The Vertebrate Fauna of Kamay Botany Bay National Park

Biodiversity Survey & Assessment Section, Metropolitan Branch
Environment Protection and Regulation Group
Department of Environment, Climate Change & Water (NSW)
March 2011

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THE VERTEBRATE FAUNA OF KAMAY BOTANY BAY NATIONAL PARK

FINAL REPORT Version 1

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Cover Photos

Front cover
Feature Photo, Kamay Botany Bay National Park from east of Henry Head looking at Henry Head and across the Bay to the Kurnell Precinct: E. Magarey/DECCW
Sand Heath in the Kurnell Precinct: R. Woodward/DECCW
Wallum Froglet: M. Schulz
Dune Forest in the Kurnell Precinct: M. Schulz
New Holland Honeyeater on Banksia flower: DECCW

Back cover
Eastern Blue-tongue Lizard: N. Williams
Blue Hole Gorge: M. Schulz
Gould's Long-eared Bat: N. Williams
Littoral Rainforest: M. Schulz

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OVERVIEW

Kamay Botany Bay National Park (KBBNP) is an iconic Sydney reserve, not only for its cultural and historical value to all Australians but also for its spectacular scenery and clear vantage points to the open sea. The reserve comprises two separate sections on the northern and the southern headlands of Botany Bay, the La Perouse Precinct and Kurnell Precinct respectively. Both Precincts are largely isolated from other contiguous native vegetation cover by intense urban and industrial landscapes, yet retain some of the best remaining examples of the native vegetation that once stretched along the Sydney coastline. Despite high levels of visitation and a long standing historical and scientific interest in the park, the vertebrate fauna values of KBBNP have remained incompletely described.

In 2010, as part of the Biodiversity Survey Priorities Program, DECCW undertook a project to address this information shortfall. The project included compilation and review of fauna information already existing in various forms, new systematic and targeted survey work, and production of a report to provide an inventory and prioritisation of fauna species, habitats and threats. A profile was created for each threatened species to summarise current distribution and status in the reserve, while habitat profiles describe the fauna typical of each of the main habitats. Threatening processes were identified and ranked, with management recommendations targeted towards the highest priority fauna species.

The project found that 190 native terrestrial vertebrate fauna species are residents in or visitors to the reserve, in addition to 14 introduced species. Eighteen species listed as threatened under the *Threatened Species Conservation Act* 1995 use the reserve to varying degrees, nine of which KBBNP is considered to contribute significantly to their regional conservation. Being four times the size of the La Perouse Precinct, the Kurnell Precinct currently supports a richer assemblage of fauna, with 182 native species compared to 118 in La Perouse. These levels of diversity are comparable to other reserves in the Sydney urban area, such as Sydney Harbour NP.

The swamp sedgelands, which primarily occur in the Kurnell Precinct, are considered the highest priority fauna habitat in KBBNP as they support two of the most significant fauna species: Wallum Froglet and Grass Owl. Though it is hard to see, the tinkling call of this tiny brown frog can be heard on cool humid nights from the majority of the sedgelands that are nestled in the sand dunes at the southern end of the park. The sighting of a single Grass Owl also in the swamp sedgelands of the Kurnell Precinct was the most exciting finding of the field surveys. This owl is a very rare sight in the Sydney Basin, with only three other confirmed records. The significance of this sighting was enhanced by the detection of several 'pellets' at a roost site. These pellets are regurgitated by the owl to remove non-digestible components of prey such as bone and hair, and on analysis were found to almost exclusively contain Black Rat and House Mouse remains, providing a rare insight into the diet of this owl in an urban reserve. The swamp sedgelands also provide habitat to several regionally significant species including Southern Emu-wren, Tawny-crowned Honeyeater, Buff-banded Rail, Lewin's Rail, Pheasant Coucal and Golden-headed Cisticola.

Arguably the most characteristic vegetation of both Precincts is the heathland that stretches from the exposed sandstone clifftops to the deep sand dunes. These also have high significance to fauna, not least by the provision of foraging resources for the Grey-headed Flying-fox. Many people visit KBBNP to spot shorebirds along the ocean coastline, where the intertidal rock platforms and small beaches provide another type of priority fauna habitat. Threatened or declining species that occur along the shoreline include Sooty Oystercatcher, Pied Oystercatcher, Australian Fur-seal, New Zealand Fur-seal and infrequently Little Tern, Double-banded Plover, Pacific Golden Plover, Lesser Sand-plover and several additional migratory birds. The significance of the swamp forest that grows around the picnic areas and park facilities at Commemoration Flat in the Kurnell Precinct often goes unnoticed by park visitors. Though the nature and extent of this habitat is the most highly modified in the park, the Swamp Mahogany trees still provide foraging resources for several nectarivorous parrots and bats including the endangered Swift Parrot, and hence are also considered to be priority fauna habitat.

Various fauna species of KBBNP have responded differently to the pressures of being in a relatively small urban reserve. In the La Perouse Precinct threatened Eastern Bentwing-bat show their adaptability by regularly roosting in the man made gun emplacements. In contrast, many species are known or suspected to have been lost or declined from the reserve. Most strikingly, only one native ground mammal species remains, and even that in low number, although what constituted the mammal assemblage in the 1700s is unclear. Several bird species have ceased to occur, including White-fronted Chat, Eastern Bristlebird, Painted Button-quail and Brown Thornbill, amongst others. Losses from the La Perouse Precinct have been more numerous, for example Green and Golden Bell Frog, Small-eyed Snake and Blackish Blind-snake.

The greatest threats to the ongoing survival of priority fauna species within KBBNP at this time are predation by the Fox and Cat, changes to local hydrology, fire, weed invasion, establishment of feral Deer, and public disturbance. Threats to fauna diversity as a whole include invasion of the Cane Toad and the lack of connectivity to other reserves meaning that the two precincts effectively operate as two islands. Addressing the latter threat will require promotion of habitat linkages between the Kurnell Precinct and Towra Point Nature Reserve and between the La Perouse Precinct and the new reserve at Malabar Headland.

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1 INTRODUCTION

1.1 PROJECT RATIONALE

Information that describes the type, distribution and status of biodiversity in NSW is required by many arms of the Department of Environment, Climate Change and Water (DECCW) for regulatory, conservation assessment and land management purposes. In the Sydney Basin Bioregion over 60 per cent of extant native vegetation occurs in DECCW reserves making it the largest individual custodian of native flora and fauna in the region. Since 2003, the former Central Branch of the Parks and Wildlife Group has funded a Biodiversity Survey Priorities (BSP) Program with the aim of providing all reserves with an equivalent level of information on flora and vertebrate fauna irrespective of size and location and to ensure that biodiversity data collection is approached in a strategic and systematic way. As a result of the first five years of the program, 28 reserves have been surveyed for fauna or flora or both, addressing the largest data gaps and making data available in stand-alone, easily accessible reports and maps. This work has altered previous knowledge of the distribution of many threatened species and endangered ecological communities and now over 75 per cent of the reserves of the former Central Branch are covered by adequate standards of fauna data and over 60 per cent are covered by adequate vegetation maps.

In 2009 the BSP program was extended for a further five years across an expanded region to include all of the Sydney Basin Bioregion. As part of the extension, a review of progress and priorities was completed. The Royal National Park (NP), Heathcote NP and Garawarra State Conservation Area (SCA) reserve complex and Kamay Botany Bay National Park (KBBNP) were identified for systematic fauna survey since: assessing the reserves in the southern Sydney metropolitan region was deemed a priority; no single comprehensive report detailing the fauna of these reserves currently exists; and the reserve Plans of Management are due for revision. The existing Plan of Management for Botany Bay National Park (NPWS 2002a) sets the following policy: “improve knowledge of the vertebrate and invertebrate fauna of the park to provide a baseline measure of biodiversity”. The plan also sets the following management strategy “on the basis of the biodiversity assessment key fauna habitats within Botany Bay National Park will be identified. Specific threats will be identified and ameliorative strategies devised”. The current project was designed to address the aims of both the BSP programme and the existing park Plan of Management and to provide an adequate level of information on native vertebrate fauna on the reserve to inform the revised Plan of Management.

1.2 PROJECT AIMS

The primary objectives of the surveys were to:

- Undertake a review of previous systematic fauna survey effort across the study area and identify gaps for particular fauna groups, habitats or areas.
- Undertake systematic fauna survey to fill in the gaps identified above.
- Undertake targeted survey for threatened and regionally significant species.

The specific objectives of this report are to:

- Document the methodology of the survey techniques applied.
- Document, review and collate information on the terrestrial vertebrate fauna of the study area, bringing together results of the current survey project with those of previous studies to provide an accurate species inventory.
- Make an assessment of the contribution that KBBNP makes towards the protection of vertebrate fauna in the region, with a focus on threatened and regionally significant fauna species.
- Identify broad-scale patterns in fauna habitat use across the study area and identify habitats of particular conservation significance in a regional context.
- Identify major threatening processes to native fauna in KBBNP.
- Identify priorities for conservation and management of terrestrial vertebrate fauna in the study area and propose management strategies to maintain or enhance the current fauna values.

1.3 STUDY AREA

1.3.1 Boundaries of the study area

Kamay Botany Bay National Park (KBBNP) straddles the headlands of the entrance to Botany Bay within the Sydney metropolitan area (Map 1). The section known as the Kurnell Precinct, on the southern headland, makes up the majority of the park covering almost 400 hectares of land. That on the northern headland, known as the La Perouse Precinct, covers just over 100 hectares. KBBNP was gazetted in 1988 but incorporates areas which have long been reserved for public use. Most notably this includes 100 hectares of land at Captain Cooks Landing Place which has national historical significance.

The boundary of KBBNP technically extends to the high tide mark; however intertidal habitat has been included within the study area for this report. Pelagic habitat is not included in the study area. Therefore, in this report vertebrate fauna considered excludes fish and pelagic fauna that occur with varying frequency in offshore waters and do not use the shoreline for resting, foraging or nesting purposes. As a result species such as terns and cormorants which roost on the shoreline, seals that occasionally haul out or Little Penguins that may occasionally come ashore to moult and formerly nested within the area are included. Species such as marine turtles, sea snakes, cetaceans and pelagic seabirds (i.e. storm-petrels, albatross, petrels, gannets, jaegers, pelagic terns and various noddy species) are not included. As Cape Solander is a key location for the viewing of such pelagic species, however, they are discussed in Appendix A.

