rare species in group :** 1

Large Group 6:

Freq	c/a		Scientific Name	Common Name
071	1		*Threlkeldia diffusa*	Coast Bonefruit
071	1	*	*Thinopyrum junceiforme*	Sea Wheat-grass
071	1		*Olearia axillaris*	Coast Daisy-Bush

Number of Quadrats in Group : 14 **Number of Character Species in Group :** 3
Mean (median) spp. no. and range : 20 (20) : (9-36) **Mean altitude and range :** 20 (2-45)
Mean non-native number and range : 25% (0 - 64) **Mean non-native cover and range :** 25% (0-63)
Ratio of number of Character Species to Mean Number of Species per Quadrat : 15%
Total number of species in group : 79 **Total number of non-native species in group :** 27
Total regional rare species in group : 3 **Total national rare species in group :** 0

APPENDIX 7. Summary of fauna survey results for each site

A-Abundant
C-common
Un-Uncommon
R-Rare

Site 1: Golf Course

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	2						
*Cat (feral)	1						
*Red Fox	1						
Black Wallaby	1						
Swamp Rat	2						
Common Ringtail Possum	1						
Reptiles							
Blotched Blue-tongued Lizard	1						
Garden Skink	2						
Mainland Tiger Snake	1						
Birds							
Superb Fairy-wren			C	C	C	C	C
Red Wattlebird			C	C	C	C	
Eastern Yellow Robin			C	Un	Un	Un	Un
Silvereye			C	C		C	C
White-browed Scrubwren			C	C		C	C
*Common Blackbird			C	C		C	C
Brown Thornbill			C		C	C	C
Australian Magpie			C	C			
Crescent Honeyeater					Un	Un	
Grey Shrike-thrush					Un	Un	Un
Mistletoebird					C		
Musk Lorikeet			C				
Welcome Swallow			C				
Brown Goshawk			Un			C	C
Swamp Harrier		X	C			Un	
Wedge-tailed Eagle		X	Un				
Whistling Kite		X				Un	
White-throated Needletail		X	C				
Yellow-faced Honeyeater							Un

Site 2: Wilsons Folly East

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	3						
*Red Fox	1						
Black Wallaby	2						
Long-nosed Bandicoot	1						
Swamp Rat	12						
White-footed Dunnart	2						
Short-beaked Echidna	1						
Reptiles							
Blotched Blue-tongued Lizard	1						
Tree Dragon	1						
White-lipped Snake	1						
Southern Grass Skink	1						
Birds							
White-browed Scrubwren			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Grey Shrike-thrush				C	C	C	C
Red Wattlebird			C	C	Un		
Eastern Yellow Robin			Un	Un	Un		Un
Brown Thornbill					C	C	C
Crescent Honeyeater				Un		Un	
Silvereye			C		C		C
Spiny-cheeked Honeyeater			C		C		
Brown Goshawk			Un		C		Un
Swamp Harrier		X		Un	C	Un	
Golden Whistler					C		
Musk Lorikeet					C		
Welcome Swallow					C		
Spotted Quail-thrush							R
Black-shouldered Kite							R
Red-browed Finch					Un	Un	
White-throated Needletail					C		
Wedge-tailed Eagle		X			Un		
Whistling Kite		X		Un			Un
Black Falcon		X				R	
Buff-banded Rail					R		
Australian Shelduck					Un	Un	
Spotted Quail-thrush							R
Yellow-faced Honeyeater							Un

Site 3: Wilsons Folly West

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	1						
*Red Fox	1						
Black Wallaby	1						
Long-nosed Bandicoot	2						
White-footed Dunnart	1						
Common Ringtail Possum	1						
Short-beaked Echidna	1						
Birds							
Superb Fairy-wren			C	C	C	C	C
Eastern Yellow Robin			Un	Un	Un	Un	Un
Brown Thornbill			C	C	C	C	C
Silvereye			C	C	C		C
*Common Blackbird			C	C	C		C
White-browed Scrubwren			C	C	C		C
Golden Whistler			Un	Un	Un		
Crescent Honeyeater				Un	Un	C	Un
Brown Goshawk				C	C		Un
Eastern Rosella			Un		C		
Mistletoebird			C			C	
Red Wattlebird				C		C	
Swamp Harrier				Un	C	Un	
Australian Magpie			Un		C		
Grey Butcherbird				Un			
Grey Fantail				Un			Un
Grey Shrike-thrush						Un	Un
Musk Lorikeet					C		
Painted Button-quail			Un		Un		
Wedge-tailed Eagle		X			Un		
Welcome Swallow					C		
Whistling Kite		X		Un		Un	Un
Yellow-faced Honeyeater						C	C
White-throated Needletail		X			C		
Spiny-cheeked Honeyeater							Un

Site 4: Wilsons Folly South

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*House Mouse	6						
*Red Fox	1						
Long-nosed Bandicoot	1						
Short-beaked Echidna	1						
White-footed Dunnart	3						
Reptiles							
Blotched Blue-tongued Lizard	1						
Eastern Three-lined Skink	1						
Tree Dragon	6						
White's Skink	2						
Birds							
Superb Fairy-wren			C	C	C	C	C
Eastern Yellow Robin			C	Un	C	Un	Un
*Common Blackbird			C	C	C		C
Brown Thornbill				C	C	C	C
Grey Shrike-thrush				C	Un	Un	Un
Silvereye			C	C	C		C
Red Wattlebird			C		C	C	
White-browed Scrubwren			C	C	C		C
Australian Magpie				C	C		
Brown Goshawk				C	C		Un
Brown Quail			Un		R		
Crescent Honeyeater				Un	Un		Un
Golden Whistler				Un	C		
Grey Fantail			Un		C		C
Mistletoebird			C			C	
Brush Bronzewing			Un				
Red-browed Finch							C
Musk Lorikeet					C		
Swamp Harrier		X			C	Un	
Wedge-tailed Eagle		X			Un		
Welcome Swallow					C		
Whistling Kite		X		Un		Un	Un
White-throated Needletail		X			C		
Spiny-cheeked Honeyeater							Un