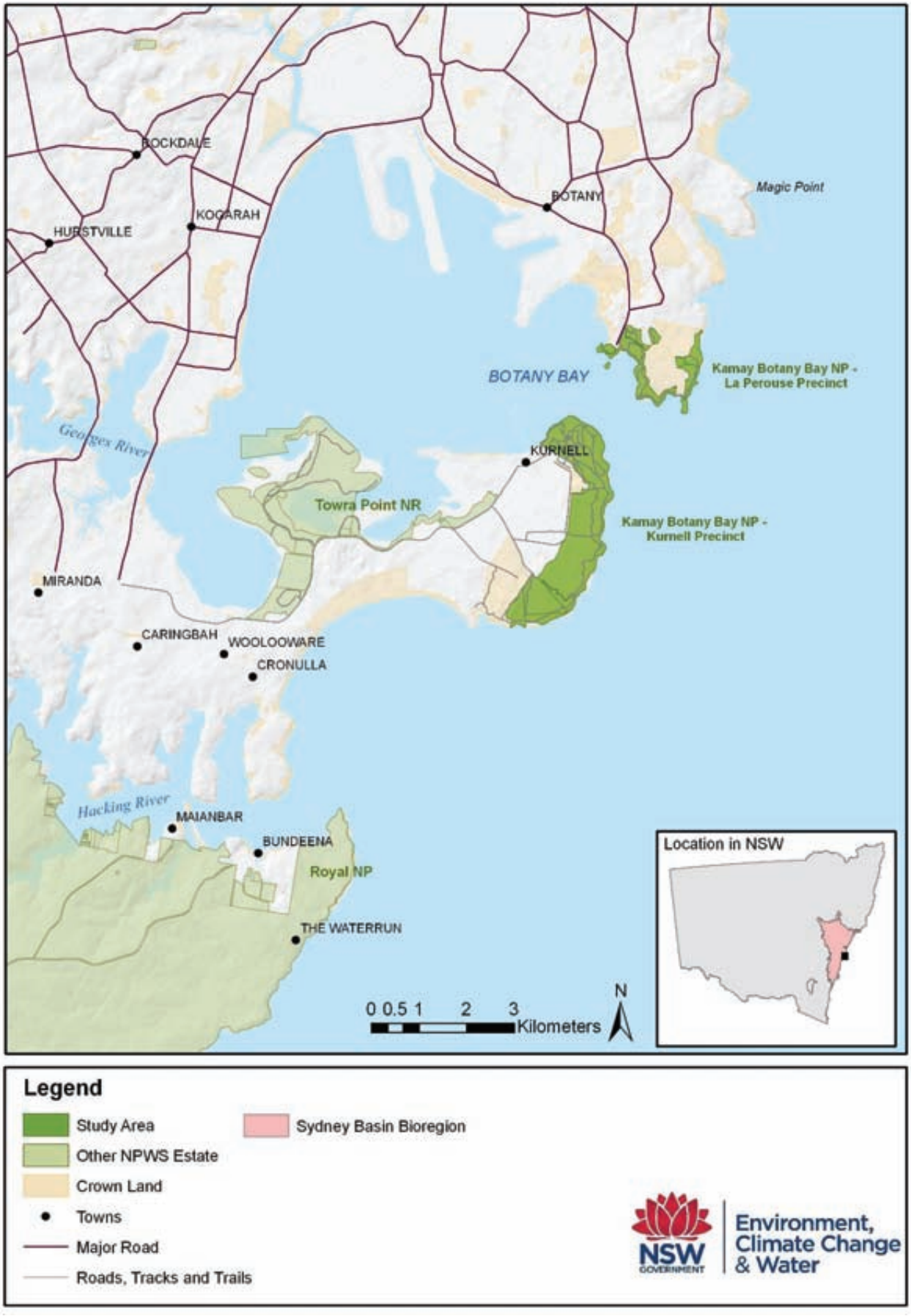
The La Perouse Precinct is largely isolated from other native vegetation remnants, being bordered by residential development and golf courses and of course the ocean. The Kurnell Precinct is surrounded by a variety of land uses including residential areas, industrial sites, and remnants of native vegetation on various tenures, thereby maintaining tenuous links with other reserves, particularly Towra Point Nature Reserve (NR) and Lucas Reserve. These links, or corridors, have been highlighted as part of the Kurnell 2020 project (Brennan 2009) with the aim of managing them to maximise their use by native fauna and flora. On the ocean side of the reserve lie a series of Intertidal Protected Areas and Aquatic Reserves as follows: Inscription Point Intertidal Protected Area extends from the Captain Cook obelisk around the headland to the east to the walking track (managed by the NSW Department of Industry and Investment - Fisheries); Boat Harbour Aquatic Reserve abuts the park at its southern extremity and includes Merries Reef and Potter Point (managed by DECCW); Cape Banks Aquatic Reserve abuts the La Perouse Precinct extending from the bridge at Cape Banks to the Endeavour Light at Henry Head and 100 metres seaward from mean low water (also managed by DECCW).

1.3.2 Geomorphology, soils, elevation and climate

The study area encapsulates a gradation of environments including intertidal rock platforms, dramatic sandstone sea cliffs, exposed elevated rock plates, shallow and deep sand dunes, sedgelands and wetlands, and sheltered areas behind the dunes.

The dominant underlying geology of the park is Hawkesbury Sandstone, laid down during the Triassic period (NPWS 2002a). This sandstone is dramatically displayed at each of the headlands where cliffs rise almost vertically from the intertidal zones up to 40 metres above sea level. The sandstone bedrock is also exposed in several locations in the park, particularly through the central part of the Kurnell Precinct (east of the Caltex oil refinery). During the Tertiary period ten basalt dykes intruded into the sedimentary rocks (NPWS 2002a). These have since eroded leaving narrow gorges in the sandstone cliffs (four near the northern boundary of La Perouse Precinct and six near Yena and Tabbigai in the Kurnell Precinct).

A characteristic feature of the park (and surrounding environments) is the loose sand deposits that overly the sandstone bedrock. These deposits are largely relicts of aeolian (wind-blown) sand dunes that were deposited over much of the headlands (Roy and Crawford 1981). These sand dunes overlay older terrestrial dunes, a small remnant of which outcrops near the western boundary of the Kurnell Precinct east of Caltex refinery (Roy and Crawford 1981). The sand deposits now range from a shallow sand mantle down to a depth of 40 metres (Roy and Crawford 1981). The dunes are most noticeable today at the southern end of the Kurnell Precinct. These sand deposits have long been exposed to weathering and leaching leaving highly infertile soils in the upper horizon.



Map 1: Location of Kamay Botany Bay National Park.

There are sources of freshwater in both sections of the park. Several freshwater springs occur on the margins of the Botany sandbed aquifer, supporting a number of wetland areas (NPWS 2002a). Intermittent streams occur in both precincts of the park, while a small permanent stream rises near the Discovery Centre and flows into Botany Bay adjacent to Alpha Farmhouse. This stream provided fresh water to indigenous people and the crew of the Endeavour.

The park falls within a warm temperate climatic zone with rainfall patterns characterised by wet summers and drier winters, with a mean annual rainfall in the park of around 1000 millimetres (NPWS 2002a). During the summer, north-easterly and westerly winds predominate resulting in moist humid conditions, while winter winds are typically from the south and west, resulting in dry to moist conditions.

1.3.3 Vegetation

The vegetation of the study area holds historical value as the site that botanists Banks and Solander made their first observations and collections during the Cook exhibition of 1770. The most well known vegetation feature of KBBNP is the heathland that extends from the exposed sandstone rock plates at the top of the sea cliffs to the deep sand dunes. Scattered through the park, and through the sand dune heathlands in particular, are freshwater wetlands of varying size and permanency. In the north and west of the Kurnell Precinct and the west of the La Perouse Precinct dry sclerophyll forests grow either on deep sand dunes or on sandstone, much of which support a somewhat mesic understorey. Another key feature of the study area are forested wetlands that grow in the vicinity of the Discovery Centre and adjacent picnic areas in the Kurnell Precinct which, though they include key flowering tree species today, differ markedly from what would have been encountered by Europeans in 1770.

The native vegetation of KBBNP has recently been remapped as part of a Sydney Metropolitan Catchment Management Authority (SMCMA) area wide study (DECCW 2009). The vegetation mapping used for this report follows that delineated by the SMCMA study as at September 2010. It must be noted, however, that this mapping is currently undergoing further review, with release of a final version of the map due in 2011. The SMCMA project is mapping vegetation communities in the study area in the context of the whole CMA and allocates communities to the formations and classes described by Keith (2004) to provide state-wide context. By broadly following the Keith class allocation the vegetation communities mapped in the study area have been grouped into ‘habitat groups’ for this report on the basis of similarity in vegetation structure, soil type, floristics and position in the landscape. The habitat groups and how they relate to the vegetation communities mapped in DECCW (2009) are described in Section 3.2.1 and presented in Map 2.

1.3.4 Fire history

Fire has long been an important factor influencing the environment of KBBNP. The known history, pattern, behaviour and management of fire in the reserve are detailed in the Fire Management Plans (NPWS 2001a, 2002b). The reserve is subject to periodic wildfires, however these are generally contained in sections and are usually small and patchy (NPWS 2001a). Hence there is a complex mosaic of vegetation age classes ranging from patches that are frequently burnt to patches that have not been burnt for decades. Through the large majority of the Kurnell Precinct and sections of the La Perouse Precinct the aim of fire management is to maintain fire frequencies within the biodiversity threshold for each vegetation community and to avoid burning all of a vegetation community at any one time (NPWS 2001a). Of note is the late successional stage heathlands present in the northern end of the Kurnell Precinct, which are quite rare in the Sydney Basin (NPWS 2001a).

1.3.5 Past and present land use

Land now included in Kamay Botany Bay National Park has long been recognised for its scenic, ecological, historical and cultural significance to both indigenous and non-indigenous Australians. The park is highly significant as the site of some of the earliest landings of European explorers, namely the expeditions of James Cook on the Kurnell side and Comte de Laperouse on the northern side, and the fact that the former led to the subsequent establishment of a colony in Australia. Despite initial dispossession a vibrant Aboriginal community persists.

Kurnell Precinct

The area around the current Discovery Centre has been, and still is, subject to the greatest amount of human usage in the Kurnell Precinct, including vegetation clearing, agricultural pursuits, changes to hydrology, damning of the stream adjacent to Alpha House, tree plantings and construction of monuments and art installations. This area now has extensive lawns with picnic facilities and

interpretive signage, while patches of remnant vegetation along the freshwater stream are being regenerated with the aim of restoring them to their pre-European condition.

The majority of the remainder of the precinct has been subject to minimal disturbance and retains the vegetation that once covered the coastline from Sydney Harbour to Port Hacking. Land uses in this section have largely had a small footprint including concrete bunkers during World War II, dwellings utilising caves in the cliffs near Tabbigai (NPWS 2002a), and the lighthouse at Cape Baily. The dunes at the far southern end of the Kurnell Precinct appear to have been quite heavily disturbed, with the Botany Cone damaged by four wheel driving, motor bike and horse activity (NPWS 2002a). West of Potter Point there is a major blowout in the dune field though it appears to currently be stable (NPWS 2002a).

Current land uses are primarily educational and recreational and include walking (leading to a network of formal and informal tracks), bike riding, fishing, surfing and spotting of whales and other marine species from the dedicated shelter at Cape Solander. The proximity of residential areas leads to use of the park by dog walkers, horse riders and mountain bikers, to rubbish dumping and to incursion from domestic Cats and Dogs.

Adjacent land uses that may influence the native fauna on the park include: the Intertidal Protected Area and Aquatic Reserve around Inscription Point and Boat Harbour respectively; the parcel of land owned by the La Perouse Local Aboriginal Land Council to the west of Botany Cone which retains much native vegetation; the presence of heavy industry in neighbouring lands including Continental Carbon, Caltex Oil Refinery and Holt Group Sandmining and 4WD park; and use of Botany Bay itself by the shipping industry leading to a risk of chemical spill.

La Perouse Precinct

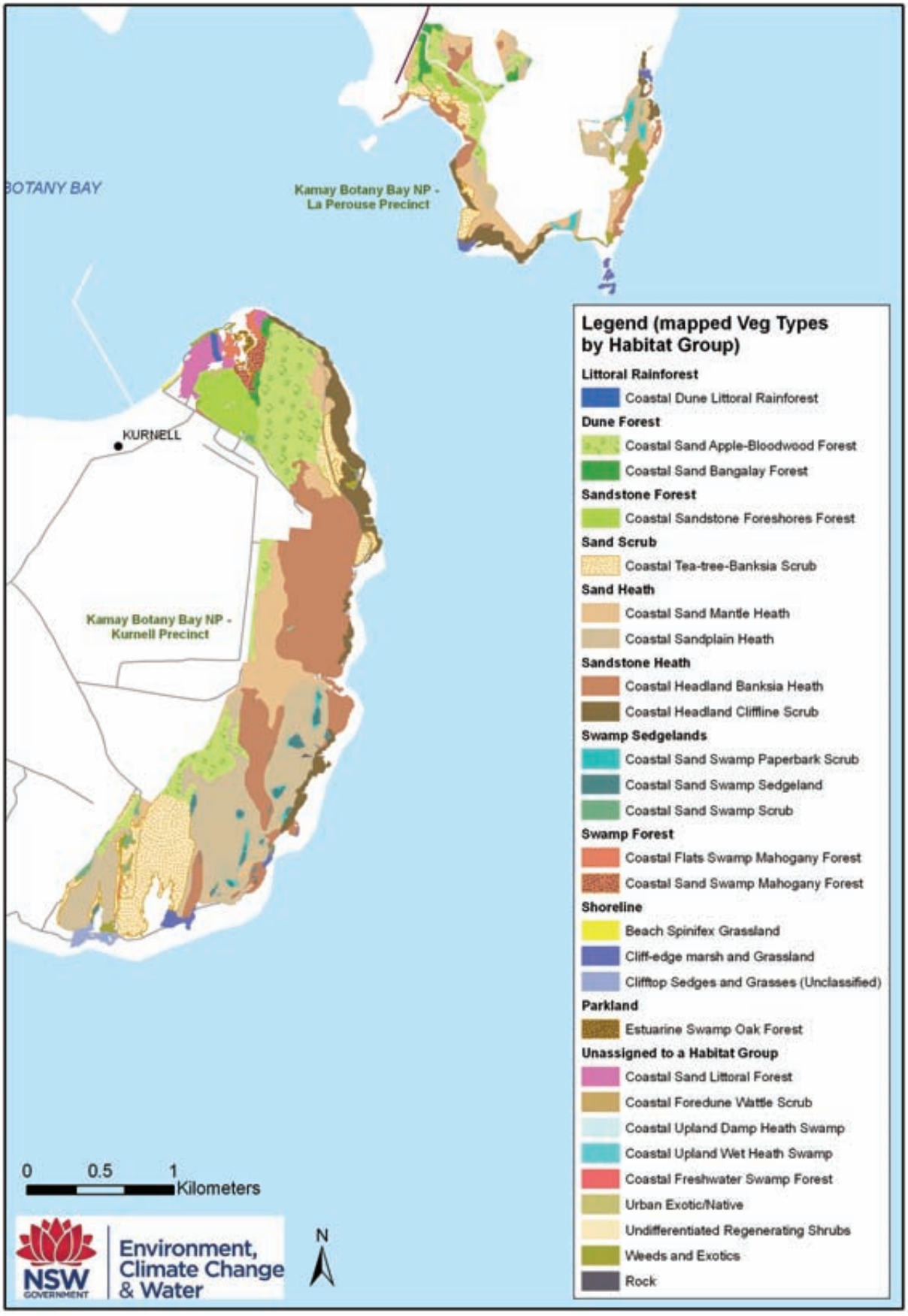
The far western side of the La Perouse Precinct contains the majority of historic attractions and visitor facilities including Macquarie Watchtower, La Perouse Monument, the Cable Station and Bare Island and is a highly modified environment with little remnant vegetation. The remainder of the Precinct, east of Anzac Parade, supports a mix of native and introduced vegetation that has almost all been subject to some level of disturbance. Past land uses have included vegetation clearing, agricultural pursuits, sandmining, a cemetery, military fortifications and infrastructure, and a camp during the Depression (NPWS 2002a). The proximity to residential areas and its high cultural importance leads to a high visitation rate, with current land uses including walking, bike riding, fishing, a Scout Camp, a Pistol Club, horse riding, flying of hang-gliders and model aeroplanes, and access for swimming and surfing. Adjacent land uses that may influence the native fauna on the park include: the neighbouring Golf Courses, use of Botany Bay itself by the shipping industry leading to a risk of chemical spill, and the very tenuous vegetation links to heathland at Malabar headland and Magic Point.

Fishing is a common recreational use of the parks shoreline. Photo © E. Magarey/DECCW

1.4 PROJECT TEAM

This project was carried out by the Biodiversity Survey and Assessment Section in the Metropolitan Branch of the Environment Protection and Regulation Group (EPRG). The project was funded under the Biodiversity Survey Priorities Program, a jointly funded biodiversity survey program between EPRG and the Metro Branch of the Parks and Wildlife Group.

Elizabeth Magarey undertook project management, background research, site selection, field survey planning and logistics and report writing. Field surveys were primarily undertaken by Martin Schulz. Martin Schulz also made a significant contribution to the threats and management sections of this report. Additional field survey was undertaken by Elizabeth Magarey and Debbie Andrew with assistance from Michael Hand, Barry Hodgson, Jason Bishop, David Croft, other Botany Bay Area staff, James Dawson, Kylie McClelland, Alison Foster and volunteer Wendy Kinsella. Report maps were produced by Clare O'Brien. Valuable comments on earlier drafts of this report were provided by Martin Schulz, Daniel Connolly and Debbie Andrew. Kerry Oakes designed the report cover and formatted the report.



Map 2: The native vegetation of Kamay Botany Bay National Park (DECCW 2009).
Note that delineation of vegetation communities is currently being revised for the final version of the Sydney Metropolitan CMA area vegetation mapping report, due for release in 2011.

2 METHODS USED TO BUILD THE SPECIES INVENTORY

2.1 COMPILATION OF EXISTING FAUNA DATA

The study area has a long history of interest in its fauna values. There have been a wide variety of formal and informal studies carried out, the results of which are retained in many different formats. Some are recorded in corporate databases such as the Atlas of NSW Wildlife, some in published and unpublished reports and many remain anecdotal. This project attempted to extract information from as many of these resources as possible.

2.1.1 Systematic fauna survey data

Systematic fauna surveys are those for which the same methods are employed at each site. This includes timed search efforts within fixed areas. These surveys record all species found using the method, and importantly record nil results where no animals were found. In this way the survey effort is recorded wherever sites are located in the park.

In 2006 the Sydney Metropolitan Catchment Management Authority (SMCMA) commissioned DECCW (then DECC) to undertake a rapid fauna habitat assessment across the larger vegetation remnants in the SMCMA area. As part of that project systematic fauna survey sites were established in KBBNP. These surveys utilised the same techniques and the same primary field surveyor as the 2010 project. Table 1 summarises the techniques undertaken in 2007, which are described in 2.4.1 below. The techniques described in Section 2.4.1 are herein referred to as current DECCW standard systematic survey techniques.

Table 1: DECCW standard systematic fauna survey effort prior to July 2009

Project	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal call playback	Timing of survey
Rapid Fauna Habitat Assessment of the SMCMA – KBBNP Kurnell Precinct	9	7	6	8	1	4	February 2007
Rapid Fauna Habitat Assessment of the SMCMA – KBBNP La Perouse Precinct	7	3	5	5	1	2	March to April 2007

In January and February 2009 the study area was subject to a limited amount of dedicated fauna survey as part of the Kurnell 2020 Corridor Delineation project (Brennan 2009). This work was focused at four sites within the Kurnell Precinct, namely: along the western boundary adjacent to Continental Carbon; adjacent to the Caltex boundary south of the road to Tabbigai Gap; near the end of Polo Street; and between Potter Point and Cape Baily Lighthouse. Diurnal and nocturnal survey techniques were undertaken to sample birds, herpetofauna, bats, terrestrial and arboreal mammals. Methods differed from the current standard techniques used by DECCW and deployed during the 2007 and 2010 surveys (see UBM Ecological Consultants 2009 for details of the census techniques used). The Atlas of NSW Wildlife was used to access the results of these surveys, while a summary of techniques deployed is provided in Table 2.

Table 2: Other systematic fauna survey effort prior to July 2009

Project	Diurnal bird watching transect	Herpetofauna transect	Spotlighting transect	Hair funnel traps	Anabat detector	Pitfall trapping	Timing of survey
Fauna Surveys in Support of the Proposed Development of Wildlife Corridors on the Kurnell Peninsula (see UBM Ecological Consultants 2009 for detail of census techniques)	4	4	4	4	4	2	January and February 2009

2.1.2 Other Atlas of NSW Wildlife records

The Atlas of NSW Wildlife (DECCW 2010a) was the primary resource used to access data on the fauna of the study area. Kamay Botany Bay National Park has been visited by numerous fauna enthusiasts and researchers over many decades, resulting in a large number of sighting records. Records within the Atlas of NSW Wildlife derive from observations made by: park rangers and field officers; bushwalkers and naturalists; scientific researchers; environmental consultants; bird surveyors undertaking bird counts for the second Atlas of Australian Birds project (Barrett *et al.* 2003); neighbours and other visitors to the park. These records have various levels of reliability depending on the type of observation, as well as the certainty and identification experience of the observer.

2.1.3 Literature review

As part of this project an effort was made to collate fauna records from various written sources that have not been entered into the Atlas of NSW Wildlife.