Site 5: Sierra Nevada Track

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	5						
Short-beaked Echidna	1						
Birds							
*Common Blackbird			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	Un	C
Brown Thornbill			C	C	C	C	C
Red Wattlebird			C	C	C		
Silvereye			C	C	C		C
Eastern Yellow Robin				Un		Un	Un
Grey Fantail				C	Un		C
Grey Shrike-thrush			Un		Un		Un
Crescent Honeyeater				Un	Un		Un
Golden Whistler				Un			
Grey Butcherbird				C			
Mistletoebird			C				
Australian Magpie				Un			
Welcome Swallow						Un	
Swamp Harrier		X		Un	Un	Un	
Whistling Kite		X	Un	Un	Un	Un	Un
Wedge-tailed Eagle		X			Un		
White-throated Needletail		X			C		
Brush Bronzewing				Un			
Common Bronzewing						Un	
Spiny-cheeked Honeyeater							Un

Site 6: Crematorium

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
Black Wallaby	1						
Short-beaked Echidna	1						
Reptiles							
Metallic Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Grey Fantail			Un	C	C	Un	C
Spiny-cheeked Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Yellow-faced Honeyeater			C	C	C	C	C
Eastern Yellow Robin			C	C	C		Un
Silvereye			C	C	C		C
Whistling Kite		X	Un	Un	UnB	Un	Un
Australian Magpie			C		C		
Crimson Rosella				Un		Un	
New Holland Honeyeater			C		C		C
Red Wattlebird			C			C	
Spotted Pardalote			Un	C			
Eastern Rosella						Un	
Golden Whistler				C			
Mistletoebird			C				
Striated Thornbill			Un				
Welcome Swallow			C				
White-throated Needletail		X			C		
Swamp Harrier		X		Un		Un	
Magpie-lark						Un	
Galah						Un	

Site 7: Harrison's Bowl North

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	1						
*Red Fox	1						
Common Ringtail Possum	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Goshawk			Un	Un	Un	Un	Un
Silvereye			C	C	C		C
Crescent Honeyeater				C		C	
Golden Whistler				C	C		
Grey Fantail				C	C		
Grey Shrike-thrush			Un		C		
Red Wattlebird			C		C		
Southern Boobook			Un		Un		
Spiny-cheeked Honeyeater			C		C		C
Welcome Swallow			C		C		
Yellow-faced Honeyeater			Un		C		
Eastern Yellow Robin				Un			
Grey Butcherbird				Un			
Mistletoebird			C				
Spotted Pardalote			Un				
Tawny Frogmouth					Un		
Whistling Kite		X	Un	Un	Un	Un	Un
Swamp Harrier		X		Un	Un	Un	
Wedge-tailed Eagle		X			Un		
White-throated Needletail		X			C		

Site 8: Quarantine Moonah South

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	3						
*Cat (feral)	1						
Common Ringtail Possum	1						
Birds							
*Common Blackbird			C	C	C	C	C
Grey Shrike-thrush			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Yellow-faced Honeyeater			C	C	C	C	C
Brown Thornbill			C		C	C	C
Red Wattlebird			C	C	C		
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater			C		C	C	C
Australian Magpie				C		C	C
Crimson Rosella				C		Un	
Eastern Rosella				C		C	
Eastern Yellow Robin				Un		Un	Un
Grey Fantail				C	C		
Golden Whistler					C		
Mistletoebird			C				
Spotted Pardalote			Un				
Welcome Swallow					C		
White-throated Needletail		X			C		
Brown Goshawk			C	C	C	C	C
Whistling Kite		X	Un	C	Un	Un	Un
Swamp Harrier		X		Un	C	Un	
Wedge-tailed Eagle		X			Un		
Crested Pigeon							Un M

Site 9: Quarantine Moonah West

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Cat (feral)	1						
Black Wallaby	1						
Common Ringtail Possum	1						
Reptiles							
Blotched Blue-tongued Lizard	4						
Garden Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Eastern Yellow Robin			C	C	C	Un	Un
Grey Shrike-thrush			Un	Un	C	Un	Un
Spiny-cheeked Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Red Wattlebird			C	C	C		
Silvereye			C		C	C	C
Yellow-faced Honeyeater			Un		C	C	C
Grey Fantail				C	C		
Australian Magpie						C	
Australian Raven						C	
Crimson Rosella				C			
Golden Whistler				Un			
Mistletoebird			C				
New Holland Honeyeater						Un	
Rufous Whistler						Un	
Shining Bronze-cuckoo						Un	
Spotted Pardalote						C	
Welcome Swallow					C		
Southern Boobook			R				
White-throated Needletail		X			C		
Brown Goshawk			Un	C	C		C
Whistling Kite		X	Un	Un		Un	Un
Swamp Harrier		X		Un	C	Un	
Wedge-tailed Eagle		X			Un		