2.1.4 Unpublished and other information

As part of this project an effort was made to collate fauna sightings made by various naturalists and park staff that had not previously been entered into the Atlas of NSW Wildlife or documented in the literature. Several people with long term observations of the park were interviewed. Websites and forums were scanned for sighting information including Birding Aus and NSW Birdline.

2.2 REVIEW OF EXISTING RECORDS

2.2.1 Review of status of existing fauna species records

All compiled information on fauna species recorded in the reserves was reviewed. Each recorded species was allocated to one of the following classes.

1. Species only with unreliable record(s) due to poor locational accuracy. These species were excluded where the locality description did not actually occur within the study area, or where the methods used to identify the location of the sighting had very low spatial accuracy. Species records were not accepted unless supporting evidence was available from other sources.
2. Species only with unreliable record(s) due to probable misidentification or data entry error. These species were highlighted as they: do not have suitable habitat in the reserve; are outside their known range; and/or have been surveyed for by experts on the species and never confirmed to occur. These species were excluded unless alternative supporting evidence of their occurrence was available from other sources.
3. Introduced and non-local species that do not have established wild populations in the study area, including aviary escapees. These species were excluded from the species inventory.
4. Pelagic Species. These are offshore species that do not use the study area for resting, foraging or nesting purposes. These are excluded from the species inventory and given a separate discussion in Appendix A.
6. Included Species. These species are included as suitable habitat occurs *and* they have been reliably and accurately identified either in the past or during recent surveys. This category was then revisited at the end of new survey work to assess the status of all included species.

2.2.2 Identification of species to target during field survey

A list of target species was derived prior to the commencement of field surveys, in an effort to ensure adequate survey effort was directed towards these fauna species. This list was compiled using expert opinion (M. Schulz and E. Magarey) and DECC (2008a) on regionally and locally significant species that have the potential to occur in the study area but had not been accurately recorded to date, as well as state and/or federally listed threatened species that had not been adequately surveyed. The list of target species derived is presented in Table 3.

2.3 ANALYSIS OF PREVIOUS SURVEY EFFORT

Prior to the commencement of field survey, an analysis was performed to identify gaps in the fauna survey effort previously undertaken within the study area.

2.3.1 Gap analysis of systematic survey effort

The aim of systematic survey is to ensure that each of the habitat types contained within a given area is systematically sampled in proportion to the land area they occupy. The primary stratum used as a surrogate for habitat type was vegetation community, using the draft digital map produced by DECCW (2009). The survey strategy aimed to sample each vegetation community and where possible to include repeat sampling within each habitat group to provide reasonable reliability that potential variation within each stratum were captured. Such replication of sites serves to strengthen the reliability of patterns derived from collected data.

The gap analysis quantitatively assessed the level of existing DECCW standard systematic sampling for each fauna group within each vegetation community and habitat group and identified gaps in survey effort. The primary gaps identified in systematic fauna survey were:

- Frog survey in sedgeland communities.
- Ground mammal surveys in all vegetation communities, particularly heathlands.
- Reptile surveys in several vegetation communities.
- Anabat recording in several vegetation communities.

2.4 CURRENT SURVEY PROGRAM

2.4.1 Systematic fauna survey techniques

The systematic fauna survey methods used in 2007 and 2010 were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997a) and are in this document referred to as DECCW standard systematic survey techniques. The methods sample the following vertebrate fauna groups: diurnal and nocturnal birds, diurnal and nocturnal reptiles, bats, arboreal and ground-dwelling mammals and amphibians. Consistency in the use of the systematic techniques allows a comparison between fauna species detected across different vegetation communities and environments within the study area. Furthermore, it will allow future comparisons with consistent surveys of environments elsewhere.

Field surveyors were supplied with field proformas to facilitate comprehensive, consistent recording of field data and to increase accuracy and efficiency of data entry into the DECCW Biodiversity Sub-system (BSS) of the Atlas of NSW Wildlife computer database. The names of observers and recorders were noted on every data sheet to aid data verification and entry.

Site Selection

Sites were initially selected using a Geographic Information System (ArcMap 9.2) with information gained from the DECCW (2009) vegetation map, topographic maps, access trails, and knowledge held by park staff. Sites were placed as far away from each other as possible. However, due to the size and shape of the two sections of the reserve and the location of different vegetation types, site spacing was closer than would be ideal from a statistical perspective. The placement of harp traps to capture microbats was limited by the availability of suitable fly-ways, such as constrictions in taller vegetation types along roads and creek lines.

In the field, the proposed site locations were ground-truthed to ensure that they were representative of the mapped vegetation community, had suffered a minimum amount of disturbance and comprised a single vegetation community. If these criteria were not met, an alternative location was selected for the site. Wherever possible, systematic survey sites were 100 metres by 200 metres (two hectares) in area, however due to the small patch size of some vegetation communities, a small number of sites were necessarily smaller or were comprised of several neighbouring patches.

Site Attributes

A site attribute form, aiming to characterise fauna habitat, was filled out at every systematic site where survey techniques were conducted. A 20 by 20 metre quadrat typical of the overall 100 by 200 metre site was used for the assessment. The site attribute locates and describes the site in a format that is comparable to other sites. Data relating to physio-geographic, disturbance, structural and floristic, microhabitat and stream categories were recorded. Standard codes provided by the Australian Soil and Land Survey Handbook (McDonald *et al*. 1990), particularly for vegetation (i.e. Walker and Hopkins 1990) were used wherever possible.

Diurnal Bird Survey

Diurnal bird censuses comprised a twenty-minute observation and listening search within a two hectare (100 by 200 metre) area, conducted by an experienced bird surveyor. Censuses were conducted only during periods of relatively high bird activity (usually in the early morning) and reasonable detectability (e.g. low wind and cicada activity). All bird species and the abundance of individuals seen or heard were recorded. Individuals were scored as on-site if they were detected within the two hectare plot. Individuals recorded outside the plot, in adjacent vegetation types or flying overhead were recorded as off-site.

Diurnal Herpetofauna Search

A standard half hectare (50 by 100 metre) area was searched for one person-hour at each site. Censuses were restricted to the period between mid-morning to late afternoon, when temperature and insolation are sufficient to ensure maximum reptile activity. Surveying was not conducted on overcast or rainy days or in extreme heat.

This census technique entailed active searching of potential reptile and frog microhabitats within the half hectare area. Active or basking reptiles were identified by sight or captured and identified by the use of keys. Sheltering or cryptic species were detected by searching around, under and within fallen logs, litter, decorticating and fallen bark, rock outcrops, crevices and other likely shelter sites. Incidental observations of other fauna were also recorded.

Nocturnal Site Spotlighting Survey

This census comprised searching for arboreal mammals along a 200 metre transect within a site for half a person hour. Fifty watt spotlights were used to scan the vegetation for animals and enable detection of reflected eye shine. Surveyors also listened intently for fauna calls during the survey period. All fauna observed or heard within the census period were recorded, noting whether they were on or off site.

Harp Trapping

While ultrasonic recorders were used principally to detect high-flying bat species, collapsible bat traps, known as harp traps (Tidemann and Woodside 1978), captured low-flying species. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually positioned on tracks or creek lines or in gaps between trees where adjacent vegetation may 'funnel' flying bats. The standard technique deploys a harp trap for two consecutive nights at a site, in the warmer months between spring and autumn. However, during the 2007 and 2010 surveys some sites were only trapped for one night. This variation to the standard survey effort is recorded in the BSS, but both one and two night trapping sites are included in the summary in Table 5.

Harp trapping was used to sample microbat species. This trap was set in Blue Hole Gorge in 2007. Photo © M. Schulz/DECCW

Traps were checked during the night and each

morning. Captured bats were identified by external morphology, forearm measurement and body weight, and keyed out where necessary using Parnaby (1992a) and Churchill (1998). Animals were released either in the early morning or on the following night at the point of capture.

Bat Ultrasonic ('Anabat') Call Recording

Ultrasonic recorders (Corben 1989) are particularly useful for detection of high-flying species, which often comprise more than one third of an area's bat species (Parnaby 1992b), yet are under sampled by harp trapping (Richards 1992). Additionally, ultrasonic detectors also record low-flying species. The method requires the recording and identification of high frequency, echo-location "calls" made by bats, which, except for one or two species, are ultrasonic, that is, inaudible to humans.

The recording equipment for the surveys consisted of either an Anabat II® detector and digital flash card recorder or a combined Anabat SD1 detector, each housed within a Tupperware box for weather protection. The box was set up at sites where bats were expected to fly, such as over water bodies, at cave entrances and along tracks. A 40 kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session. The standard technique deploys an Anabat detector overnight at a site, set to commence detection at dusk and turn off at dawn. During the night, a delay switch operates to turn on the recording device when bat activity is detected and then de-activated the device while no bat activity is occurring. However, during the 2007 and 2010 surveys the detector was only deployed for part of the night (approximately five hours) at some sites. This variation to the standard survey effort is recorded in the BSS, but both full and half night sites are included in the summary in Table 5.

Anabat recordings were transferred onto computer and analysed by Narawan Williams, a recognised expert in this field. Troublesome calls were further verified by Michael Pennay. Identification was designated as definite, probable or possible, following the methodology of Parnaby (1992b) and Pennay *et al.* (2004).

Nocturnal Streamside Search

Streamside searches for frogs were undertaken for half a person hour in one of two ways: in stream or gully habitats a 200 metre stretch was searched; while at standing water bodies a half hectare (50 by 100 metre) area was surveyed. The searches were only conducted on warm, dark, humid and wet nights or nights within two days of rain. All frogs, and other animals, identified visually or by call within the time period were recorded, together with the weather conditions at the time of the survey.

Nocturnal Call Playback for Threatened Forest Owls

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact, behaviour which can be elicited by broadcasting specific calls. A standard survey census involved broadcasting the calls of each of the four large forest owls - Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Sooty Owl (*T. tenebricosa*) and Barking Owl (*N. connivens*) - from the centre of a site. Prior to call broadcasts, on arrival at the site, the surrounding area was searched by spotlight for five minutes to detect any fauna in the immediate vicinity and then a ten minute period of listening was undertaken.

A pre-recorded compact disc of each species' call series was played, amplified through a megaphone. Calls of each species were played for five minutes, followed by a five minute listening period. The surrounding area was again searched by spotlight after a final ten minute listening period. After the census, the response or presence of any fauna, date and time that response occurred, and weather details such as amount of cloud cover was recorded. Very windy and rainy periods were avoided where possible. Censuses conducted in poor weather were noted.