Site 10: Monash Break North

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	3						
*Red Fox	1						
Short-beaked Echidna	2						
Birds							
*Common Blackbird			C	C	C	C	C
Australian Magpie			C	Un	C	Un	
Silvereye		X	C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Grey Shrike-thrush			C		C	Un	Un
Red Wattlebird		X	Un		C	C	
Crimson Rosella				C		C	
Australian Raven						C	
Wedge-tailed Eagle		X			Un		
Welcome Swallow					C		
Brown Thornbill			C	C	C	C	C
Eastern Yellow Robin			Un	Un	C	Un	Un
Flame Robin				Un			
White-browed Scrubwren			C	C	C	C	C
Brown Goshawk		X	C	C		Un	Un
Grey Fantail		X		C	C	Un	Un
Whistling Kite		X	Un	Un		Un	Un
Yellow-faced Honeyeater		X		C	C	C	C
Spiny-cheeked Honeyeater		X	C		C		
Swamp Harrier		X		Un	C		
Mistletoebird		X	C				
New Holland Honeyeater		X				Un	
Spotted Pardalote		X				Un	
White-throated Needletail		X			C		

Site 11: Wombat Flat

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*European Rabbit	1						
Black Wallaby	5						
Common Ringtail Possum	1						
Reptiles							
Blotched Blue-tongued Lizard	1						
Eastern Three-lined Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Grey Shrike-thrush			C	C	C	Un	Un
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater				C	C	C	C
Red Wattlebird					C	C	
Yellow-faced Honeyeater					C	C	C
Grey Fantail						Un	
Mistletoebird			C				
Spotted Pardalote						C	
Welcome Swallow					C		
Swamp Harrier		X		Un	C		
Whistling Kite		X	Un	Un		Un	Un
Brown Goshawk						C	C
Silver Gull		X				C	
Wedge-tailed Eagle		X			Un		
White-throated Needletail		X			C		

Site 12: Wombat Foreshore

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	1						
Short-beaked Echidna	1						
White-footed Dunnart	1						
Reptiles							
Blotched Blue-tongued Lizard	1						
Eastern Three-lined Skink	2						
Garden Skink	1						
Mainland Tiger Snake (juv.)	1						
Birds							
Brown Thornbill			Un	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater				C	C		
Eastern Yellow Robin					C		
Mistletoebird			C				
Red Wattlebird					C		
Wedge-tailed Eagle		X			Un		
Welcome Swallow					C		
White-throated Needletail					C		
Yellow-faced Honeyeater					C		
Masked Lapwing							Un
Australasian Gannet		X	C	C	C	C	C
Pacific Gull		X	Un	Un	C	Un	
Little Penguin		X	C	Un		C	
Brown Goshawk			Un			Un	C
Silver Gull		X		C		C	C
Swamp Harrier		X		Un	C	Un	
Whistling Kite		X	Un	Un		Un	Un
Crested Tern		X				Un	
Kelp Gull		X				R	
Pied Cormorant		X		R			

Site 13: Monash Foreshore

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	3						
*Red Fox	2						
Swamp Rat	5						
Birds							
Silvereye			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Thornbill				C		C	C
Spiny-cheeked Honeyeater			Un		C		
Swamp Harrier				Un	C	Un	
Yellow-faced Honeyeater					C	C	C
*Common Blackbird				C			
Australian Magpie				C			
Australian Raven						Un	
Grey Fantail						Un	Un
Grey Shrike-thrush				Un			
Red Wattlebird						C	
Spotted Pardalote						C	
Welcome Swallow					C		
White-throated Needletail					C		
Australasian Gannet		X	C	C	C	C	C
Little Penguin		X	C	Un		C	
Brown Goshawk		X	Un			Un	Un
Pacific Gull		X			Un	Un	Un
Brown Falcon		X					Un
Pied Cormorant		X	Un	Un			
Silver Gull		X		C		C	C
Whistling Kite		X	Un	Un		Un	
Hooded Plover		X	R				
Kelp Gull		X				R	
Wedge-tailed Eagle		X			Un		

Site 14: Observatory Point

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*Red Fox	1						
*Cat (feral)	1						
Long-nosed Bandicoot	1						
Swamp Rat	1						
Short-beaked Echidna	1						
Reptiles							
Eastern Three-lined Skink	1						
Garden Skink	1						
Birds							
Brown Thornbill			C	C	C	C	C
Silvereye			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Grey Shrike-thrush			C	C			C
Mistletoebird			C			C	
Welcome Swallow				C	C		
Australian Magpie				C			
Eastern Yellow Robin						Un	Un
Golden Whistler				Un			
Grey Fantail				C			
Spiny-cheeked Honeyeater					Un		
Swamp Harrier					C	Un	
White-throated Needletail					C		
Yellow-faced Honeyeater					C		
Australasian Gannet		X	C	C	C	C	C
Little Penguin		X		Un		C	
Silver Gull		X		C		C	C
Whistling Kite		X	Un			Un	Un
Brown Goshawk		X				Un	Un
Crested Tern		X		Un			
Brown Falcon		X					Un
Hooded Plover		X	R				
Pacific Gull		X			Un		
Wedge-tailed Eagle		X			Un		

Site 15: Coles Track

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
Black Wallaby	1						
Common Ringtail Possum	1						
Reptiles							
Eastern Three-lined Skink	1						
Garden Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater							C
Eastern Yellow Robin			C		C	C	
Grey Fantail			C		C		
Mistletoebird			C			Un	
Welcome Swallow					C	C	
Yellow-faced Honeyeater					C	Un	
Red Wattlebird					Un	C	C
Southern Boobook					R		
White-throated Needletail					C		
Brown Goshawk				C		Un	Un
Swamp Harrier		X		Un	C	Un	
Whistling Kite		X	Un	Un		Un	
Galah						C	
Wedge-tailed Eagle		X			Un		

Site 16: Happy Valley

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	4						
*House Mouse	3						
White-footed Dunnart	2						
Common Ringtail Possum	1						
Black Wallaby	1						
Birds							
*Common Blackbird			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Eastern Yellow Robin			C	C	C		
Grey Fantail				Un	C	Un	
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater			C		C	Un	C
Red Wattlebird			C		C		
Yellow-faced Honeyeater					C	C	C

Australian Magpie			Un			
Common Bronzewing		Un				
Crimson Rosella			Un		Un	
Grey Butcherbird		Un				Un
Grey Shrike-thrush			Un			
Mistletoebird		C				
Spotted Pardalote		C				
Welcome Swallow				C		
Brown Goshawk		C		C		C
Whistling Kite	X	Un			Un	Un
Swamp Harrier	X			C	Un	
Wedge-tailed Eagle	X			Un		
White-throated Needletail	X			C		

Site 17: Eagles Nest

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	2						
*Red Fox	1						
Long-nosed Bandicoot	4						
Swamp Rat	8						
Common Ringtail Possum	1						
Black Wallaby	1						
Reptiles							
Garden Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Silvereye			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Singing Honeyeater			Un		C	C	C
Spiny-cheeked Honeyeater		X	C	C		C	C
*Spotted Turtle-Dove				C		C	C
Brown Thornbill				C		C	C
Red Wattlebird			C		C		
Welcome Swallow					C	Un	Un
Brush Bronzewing			R				
Grey Fantail				Un			
Spotted Pardalote						C	
White-throated Needletail					C		
Brown Goshawk		X	Un	C		Un	C
Black Falcon		X		R		R	
Galah						Un	

Site 18: Pearce Barracks

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Reptiles							
Blotched Blue-tongued Lizard	1						
Mammals							
*Black Rat	8						
*House Mouse	1						
*Red Fox	1						
Short-beaked Echidna	1						
Swamp Rat	1						
Birds							
*Spotted Turtle-Dove			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Singing Honeyeater			C	C	C	C	
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
*Common Blackbird			C	C	C		C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater		X	Un	C		Un	Un
Welcome Swallow				C	C	C	C
Australian Magpie			C		C		
Eastern Yellow Robin			C		C		
Nankeen Kestrel				C		Un	
Peregrine Falcon			R	Un			C
Red Wattlebird			Un		C		
Silver Gull		X		C		C	C
New Holland Honeyeater			Un				
White-throated Needletail					C		
Brown Goshawk		X	C	C	C	C	C
Whistling Kite		X	Un	Un		Un	Un
Black Falcon		X		R		R	
Crested Tern		X		Un			
Swamp Harrier		X			C	Un	
Wedge-tailed Eagle		X			Un		

Site 19: Fort Nepean South

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	2						
Swamp Rat	3						
Short-beaked Echidna	1						
Reptiles							
Common Blue-tongued Lizard	1						
Birds							
Singing Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Brown Goshawk			C	Un	C		
Silvereye			C	C	C		C

*Common Blackbird			C		Un	C
Brown Thornbill			C		C	C
Nankeen Kestrel			C		Un	Un
Spiny-cheeked Honeyeater	X	Un			Un	Un
Welcome Swallow			C	C		C
White-browed Scrubwren			C		C	C
Australian Magpie		Un				
Grey Shrike-thrush					Un	
Peregrine Falcon			Un			
Powerful Owl				R		
Silver Gull	X		C			C
White-throated Needletail				C		
Yellow-faced Honeyeater					Un	C
Wedge-tailed Eagle	X		Un	Un		
Whistling Kite	X	Un			Un	
Australasian Gannet	X		C			C
Black Swan	X				R	
Swamp Harrier	X			Un	Un	

Site 20: Hand Grenade West

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	3						
Short-beaked Echidna	1						
Common Ringtail Possum	1						
Birds							
*Common Blackbird			C	C	C	C	C
Eastern Yellow Robin			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Thornbill				C	C	C	C
Grey Shrike-thrush			C	C	C		
Silvereye			C	C	C		C
Grey Fantail				C	C		
Red Wattlebird			C		C		
Spiny-cheeked Honeyeater			C		C		C
Yellow-faced Honeyeater					C	C	C
Australian Magpie				Un			
Eastern Rosella				Un			
Golden Whistler			Un				
Mistletoebird			C				
Spotted Pardalote			Un				
Swamp Harrier		X			C	Un	
Welcome Swallow					C		
White-throated Needletail					C		
Wedge-tailed Eagle		X			Un		
Whistling Kite		X	Un			Un	Un

Site 21: Rifle Range

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*House Mouse	1						
*Red Fox	1						
Black Wallaby	2						
Long-nosed Bandicoot	1						
Swamp Rat	1						
Short-beaked Echidna	1						
Reptiles							
Eastern Three-lined Skink	1						
Whites Skink	2						
Birds							
*Common Blackbird			C	C	C	C	C
Australian Magpie			C		C	C	
Brown Falcon		X	Un		Un		
Brown Thornbill		X		C		C	C
Welcome Swallow					C	Un	
Eastern Rosella						Un	
Flame Robin			Un				
Whistling Kite			Un			Un	Un
Silvereye		X	Un	C	C	Un	C
White-browed Scrubwren		X	C	C	C	C	C
Superb Fairy-wren		X	C	C	C	C	C
Yellow-faced Honeyeater		X	C	C	C	C	C
Eastern Yellow Robin		X	Un	Un	C		
Eastern Spinebill		X	Un		Un		
Golden Whistler		X		C	C		
Grey Fantail		X		C	C		C
Grey Shrike-thrush		X	Un		Un		
New Holland Honeyeater		X	Un		Un		
Red Wattlebird		X	Un		C		
Grey Butcherbird		X	Un				
White-throated Needletail		X			C		
Spiny-cheeked Honeyeater		X				Un	Un
Wedge-tailed Eagle		X			Un		