Vegetation Communities and Habitat Types Not Sampled

A number of vegetation communities are mapped at too small an extent to be systematically sampled for fauna or warrant inclusion as separate habitat types. These vegetation communities are: Coastal Upland Wet Heath Swamp (0.16 ha), Coastal Upland Damp Heath Swamp (0.25 ha), Coastal Foredune Wattle Scrub (0.14 ha), Coastal Freshwater Swamp Forest (0.17 ha) and Beach Spinifex Grassland (0.21 ha). The majority of both Coastal Flats Swamp Mahogany Forest and Estuarine Swamp Oak Forest are so highly disturbed within the study area, largely with just canopy trees standing above a mown turf understorey, that they also did not warrant systematic fauna sampling. Other mapping units that are not classified as vegetation communities in DECCW (2009) and were therefore not sampled are Clifftop Sedges and Grasses, Regenerating Shrubs and Weeds and Exotics.

Coastal Sand Littoral Forest (6.88 ha) was also not systematically surveyed. This community was not accurately mapped at the time of site stratification and hence was inadvertently left unsampled. Further, it is highly disturbed and today comprises a mix of habitat types including sand scrub, wet sclerophyll forest, dry sclerophyll forest and canopy trees above an open mown grassland (essentially parkland). Due to the history of disturbance, changing nature of the site and variable vegetation structure this community was not given its own, or allocated to an existing, habitat group. Understanding of the fauna currently utilising this vegetation community remains incomplete. Similarly Coastal Sand Swamp Scrub was not mapped at the time of the stratification and survey and hence was inadvertently left unsampled.

Two extra habitat types that are not native vegetation communities but are present in the study area, Parklands and Shoreline, were not suitable for systematic sampling. Hence the fauna descriptions for these habitats in this report rely on opportunistic records, surveys done in adjacent lands, and expert knowledge.

2.4.2 Assessment of survey adequacy for target species

Following the systematic survey gap analysis and the allocation of 2010 systematic survey effort to particular vegetation communities and fauna groups, an assessment was made as to whether each of the target fauna species would be adequately sampled by the systematic survey design. This assessment is presented in Table 3. As can be seen in the table, effective survey for some target species required the application of extra systematic searches in suitable habitat. Other target species were assessed to not be adequately sampled by DECCW standard systematic techniques and hence required the design and deployment of targeted survey techniques. The assessment thus led to two aspects of field survey, being systematic techniques (Section 2.4.1) and targeted techniques (Section 2.4.3).

Table 3: Target species list derived prior to the commencement of the 2010 field surveys.

Common name	Scientific name	Reason for inclusion as target species	Optimal survey method	Adequately sampled by systematic survey design?
Wallum Froglet	*Crinia tinnula*	Threatened. Occurrence on northern headland unconfirmed and distribution on southern headland not comprehensively understood.	Nocturnal and diurnal aural searches after rain in autumn and winter.	No – requires application of extra systematic searches in suitable habitat in autumn and winter. NB. Optimal survey method not achieved during 2007 or 2010 surveys.
Giant Burrowing Frog	*Heleioporus australiacus*	Threatened. Recorded in large numbers in Royal NP. Rumoured to potentially occur.	Nocturnal searches after rain in summer.	Yes NB. Optimal survey method not achieved during 2007 or 2010 surveys.
Green and Golden Bell Frog	*Litoria aurea*	Threatened. Although subject to intensive survey elsewhere on the Kurnell Peninsula its use of the park is not well understood.	Nocturnal searches after rain in summer.	Yes NB. Optimal survey method not achieved during 2007 or 2010 surveys.
Freycinet's Frog	*Litoria freycineti*	Identified as regionally significant in DECC (2008a).	Nocturnal searches after rain in summer.	Yes NB. Optimal survey method not achieved during 2007 or 2010 surveys.
Mainland She-oak Skink	*Cyclodomorphus michaeli*	Identified as regionally significant in DECC (2008a). Occurrence requires confirmation.	Diurnal herpetofauna census, pitfall trapping.	No – requires pitfall trapping.

Common name	Scientific name	Reason for inclusion as target species	Optimal survey method	Adequately sampled by systematic survey design?
King Quail	*Coturnix chinensis*	Identified as regionally significant in DECC (2008a). No records but suitable habitat occurs.	Diurnal bird census, passive listening, traverses of wetland and heathland areas during the daytime to flush individuals.	No – requires passive listening and active searching in potential habitat.
Australasian Bittern	*Botaurus poiciloptilus*	Threatened. Not previously recorded but marginal habitat occurs.	Diurnal bird census, traverses of wetland areas during the daytime to flush roosting individuals; spotlighting wetlands.	No – requires active searching in potential habitat.
Lewin's Rail	*Lewinia pectoralis*	Identified as regionally significant in DECC (2008a). Only one recent record in the study area.	Diurnal bird census, traverses of wetland areas during the daytime to flush roosting individuals; infra-red camera traps.	No – requires active searching in potential habitat and use of camera traps.
Swift Parrot	*Lathamus discolor*	Threatened. Recorded in study area in 1975.	Winter searches of flowering eucalypts, particularly Swamp Mahogany which is an important feed tree.	No – requires survey of flowering trees in autumn and winter.
Eastern Ground Parrot	*Pezoporus wallicus wallicus*	Threatened. Potential habitat occurs but species not recorded.	Passive dusk listening, diurnal bird searches, traverses of wetland areas during the daytime to flush roosting individuals.	No – requires passive listening, targeted call playback and active searching in potential habitat.
Pheasant Coucal	*Centropus phasianinus*	Identified as regionally significant in DECC (2008a). Not previously recorded but potential habitat occurs.	Diurnal bird census, passive listening, traverses of wetland and low heathland areas during the daytime to flush individuals.	No – requires passive listening and active searching in potential habitat.
Red-browed Treecreeper	*Climacteris erythrops*	Identified as regionally significant in DECC (2008a). Probably lost from the park.	Diurnal bird census, opportunistic survey.	Yes
Rockwarbler	*Origma solitaria*	Identified as regionally significant in DECC (2008a). Probably lost from the park.	Diurnal bird census, opportunistic survey.	Yes
Spotted Quail-thrush	*Cinclosoma punctatum*	Identified as regionally significant in DECC (2008a). Probably lost from the park.	Diurnal bird census, opportunistic survey.	Yes
Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*	Identified as regionally significant in DECC (2008a). Current status uncertain.	Diurnal bird census, opportunistic survey.	Yes
Beautiful Firetail	*Stagonopleura bella*	Identified as regionally significant in DECC (2008a). Not previously recorded but known from similar habitats elsewhere.	Diurnal bird census, opportunistic survey.	Yes

Common name	Scientific name	Reason for inclusion as target species	Optimal survey method	Adequately sampled by systematic survey design?
Powerful Owl	*Ninox strenua*	Threatened. Status not well understood.	Nocturnal call playback; spotlighting.	Yes
Masked Owl	*Tyto novaehollandiae*	Threatened. Not known from study area but could potentially occur as the species has been recorded from Towra Point.	Nocturnal call playback; spotlighting.	Yes
Grass Owl	*Tyto capensis*	Threatened. Unconfirmed record from Kurnell Precinct.	Nocturnal call playback, traverses of wetland areas during the daytime to flush roosting individuals.	No – requires active searching and targeted call playback in potential habitat.
Native small mammal assemblage	*Sminthopsis murina* *Pseudomys novaehollandiae* *Antechinus stuartii* *Rattus fuscipes* *Rattus lutreolus*	No recent records from the park or surrounding areas and could be locally extinct.	Pitfall trapping, Elliott trapping, infra-red camera traps.	No – requires targeted trapping.
Long-nosed Bandicoot	*Perameles nasuta*	Identified as regionally significant in DECC (2008a). Not previously recorded but known from similar habitats to the north and south. Unconfirmed sighting in the Kurnell Precinct.	Intra-red cameras traps; predator scat analysis.	No – requires targeted trapping.
Eastern Pygmy-possum	*Cercartetus nanus*	Threatened. Recorded in large numbers in Royal NP in similar habitat.	Pitfall trapping, Elliott trapping, infra-red camera traps, predator scat analysis.	No – requires targeted trapping.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	Threatened. Recorded from Towra Point.	Harp trapping and Anabat recording.	Yes
Southern Forest Bat	*Vespadelus regulus*	Unconfirmed record from 2007. Its occurrence would hold significance as it is rare in the region.	Harp trapping and Anabat recording.	Yes
Feral species	*Vulpes vulpes* *Felis catus* Feral Deer particularly *Cervus timorensis*.	Key Threatening Processes. Identity, distribution and status of Deer poorly understood.	Searching for tracks and scats, spotlighting, infra-red camera traps, interviews with park users and staff.	No – requires interviews with park staff and use of camera traps.

2.4.3 Targeted fauna survey techniques

A number of the threatened and regionally significant target fauna species are not adequately sampled using standard systematic survey techniques alone. Targeted survey methods were therefore used for these species. In addition, it was determined that the standard active reptile search technique was inadequate for sampling the reptile and terrestrial mammal fauna in heathlands, and that this gap should be addressed by the implementation of pitfall trapping. The targeted survey techniques employed are described below.

Pitfall Trapping

Target Species: Native terrestrial mammals (particularly the Eastern Pygmy-possum), reptiles and frogs in heathlands.

Pitfall trapping was undertaken in 2010 to sample reptiles and small terrestrial mammals. Photo © E. Magarey/DECCW

This technique involved placing five pitfall traps into the ground at approximately five metre intervals. The traps were made of PVC stormwater pipe (150 millimetres diameter, 600 millimetres deep), buried flush with the ground. Aluminium fly-wire mesh was taped over the bottom end of the pipe to prevent animals burrowing out yet allow water to drain freely. The pitfalls were connected by shade-cloth fencing designed to divert animals into the traps. The fencing was dug approximately five centimetres into the ground to prevent animals burrowing underneath it, and stood approximately 25 centimetres above the ground. The fencing was held in place by lengths of galvanised wire placed at approximately one metre intervals. A mixture of soil, leaf litter and foliage was placed at the bottom of each pitfall trap to provide substrate and shelter for captured animals. If ants were present in the vicinity of a trap, either residual powder pesticide was placed around the rim to deter ants or a thin reed was placed into the trap to allow ants to escape and hence minimise attack on trapped animals. Pitfall traps were left open for four consecutive nights per survey. Traps were checked shortly before dusk and after dawn each day, upon which captured animals were identified, sexed if possible, and released. In between surveys the traps were left in place and secured tightly with a galvanised iron lid. The timing of pitfall trapping surveys is outlined in Table 4 below.

Elliott Trapping

Target Species: Native small terrestrial mammals.

This technique involved setting Elliott A traps at approximately 5 metre intervals through a site. The number of traps set ranged from 10 to 25 per site. Traps were baited with a mixture of peanut butter, oats and honey. Traps were left in place for four consecutive nights, checked and emptied every morning soon after dawn. Any animals captured within the traps were identified, sexed if possible, and released.

Infra-red Camera Trapping

Target Species: Native terrestrial mammals and cryptic birds.