Site 22: Rifle Range Heath

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Reptiles							
Blotched Blue-tongued Lizard	1						
Garden Skink	1						
Mammals							
*Black Rat	5						
*House Mouse	7						
Short-beaked Echidna	1						
Swamp Rat	2						
Black Wallaby	1						
Birds							
*Common Blackbird			C	C	C	C	C

Silvereye		C	C	C	C	C
Spiny-cheeked Honeyeater	X	C	C	C	Un	C
Superb Fairy-wren		C	C	C	C	C
White-browed Scrubwren		C	C	C	C	C
Brown Thornbill			C	C	C	C
Eastern Yellow Robin		C		C	C	C
Grey Shrike-thrush		C		C	C	C
Pacific Gull	X	Un		C	Un	
Yellow-faced Honeyeater		C		C	C	C
Grey Fantail		C		C		
Peregrine Falcon			C		C	C
Singing Honeyeater		C		C		
Welcome Swallow				C	Un	Un
Crimson Rosella		Un				
Eastern Spinebill		Un				
Golden Whistler				Un		
Mistletoebird		C				
Nankeen Kestrel		Un			Un	Un
White-throated Needletail				C		
Australasian Gannet	X	C		C	C	
Little Pied Cormorant	X	Un		C		
Shy Albatross	X	R			C	
Whistling Kite	X	Un			Un	Un
White-faced Heron	X	Un		Un		
Silver Gull	X				C	
Swamp Harrier	X			C		
Wedge-tailed Eagle	X			Un		

Site 23: Monash Break South

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Reptiles							
Eastern Three-lined Skink	6						
White's Skink	6						
White-lipped Snake	1						
Mammals							
*Black Rat	1						
*House Mouse	4						
*Red Fox	1						
Black Wallaby	5						
Birds							
*Common Blackbird				C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Brown Thornbill				C	C	C	C
Australian Magpie					Un	C	
Brown Falcon			Un		Un		
Brown Goshawk			C	C			Un
Welcome Swallow					C		
White-throated Needletail					C		
Grey Shrike-thrush		X	C	C	C	C	C
White-browed Scrubwren		X	C	C	C	C	C
Spiny-cheeked Honeyeater		X	C		C	Un	Un

Yellow-faced Honeyeater	X	C		C	C	C
Peregrine Falcon	X		C		C	C
Red Wattlebird	X			C	C	
Silvereye	X		C	C		C
Swamp Harrier	X		Un	C	Un	
Whistling Kite	X	Un	Un		Un	Un
Eastern Yellow Robin	X		Un			Un
Galah	X				Un	
Golden Whistler	X		C			
Grey Fantail	X		C			Un
Mistletoebird	X	C				
Spotted Pardalote	X	Un				
Wedge-tailed Eagle	X			Un		

Site 24: Monash Light South

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	4						
*Cat (feral)	1						
Long-nosed Bandicoot	2						
Swamp Rat	1						
White-footed Dunnart	1						
Short-beaked Echidna	1						
Common Ringtail Possum	1						
Birds							
*Common Blackbird			C	C	C	C	C
Peregrine Falcon			Un	C	Un	C	C
Spiny-cheeked Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Thornbill				C	C	C	C
Grey Shrike-thrush			C	C	C		
Silvereye			C	C	C		C
Yellow-faced Honeyeater			C		C	C	
Grey Fantail				C	C		
Red Wattlebird			C		C		
Eastern Yellow Robin				C			Un
Golden Whistler					C		
Mistletoebird			C				
Singing Honeyeater		X		Un			Un
Spotted Pardalote			Un				
Welcome Swallow					C		
White-throated Needletail					C		
Brown Goshawk		X		C	C		
Swamp Harrier		X		Un	C		
Whistling Kite		X	Un	Un			
Galah						Un	
Wedge-tailed Eagle		X			Un		
Eastern Rosella							Un

Site 25: Hand Grenade East

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	4						
Swamp Rat	1						
Short-beaked Echidna	1						
Common Ringtail Possum	1						
Reptiles							
White-lipped Snake	1						
Birds							
Brown Thornbill			C	C	C	C	C
Grey Shrike-thrush			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Brown Goshawk				Un	C	Un	C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater			C		C	Un	C
White-browed Scrubwren			C	C	C		C
*Common Blackbird				C		C	C
Eastern Yellow Robin				Un		Un	C
Grey Fantail				C	C		
Yellow-faced Honeyeater					C	C	C
Australian Magpie						C	
Crimson Rosella			Un				
Eastern Rosella			Un				
Mistletoebird			C				
Welcome Swallow					C		
White-throated Needletail					C		
Swamp Harrier		X		Un	C	Un	
Whistling Kite		X	Un	Un		Un	
Galah		X				Un	
Wedge-tailed Eagle		X			C		

Site 26: 25m Range

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	4						
*House Mouse	4						
Swamp Rat	1						
Short-beaked Echidna	1						
Common Ringtail Possum	1						
Reptiles							
Garden Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Goshawk			C	C	C		C
Brown Thornbill				C	C	C	C
Silvereye			C	C	C		C
Yellow-faced Honeyeater				C	C	C	C
Eastern Yellow Robin				Un		Un	Un
Grey Fantail				C	Un		

Grey Shrike-thrush			C		C		
Spiny-cheeked Honeyeater			C		C		C
Brush Bronzewing			Un				
Golden Whistler				C			
Grey Butcherbird						Un	
Mistletoebird			C				
Red Wattlebird					C		
Southern Boobook			Un				
Welcome Swallow					C		
Swamp Harrier		X		Un	C	Un	
Whistling Kite		X	Un	Un		Un	Un
Wedge-tailed Eagle		X			Un		
White-throated Needletail		X			C		

Site 27: Boonwurrung Track

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*Cat (feral)	3						
*House Mouse	3						
Short-beaked Echidna	1						
White-footed Dunnart	1						
Reptiles							
Blotched Blue-tongued Lizard	1						
Garden Skink	1						
Whites Skink	1						
Eastern Three-lined Skink	1						
Tree Dragon	1						
Birds							
*Common Blackbird			C	C	C	C	C
Grey Shrike-thrush			C	C	C	C	C
Singing Honeyeater			C	C	C	Un	Un
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Thornbill				C	C	C	C
Eastern Yellow Robin			C		C	C	C
Silvereye			C	C	C		C
Spiny-cheeked Honeyeater		X	C		C	Un	C
Brown Goshawk		X		Un	Un		
Golden Whistler				C	C		
Grey Fantail			C		C		
Swamp Harrier				Un	C		
Whistling Kite			Un	Un			Un
Yellow-faced Honeyeater			C		C		C
Blue-winged Parrot			R				
Brush Bronzewing			Un				
Mistletoebird			C				
Peregrine Falcon		X		Un			C
Wedge-tailed Eagle		X			Un		
White-bellied Sea-Eagle		X			Un		
Welcome Swallow			C				
Australasian Gannet		X	Un		Un		
Pacific Gull		X	Un		C		

Pied Cormorant	X	C		C		
White-throated Needletail	X			C		

Site 28: Sierra Nevada

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	5						
*Red Fox	1						
*Cat (feral)	1						
White-footed Dunnart	1						
Black Wallaby	1						
Reptiles							
Tree Dragon	1						
Birds							
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Thornbill				C	C	C	C
Grey Shrike-thrush			C		C	C	Un
Singing Honeyeater			C	C	C		C
Silvereye			C		C		C
*Common Blackbird				C			C
Brown Goshawk		X			C		
Eastern Yellow Robin				Un			Un
Grey Butcherbird				Un			
Nankeen Kestrel				Un		Un	
Peregrine Falcon		X		Un		Un	Un
Swamp Harrier		X			C	Un	
Welcome Swallow					C		
Whistling Kite		X	Un			Un	Un
White-throated Needletail		X			C		
Yellow-faced Honeyeater					C		C
Pacific Gull		X		Un		Un	
Silver Gull		X		C		C	
Australasian Gannet		X		C			
Crested Tern		X		Un			
Wedge-tailed Eagle		X			Un		
White-bellied Sea-Eagle		X			Un		

Site 29: Butlers Track Intersection

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*House Mouse	1						
*Red Fox	1						
Long-nosed Bandicoot	1						
Common Ringtail Possum	1						
Black Wallaby	1						
Short-beaked Echidna	1						

Birds						
Yellow-faced Honeyeater		C		C	C	C
White-browed Scrubwren		C	C	C	C	C
Welcome Swallow				C		
Wedge-tailed Eagle	X			Un		
Swamp Harrier	X		Un	C	Un	
Superb Fairy-wren		C	C	C	C	C
Spiny-cheeked Honeyeater		C		C		
Silvereye		C	C	C		C
Shining Bronze-cuckoo				Un		
Red Wattlebird				Un		
Mistletoebird		C				
Grey Shrike-thrush		C	C	C	C	C
Grey Fantail				C		
Golden Whistler			Un			
Crescent Honeyeater			C		C	
Brush Bronzewing		R		R		
Brown Thornbill		C	C	C	C	C
Southern Boobook (Tas form)						
Brown Goshawk		C	Un	C	Un	Un
*Common Blackbird		C	C	C	C	C
Whistling Kite	X	Un	Un		Un	Un
Musk Lorikeet				C		
Peregrine Falcon	X		Un		Un	Un
White-throated Needletail	X			C		

Site 30: Little Harrison's Bowl

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	2						
Black Wallaby	2						
Long-nosed Bandicoot	2						
Short-beaked Echidna	1						
Swamp Rat	2						
White-footed Dunnart	2						
Common Ringtail Possum	1						
Birds							
*Common Blackbird				C		Un	C
Australian Magpie						C	
Brown Goshawk			C	C	C	Un	Un
Brown Thornbill			C	C	C	C	C
Crescent Honeyeater					Un	C	
Crimson Rosella			Un				
Eastern Rosella			Un		C		
Eastern Yellow Robin				C		C	C
Golden Whistler				C			
Grey Butcherbird						Un	
Grey Fantail				C	Un		
Grey Shrike-thrush			Un	C	Un		
Mistletoebird			C				
Red-browed Finch			Un				
Shining Bronze-cuckoo					Un		
Silvereye			C	C	C		C