Infra-red cameras were set up in 2010 to target native terrestrial mammals and cryptic birds. Photo © E. Magarey/DECCW

This technique involved setting up cameras triggered by infra-red motion sensors (GameSpyi60 Digital Game Camera with Infrared Flash). The cameras were set at ground level, anchored to a trunk or garden stake, facing a bait station designed to attract fauna into the camera's field of view. The bait station consisted of a mix of rolled oats, peanut butter and honey placed inside a PVC vent cowl pegged into the ground at a distance of one to two metres from the camera. Where necessary, minimal moving of ground cover to a distance of three metres in front of the camera and one metre either side of the bait was done to provide an uninterrupted view of animals inspecting the bait. Cameras were set to take a still photo and five second video on detecting a moving heat source, with a delay of ten minutes between subsequent photos. The internal white flash of the camera was set to be triggered in low light (including night time).

Passive Listening, Active Searching and Targeted Call Playback in Sedgelands and Heathlands

Target Species: Grass Owl, Pheasant Coucal, Eastern Ground Parrot, Australasian Bittern, Lewin's Rail, Eastern Bristlebird, and King Quail.

Highly experienced bird surveyors undertook targeted surveys for threatened and regionally significant birds in the Swamp Sedgelands, Sand Heaths and Sandstone Heaths, in February 2007 and in late February and April 2010. These surveys utilised a range of techniques including: active searching by traversing potential habitat; passive listening at dawn and dusk where potential habitat for particular species occurred; call playback where potential habitat for particular species occurred. A total of approximately 18 person-hours were spent undertaking these targeted surveys in 2010 with the areas traversed and searched in 2010 illustrated in Map 5. Additional passive listening, active searching and call playback for these species were undertaken in the 2007 survey.

Survey of Flowering Swamp Mahogany

Target Species: Swift Parrot.

In April 2010 Swamp Mahogany (*Eucalyptus robusta*) trees around the Discovery Centre in the Kurnell Precinct came into flower. This area was visited on three occasions by experienced bird observers to search for Swift Parrot and other lorikeets. Surveys involved listening for calls and searching with binoculars. These surveys were limited in time and were not expected to be exhaustive.

2.4.4 Opportunistic techniques

During the implementation of the systematic and targeted survey work, opportunistic techniques were also employed wherever possible. These included the following.

Predator and Herbivore Scat and Pellet Collection

The large numbers of hairs, and occasionally skeletal remains, in predator scats and owl pellets results in a high level of confidence in identifications of prey species and is hence an efficient sampling technique for prey animals. In addition, the recording of predator or non-predator scats constitutes records for the species that deposits the scat. Due to the unknown time delay between prey ingestion and defecation, the location in which the prey animals lived cannot be accurately known, so this technique is useful only for detecting the species presence within a general area. Lunney *et al.* (2002) showed that on average Dogs and Foxes defecate within a two kilometre radius of the site of prey ingestion.

Predator scats and pellets encountered were collected, placed in paper envelopes, labelled and sent to specialist Barbara Triggs for analysis. Skeletal remains were identified where possible and hair samples were identified using the techniques described by Brunner and Coman (1974). Identifications were classified into three levels of reliability: definite, probable and possible.

The location of herbivore scats was also noted on an opportunistic basis to indicate the presence of an animal. If there was any doubt in herbivore scat identification in the field, samples were brought back for identification by an expert.

Searches of Caves, Overhangs and Artificial Underground Structures

All encountered caves, overhangs, significant rock crevices and artificial underground structures, such as tunnels associated with the disused gun emplacements, were searched with a head torch for animals such as cave-roosting bats, geckos and nesting birds.

Scanning of the Shoreline

Shoreline areas, including beaches and intertidal rock platforms were routinely scanned for birds, including a variety of potentially occurring shorebird species.

Incidental Records

Incidental records are point localities of fauna encountered opportunistically during the survey. This is an opportunity to augment the number of records of species that are not well sampled by standard systematic survey techniques, such as large ground mammals, raptors, non-vocalising birds and secretive or cryptic species. The date, time, observer, map grid location (usually obtained from a GPS) and microhabitat of the animal were recorded on a data sheet.

2.4.5 Survey timing

The systematic and targeted field surveys techniques described above were undertaken in two main periods, February to April 2007 and February to May 2010. Table 4 summarises the timing of systematic and targeted survey techniques over this period.

Table 4: Timing of DECCW systematic and targeted fauna surveys within Kamay Botany Bay National Park.

Timing	Location	Systematic techniques employed	Targeted techniques employed
19 to 22 February 2007	Kurnell Precinct	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording, and nocturnal call playback.	Dusk listening and call playback for the Eastern Ground Parrot, call playback for the Grass Owl.
29 March to 3 April 2007	La Perouse Precinct	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording and nocturnal call playback.	
22 February to 2 March 2010	Kurnell Precinct	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording, nocturnal streamside search, and nocturnal call playback.	Elliott trapping, pitfall trapping, passive listening and active searching in sedgelands and heath.
24 March to 7 April 2010	Kurnell Precinct		Infra-red camera traps.
14 April to 5 May 2010	La Perouse Precinct	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, bat ultrasonic call recording and nocturnal call playback	Infra-red camera traps.
15 April 2010	Kurnell Precinct		Survey of flowering Swamp Mahogany and return to Grass Owl locations in sedgelands and heath.
3 to 7 May 2010	Kurnell Precinct		Pitfall trapping, Elliott trapping and survey of flowering Swamp Mahogany.

2.4.6 Survey site locations

A total of 45 systematic sites have been established and surveyed in the study area, as well as an additional 11 targeted sample points. Table 5 shows the number of systematic survey sites and targeted survey points in each vegetation community after completion of the 2010 field surveys, including sites from the 2007 SMCMA survey. Map 3 and Map 4 detail the location of systematic survey sites and Map 5 shows the location of targeted survey techniques.

2.4.7 Survey limitations

At the completion of the systematic and targeted surveys it is considered that all vertebrate fauna groups have been systematically sampled to an adequate level to provide a baseline biodiversity assessment with the exception of amphibians. No systematic frog searches were conducted during the 2007 surveys and during the summer of 2010 the water table was low meaning that many sedgelands in the study area were dry. Unfortunately time limitations did not permit additional frog searches in winter after the heavy rains of late May and early June 2010. Frog species, including Giant Burrowing Frog, Green and Golden Bell Frog, Freycinet's Frog and Jervis Bay Tree Frog are not considered adequately surveyed. The inventory of frogs in the park was developed for this report through consultation with Dr. Arthur White who has opportunistically been undertaking frog surveys in the study area for many decades. Even so, the inventory of tree frogs for the park may be incomplete and

the current status of many frog species remains uncertain. Further systematic frog surveys in the study area would be beneficial to address this information shortfall.

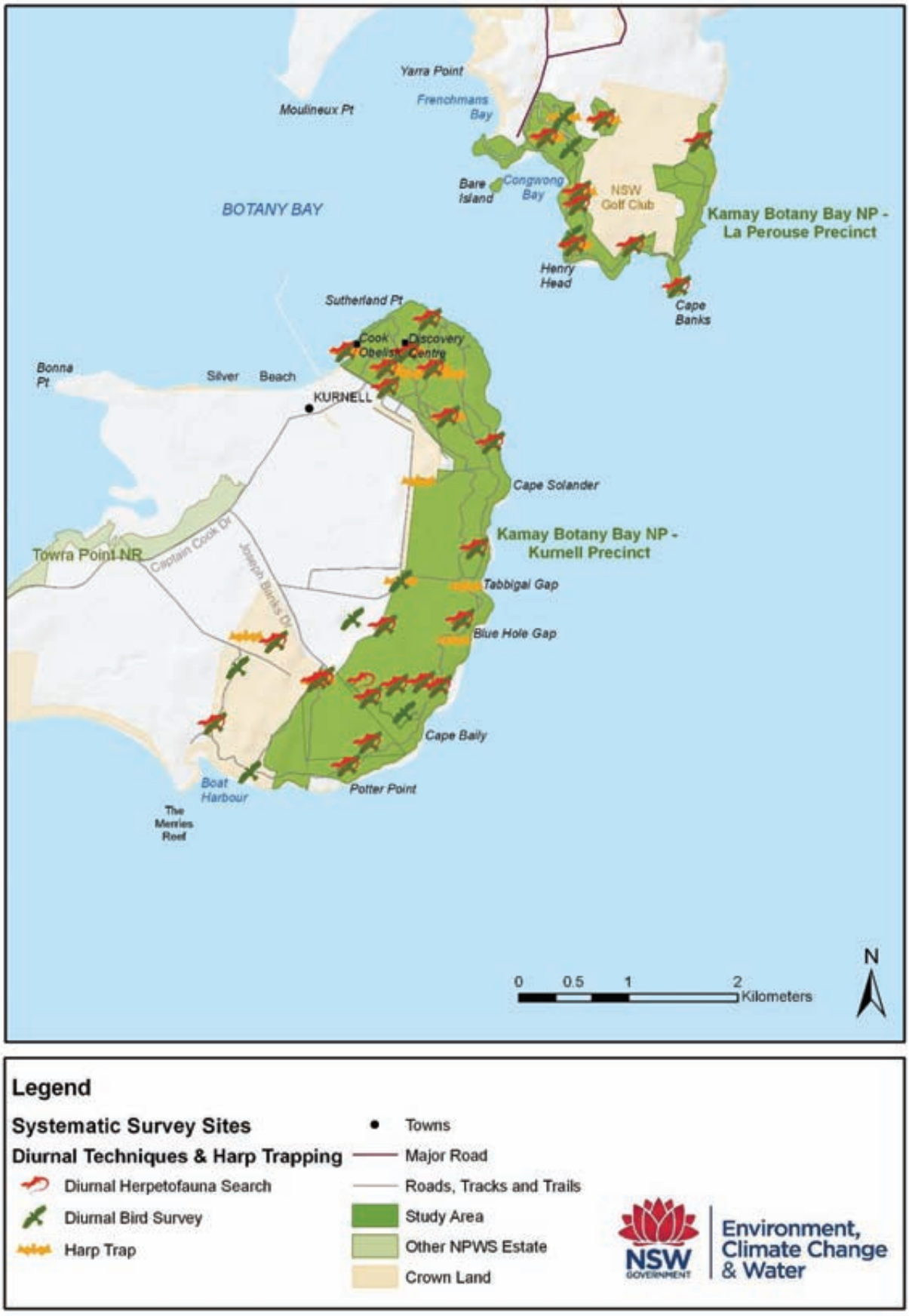
It should also be noted that both the 2007 and 2010 systematic surveys of the La Perouse Precinct were undertaken in March and April. It is therefore likely that some species that are only seasonal visitors to the region, such as Eastern Koel, or are more active in the spring and summer months, such as Chocolate Wattled Bat, were missed by the survey and are therefore missing from the baseline inventory for the La Perouse Precinct provided in this report.