Spiny-cheeked Honeyeater		C		C		C
Superb Fairy-wren		C	C	C	C	C
Swamp Harrier	X		Un	C	Un	
Wedge-tailed Eagle	X			Un		
Welcome Swallow				C		
Whistling Kite	X	Un	Un		Un	Un
White-browed Scrubwren		C	C	C	C	C
White-throated Needletail	X			C		
Yellow-faced Honeyeater			C	C	C	C
Musk Lorikeet				C		

Site 31: Cheviot Valley

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	2						
*House Mouse	5						
*Red Fox	1						
Black Wallaby	3						
Swamp Rat	1						
White-footed Dunnart	1						
Reptiles							
Common Blue-tongued Lizard	1						
Eastern Three-lined Skink	1						
Birds							
White-browed Scrubwren			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Spiny-cheeked Honeyeater			C	C	C	Un	C
Silvereye			C	C	C	Un	C
*Common Blackbird			C	C	C	C	C
Grey Shrike-thrush			Un		Un	Un	Un
Yellow-faced Honeyeater				C		C	C
Singing Honeyeater					C	Un	
Brown Thornbill				C		C	C
Brown Goshawk		X	Un	C			C
Welcome Swallow					C		C
Nankeen Kestrel				Un		Un	Un
Whistling Kite		X	Un	C		Un	Un
Australian Magpie						R	
Eastern Rosella						C	
Southern Boobook					R		
Eastern Yellow Robin						Un	Un
Wedge-tailed Eagle		X			Un		
White-throated Needletail		X			C		C

Site 32: Cheviot Foreshore

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	6						
Swamp Rat	1						
Reptiles							

Mainland Tiger Snake	1						
Eastern Three-lined Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Silvereye			C	C	C	C	C
Singing Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Nankeen Kestrel			Un	C		C	
Brown Goshawk			Un			Un	Un
Welcome Swallow				C	C		
Yellow-faced Honeyeater				C		C	C
*Spotted Turtle-Dove				C			
Brown Thornbill				C			C
Eastern Yellow Robin				Un			
Grey Shrike-thrush				Un			
Peregrine Falcon				C			Un
Spiny-cheeked Honeyeater		X		Un			
White-throated Needletail					C		
Australasian Gannet		X	C		C	C	C
Australian Magpie			Un	Un		Un	Un
Pacific Gull		X	Un		Un	Un	C
Whistling Kite		X	Un	Un		Un	Un
Crimson Rosella		X		U n			
Eastern Rosella		X		Un			
Golden Whistler				Un			
Swamp Harrier		X		Un		Un	
Wedge-tailed Eagle		X			Un		

Site 33: Cheviot Hill

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	2						
Swamp Rat	1						
White-footed Dunnart	1						
Short-beaked Echidna	1						
Reptiles							
Tree Dragon	1						
Eastern Three-lined Skink	1						
Birds							
Yellow-faced Honeyeater					C	C	C
White-throated Needletail					C		
White-browed Scrubwren			C	C	C	C	C
Welcome Swallow				C	C		C
Swamp Harrier				Un	C		
Superb Fairy-wren			C	C	C	C	C
Spiny-cheeked Honeyeater			C	C	C	Un	Un
Silvereye			C	C			C
Silver Gull						C	C

Satin Flycatcher					R	
Red Wattlebird		C		C		
Peregrine Falcon			Un		Un	Un
Nankeen Kestrel			Un		Un	Un
Mistletoebird		C				
Grey Shrike-thrush		C		C	C	C
Grey Fantail			C	C	Un	Un
Eastern Rosella					C	
Brown Thornbill			C	C	C	C
*Spotted Turtle-Dove			Un			
*Common Blackbird		C	C		C	C
Brown Goshawk	X	C	C	C		
Whistling Kite	X	Un	Un		Un	Un
Black Falcon	X				R	
Galah	X				Un	
Wedge-tailed Eagle	X			Un		
White-bellied Sea-Eagle	X				Un	

Site 34: Eagles Nest Bowl

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*House Mouse	2						
*Red Fox	1						
*Cat (feral)	1						
Long-nosed Bandicoot	1						
Short-beaked Echidna	1						
Black Wallaby	1						
Reptiles							
Blotched Blue-tongued Lizard	2						
Mainland Tiger Snake	1						
Eastern Brown Snake	1						
Eastern Three-lined Skink	2						
Birds							
Singing Honeyeater		X	Un	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren		X	C	C	C	C	C
*Common Blackbird			C		C	C	C
Silvereye		X	C	C	C		C
Spiny-cheeked Honeyeater		X	C	C		Un	Un
*Spotted Turtle-Dove				C		Un	C
Brown Thornbill				C		C	C
Nankeen Kestrel				C		Un	Un
Red Wattlebird			C		C		
Welcome Swallow				C	C		C
Brown Goshawk		X	Un				
Flame Robin			Un				
Grey Shrike-thrush				Un			
New Holland Honeyeater		X	R				
Peregrine Falcon		X		C			Un
Whistling Kite		X	Un			Un	
White-throated Needletail		X			C		
Wedge-tailed Eagle		X			Un		

Site 35: Corsair Rock

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
Australian Fur Seal	1						
Birds							
Crested Tern			A	Un	C	Un	C
Great Cormorant			Un	Un	Un	Un	Un
Kelp Gull			Un	Un	Un	Un	
Little Pied Cormorant			Un	Un	Un	Un	Un
Pacific Gull			Un	Un	Un	Un	Un
Black-faced Cormorant			C	C	C	C	C
Silver Gull			C	C	C	C	C
Little Penguin			C	Un		C	Un
Shy Albatross			Un	Un		C	
Sooty Oystercatcher			Un	Un		Un	Un
Caspian Tern				Un		Un	Un
Little Black Cormorant				Un		Un	
Masked Lapwing			Un	Un			
White-faced Heron						Un	Un
Short-tailed Shearwater		X	Un	A			
Black-browed Albatross		X		Un		Un	
Australasian Gannet		X	Un	C	C	C	C
White-faced Storm Petrel		X					Un