Finally, a shortcoming of the systematic surveys was the failure to adequately sample some vegetation communities that were not correctly mapped at the time of the site stratification and fauna field survey. The most notable case is the Coastal Sand Littoral Forest vegetation community, which due to incorrect mapping was inadvertently left unsampled. However, this vegetation community within KBBNP is highly disturbed and today comprises a mix of habitat types including sand scrub, wet sclerophyll forest, dry sclerophyll forest and canopy trees above an open mown grassland (essentially parkland). Other vegetation communities not adequately sampled due to changes in the extent of mapping are Coastal Sand Swamp Scrub (not sampled), Coastal Sand Bangalay Forest (under sampled) and Coastal Sand Mantle Heath (under sampled). In order to understand the fauna occupying these vegetation communities, further systematic sampling would be required. However, it is unlikely that additional species for the park would be discovered, and especially given the highly disturbed and changing nature of the Coastal Sand Littoral Forest, additional systematic surveys in these vegetation communities are not a priority.

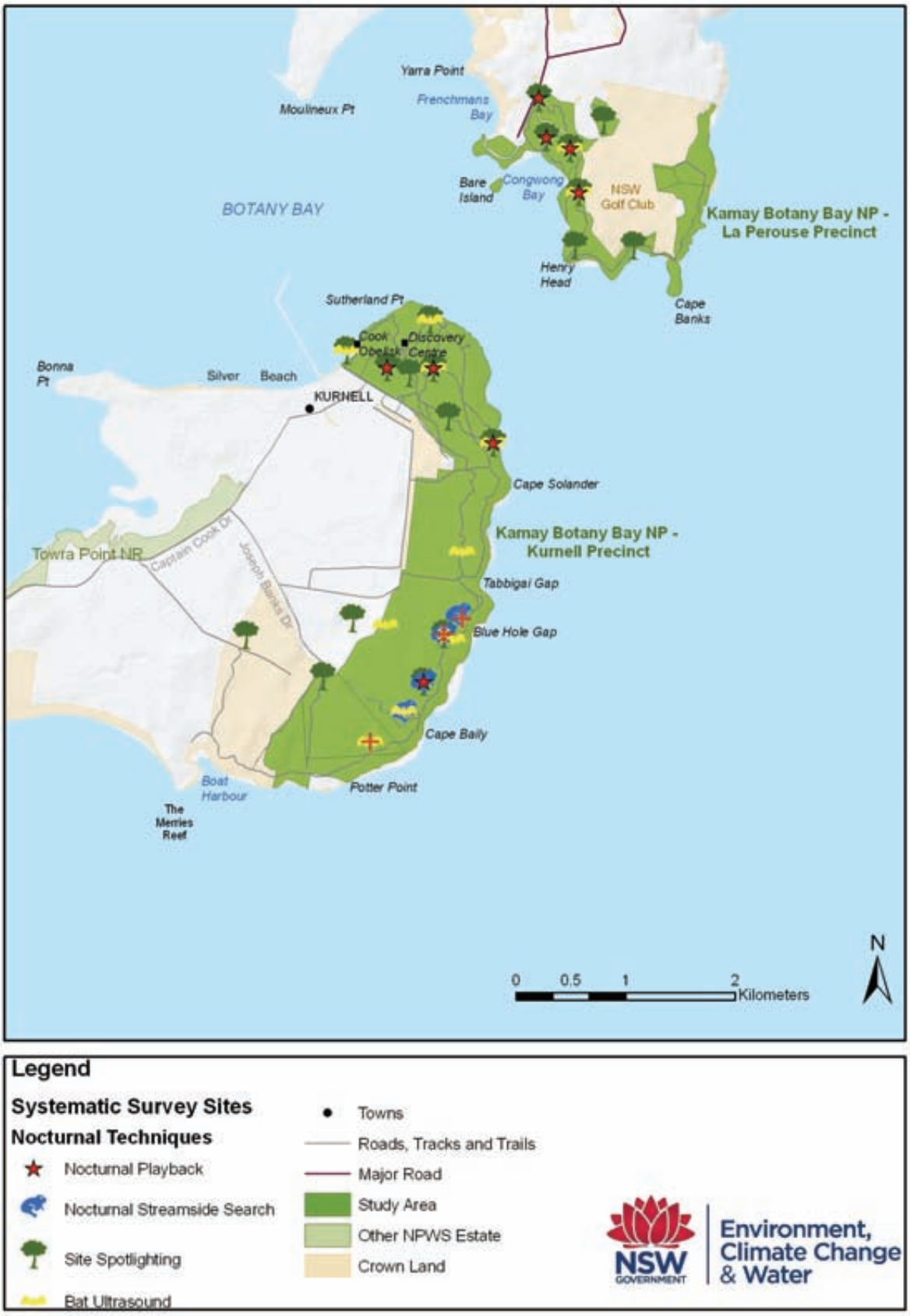
2.5 REVIEW OF PATTERNS OF LOCAL FAUNA LOSS AND DECLINE

The review of information on fauna of the survey area included compilation of a list of species which were not recorded during the current survey or other recent surveys, but for which evidence exists of their previous occurrence in the reserves. This list includes species that have been documented historically as occurring within the survey area, as well as species that are considered highly likely to have once occurred based on the presence of suitable habitat and the proximity of reliable historic records in nearby areas.

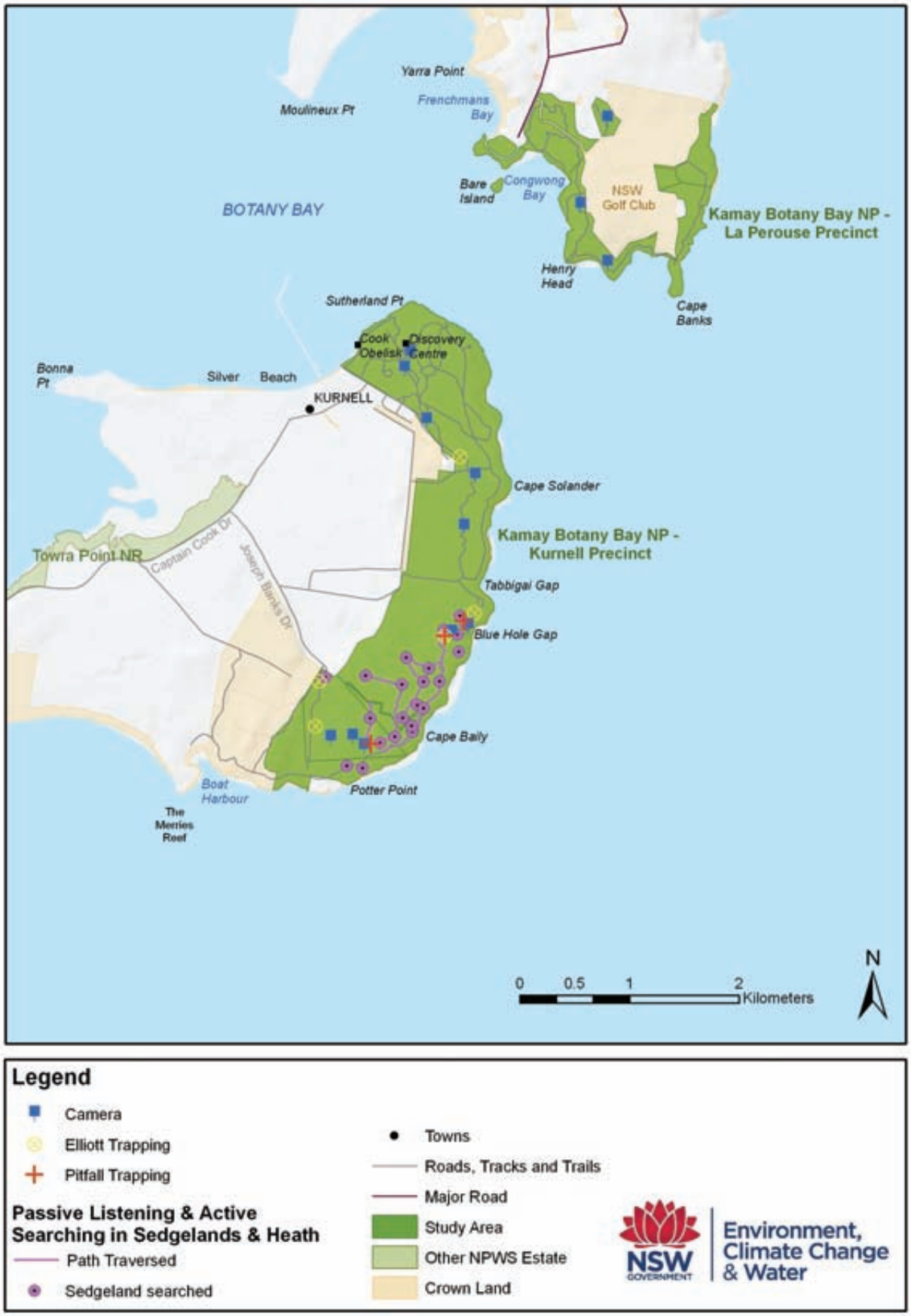
Following compilation of the above list, an assessment of the previous and current status of each species was made in order to determine the likelihood of local species losses. For each species the following was done: the veracity of all historical records was assessed; a judgement of past and present habitat availability and suitability was made; the adequacy of survey effort in preferred habitats was assessed; local naturalists and experts on the species were consulted; and patterns of decline elsewhere in the region as well as current knowledge of the species ecology were considered. It must be noted that the list compiled is derived from an assessment of current knowledge and is not definitive. The *Threatened Species Conservation Act* 1995 (*TSC Act*) considers species to be "presumed extinct in nature" if in the preceding 50 years the species cannot be located despite the searching of known and likely habitats. This definition is aimed at identifying extinction for a species across its entire range in NSW. Use of the term *species loss* for this study is not restricted to such a long time period as it is being applied to a local scale and aimed to highlight species which have not been seen recently within the study area and based on best available knowledge no longer occur. Section 4.2 discusses species that are thought to have been lost from the park or individual Precincts as well as species that appear to have significantly declined.



Map 3: **Location of DECCW standard systematic survey sites using diurnal techniques and harp trapping in Kamay Botany Bay National Park.**



Map 4: **Location of DECCW standard systematic survey sites using nocturnal techniques in Kamay Botany Bay National Park.**



Map 5: Location of targeted surveys undertaken in Kamay Botany Bay National Park in 2010.

Table 5: Vegetation communities within the study area and corresponding allocation of point-based fauna survey effort as at June 2010.