Site 36: Jarman Oval

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*House Mouse	3						
*Red Fox	4						
Reptiles							
Blotched Blue-tongued Lizard	1						
Swamp Rat	2						
Short-beaked Echidna	3						
Birds							
Brown Thornbill			C	C	C	C	C
Grey Shrike-thrush			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Silvereye			C	C	C		C
Australian Magpie					C	C	C
Welcome Swallow				C	C		C
Whistling Kite			Un	Un		Un	Un
Yellow-faced Honeyeater					C	C	C
*Common Blackbird				Un			C
Australian Raven					C		
Flame Robin			C				
Galah						Un	
Magpie-lark						Un	
Mistletoebird			C				

Red Wattlebird					C	
Wedge-tailed Eagle				Un		
Willie Wagtail					Un	
Australasian Gannet	X	C	C	C	C	C
Brown Goshawk	X	C			C	C
Little Penguin	X		Un		C	
Masked Lapwing	X	C		C		C
Pacific Gull	X		R		R	R
Silver Gull	X		C		C	C
Swamp Harrier	X		Un	C	Un	
Grey Fantail	X		Un			
Kelp Gull	X				R	
White-throated Needletail	X			C		

Site 37: 25m Range

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*European Rabbit	1						
*Cat (feral)	1						
Black Wallaby	2						
Long-nosed Bandicoot	1						
Short-beaked Echidna	4						
Common Ringtail Possum	1						
Reptiles							
Eastern Three-lined Skink	1						
Mainland Tiger Snake	1						
Birds							
*Common Blackbird			C	C	C	C	C
Australian Magpie			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Eastern Rosella			C	CB	C	C	C
Silvereye			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
Whistling Kite			Un	Un	Un	Un	Un
White-browed Scrubwren			C	C	C	C	C
Yellow-faced Honeyeater			C	C	C	C	C
Crimson Rosella			Un		C	Un	Un
Grey Shrike-thrush			C	C			
Red Wattlebird			C	C			
Welcome Swallow			C				
Brown Goshawk			Un	Un	Un	Un	Un
Eastern Yellow Robin			C	C	C	C	C
Spiny-cheeked Honeyeater			C	C			
Spotted Pardalote			Un	Un			
Mistletoebird			C				
New Holland Honeyeater			Un				
Rufous Whistler					R		
Tawny Frogmouth			R				
Barn Owl						R	
Swamp Harrier		X		Un		Un	Un
Wedge-tailed Eagle		X		Un			
White-throated Needletail		X		C			

Site 38: CO's House

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Black Rat	1						
*Cat (feral)	1						
Black Wallaby	1						
Short-beaked Echidna	1						
Common Ringtail Possum	1						
Reptiles							
Metallic Skink	1						
Birds							
*Common Blackbird			C	C	C	C	C
Australian Magpie			C	C	C	C	C
Brown Thornbill			C	C	C	C	C
Red Wattlebird			C	C	C	C	C
Silver Gull		X	C	C	C	C	C
Silvereye			C	C	C	C	C
Spiny-cheeked Honeyeater			C	C	C	C	C
Superb Fairy-wren			C	C	C	C	C
White-browed Scrubwren			C	C	C	C	C
Brown Goshawk			Un	C		C	C
Eastern Rosella			C	C	C		
Yellow-faced Honeyeater				C	C	C	C
Crimson Rosella			Un	C			
Welcome Swallow			C	C			
Willie Wagtail			C		C		
Grey Butcherbird				Un			
Laughing Kookaburra				Un			
Mistletoebird					C		
Australasian Gannet		X	C	C	C	C	C
Little Penguin		X	C	Un	C	C	
Grey Fantail				C	C		C
Spotted Pardalote			Un			C	
Eastern Spinebill				Un			

Site 39: Visitor Centre

Common Name	No. captures	Off site	Summer 05-06	Autumn 06	Winter 06	Spring 06	Summer 06-07
Mammals							
*Cat (feral)	1						
Common Ringtail Possum	1						
Black Wallaby	1						
Birds							
*Common Blackbird			C	C	C	C	C
Australian Magpie			C	C	C	C	C
Crimson Rosella			C	C	C	C	C
Eastern Rosella			C	C	C	C	C
Red Wattlebird			C	Un	C	C	C

Superb Fairy-wren		C	C	C	C	C
Welcome Swallow		C	C	C	C	C
White-browed Scrubwren		C	C	C	C	C
Grey Shrike-thrush		C	C	C		C
Willie Wagtail		C	C	C		
Australian Raven			C		Un	C
Magpie-lark			C		Un	C
Brown Thornbill		C	C	C	C	C
Silver Gull		C	C	C	C	C
Silvereye		C	C	C	C	C
Spiny-cheeked Honeyeater		C	C	C	C	C
Yellow-faced Honeyeater		C	C	C	C	C
Southern Boobook			R			
Brown Goshawk	X	Un	Un		Un	Un
Grey Fantail			C	C	Un	Un
Golden Whistler				C		
Mistletoebird		C				
Spotted Pardalote		Un				

APPENDIX 8. Bird Survey Sites