Vegetation community (DECCW 2009)	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Pitfall trapping	Infra-red camera trap
Coastal Dune Littoral Rainforest	0.7	1	1	1	1	1					
Coastal Sand Apple-Bloodwood Forest	62.4	9	7	7	9	4		3	1		2
Coastal Sand Bangalay Forest	3.8			1				1			
Coastal Sandstone Foreshores Forest	16.8	4	3	4	4	1		3			1
Coastal Tea-tree-Banksia Scrub	46.6	3	2	1	1						3
Coastal Sand Mantle Heath	47.0	1			1						1
Coastal Sandplain Heath	82.6	3	4							4	1
Coastal Headland Banksia Heath	89.7	4	2	1	1	2			2		3
Coastal Headland Cliffline Scrub	24.8	3	3	1		1		1			
Coastal Sand Swamp Paperbark Scrub	5.7	1	1	2			1	1	1	2	1
Coastal Sand Swamp Sedgeland	4.4	2	3	1		1	3	1	1		
Coastal Sand Swamp Scrub	3.1										
Coastal Sand Swamp Mahogany Forest	3.8	1	1		1						1
Coastal Flats Swamp Mahogany Forest	2.3										
Beach Spinifex Grassland	0.2										
Cliff-edge marsh and Grassland	3.8	2	2								
Clifftop Sedges and Grasses (Unclassified)	2.2										
Estuarine Swamp Oak Forest	0.8										
Coastal Foredune Wattle Scrub	0.1										
Coastal Freshwater Swamp Forest	0.2										
Coastal Sand Littoral Forest	6.9										

Vegetation community (DECCW 2009)	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Pitfall trapping	Infra-red camera trap
Coastal Upland Damp Heath Swamp	0.3										
Coastal Upland Wet Heath Swamp	0.2										
Regenerating Shrubs	0.2										
Weeds and Exotics	6.4										
Rocky Gorge (not mapped)					2	1					
Total number of sites of each technique		34	29	19	20	11	4	10	5	6	13
Total number of trap nights					29				484	120	200

3 METHODS USED TO ASSESS AND PRIORITISE SPECIES, HABITATS AND THREATS

3.1 SPECIES

Two separate ranking processes were undertaken to help identify fauna species that deserve focus given their conservation status. An initial rank was used to identify a suite of priority species. This subset was then ranked again using a different set of criteria to identify management priorities.

3.1.1 Definition of priority species

After completion of the field survey and compilation of the species inventory, the fauna species list was examined to identify *priority species*. Each of the priority species were given a species profile to detail their current status in the study area, as presented in Section 5. A priority species is any fauna species with record(s) from within the park boundary that meets one or more of the following criteria.

- **Listed as threatened under the *TSC Act* and/or the Environment Protection and Biodiversity Conservation Act 1999 (*EPBC Act*).** This includes all species reported within the study area boundaries that currently occur, are known to have occurred in the past, or for which there are unconfirmed or spatially inaccurate records. This does not include aviary escapees which do not occur naturally in the region (i.e. Superb Parrot *Polytelis swainsonii*) or pelagic species that are seen offshore or have been found washed up on the shoreline, but do not normally come ashore to utilise habitats within the park (see Appendix A).
- **Declining regionally significant species for which the study area provides important habitat for a significant population compared with elsewhere in the Sydney Basin Bioregion**. Species were included in this category if they have been identified as regionally significant in DECC (2008a) and if the study area supports important habitat and a significant population in the bioregional context.
- **Recognised as key threatening process.** This includes all terrestrial vertebrate species that are listed as Key Threatening Processes under the *TSC Act* and/or the *EPBC Act*.

3.1.2 Setting management ranking for native priority species

Land managers are faced with an ominous list of priority fauna species (including threatened species), however not all species require an equivalent level of management effort at the current time. Some species warrant quite specific active management, further survey or monitoring to increase their chances of survival in the long term, while others simply require ongoing protection of the reserve. In order to inform the management effort required at the current time, each of the native priority species identified within the study area has been ranked into a class according to its level of priority for active conservation management within KBBNP. The ranking system is derived from expert knowledge rather than quantitative assessment. It must be noted that, as priority species were defined to include all threatened species reported for the park, whether or not they were accurately recorded or currently exist, there are species classified as priority yet given a 'nil' conservation management priority ranking.

The rankings are defined as follows.

Highest: Species that are likely to become extinct from the study area in the short to medium term without action, and for which the study area is likely to play a crucial role in the regional conservation of the species. These species require management at a site by site level.

High: Species that are at risk of becoming extinct from the region without active management of key habitats and abatement of threats. This category includes species which are rare in the study area, or for which habitat is limited in extent, but for which the study area never-the-less contributes to regional conservation, as well as species that are better represented in the study area than in other reserves in the region or species with an uncertain status in the study area but with little prime habitat present in reserves within the region.

Moderate: Species for which the study area does not support a significant amount of habitat relative to that reserved elsewhere in the region and/or utilise the area for foraging but are not known to roost or breed within it. Though management of these species is not currently the highest priority for the reserve, an increase of pressure on these species elsewhere in the region, or the delineation of key threats within the study area, may require more active management in the future.

Low: Species that are either a) well represented elsewhere in the regional reserve system or b) occur only as very irregular visitors or vagrants. These species do not require any specific conservation management in the reserve at this stage, other than ongoing protection of important habitat features e.g. mature hollow-bearing trees, or in the case of seals management to protect individuals from public harassment.

Nil as Species Loss: Species that were accurately identified at the time of survey but are now considered to be lost from the study area. If these species were to be rediscovered in the park they would require a reassessment of their status and would most likely be ranked as having *Highest* conservation management priority.

Nil as Inaccurate Record: Species for which identification at the time of survey is doubtful or for which only records with low spatial accuracy occur and hence for which occurrence in the past or present is unconfirmed.

3.2 FAUNA HABITATS

3.2.1 Definition of fauna habitat groups

The study area encapsulates a gradation of environments from intertidal rock platforms and beaches to exposed rocky headlands, deep sand dunes and sheltered swamps, leading to a variation in the types of fauna habitat available. Much of the fauna habitat is in the form of native vegetation communities. The recent native vegetation mapping of KBBNP (DECCW 2009) allocated communities to the formations and classes described by Keith (2004). By broadly following the Keith class allocation the vegetation communities mapped in the study area have been grouped into 'habitat groups' for this report on the basis of similarity in vegetation structure, soil type, floristics and position in the landscape. In addition to the native vegetation there are other unmapped habitat types, such as shorelines and picnic areas. Where appropriate these habitat types have also been allocated a 'habitat group' in this report.

These habitat groups act as a surrogate for environments utilised by a suite of fauna with similar habitat requirements. They represent the different environmental gradients that occur across the study area and, being a mappable unit, are able to be easily applied for targeted management of the reserve. It must be remembered, however, that the habitat groups were not derived from statistical analysis of fauna records and thus do not necessarily represent true fauna assemblage boundaries for each taxonomic group. Nevertheless the habitat groupings provide a useful broad-scale basis for understanding fauna distribution patterns across the study area.

It must be noted that the vegetation mapping used for this report follows that delineated by the SMCMA study as at September 2010. The mapping is currently undergoing further review, with release of a final version due in 2011. When this final version is released the fauna habitat groups described below should be correlated to the new mapping units, with changes to habitat delineations and definitions revised as necessary.

The fauna habitat groups, eight of which are defined by their native vegetation communities and two of which are defined by other features, are summarised in Table 6 and described below. Each of the habitat groups were given a profile, as presented in Section 6.

Littoral Rainforest

Vegetation Communities Included: Coastal Dune Littoral Rainforest.
Corresponding Statewide Class*:* Littoral Rainforests.
A single very narrow patch comprising 0.14% of the study area occurs along the freshwater stream/gully line west of the Discovery Centre in the Kurnell Precinct. This community is highly modified from its 1770 state due to past clearing, grazing, damning of the stream and planting of exotic species (Benson and Eldershaw 2007). Native tree species include Tuckeroo (*Cupaniopsis anacardioides*), Cabbage Tree Palm (*Livistona australis*) and Magenta Lilly Pilly (*Syzygium paniculatum*) while the dense understorey features mesic species such as Sweet Pittosporum (*Pittosporum undulatum*).

Dune Forest

Vegetation Communities Included: Coastal Sand Apple-Bloodwood Forest and Coastal Sand Bangalay Forest.
Corresponding Statewide Class*:* Coastal Dune Dry Sclerophyll Forest and South Coast Sands Dry Sclerophyll Forests.
Dune Forest is the most extensive forest/woodland type in KBBNP, occupying 13.28% of the area. It occurs on deep sand dunes in the northern end and along the western edge of the Kurnell Precinct as well as through the western half of the La Perouse Precinct. The forest is of low to moderate height and is characterised by an open cover of dry shrub and heath plants. Typically the canopy comprises Smooth-barked Apple (*Angophora costata*), Old-man Banksia (*Banksia serrata*) and Red Bloodwood (*Corymbia gummifera*), though may also include Broad-leaved Scribbly Gum (*Eucalyptus haemastoma*) and Bangalay (*Eucalyptus botryoides*). The impoverished soils, in combination with the exposed situations, lead to a heathy understorey of tea trees, banksias, broom heath and grass trees above a ferny ground cover.

Sandstone Forest

Vegetation Communities Included*:* Coastal Sandstone Foreshores Forest.
Corresponding Statewide Class*:* Sydney Coastal Dry Sclerophyll Forests.
Sandstone Forest occupies 3.37% of the study area and is mapped in two discrete patches, one east of Cape Solander Drive between Polo Street and Yena Track and the other east of Anzac Parade between the Golf Course road and Congwong Bay. The key feature of this type is its proximity to sandstone bedrock and sandstone outcroppings, with a thin or absent layer of sandy soil. The canopy is dominated by Smooth-barked Apple with localised patches of Red Bloodwood, Broad-leaved Scribbly Gum, Bangalay and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*). Due to the sheltered location a prominent layer of hardy mesic small trees and shrubs is present, such as Sweet Pittosporum, Cheese Tree (*Glochidion ferdinandi*) and Blueberry Ash (*Elaeocarpus reticulatus*). There is a ground cover of ferns, rushes and grasses.

Sand Scrub

Vegetation Communities Included: Coastal Tea-tree-Banksia Scrub.
Corresponding Statewide Class*:* Coastal Headland Heaths.
Coastal Tea-tree Banksia Scrub is mapped on the large deep sand dune north of Potter Point, smaller patches on dunes inland and north of Cape Solander and in patches between Anzac Parade and Henry Head. It occupies 9.34% of the park. Typically it comprises a dense cover of Coast Tea-tree (*Leptospermum laevigatum*) and Coast Banksia of five to fifteen metres in height. Shrubs present can include Tree Broom-heath (*Monotoca elliptica)* and Wattle *(Acacia longifolia* subspp.*).* The dense canopy often excludes light from penetrating below resulting in a sparse ground cover. These patches of Sand Scrub have probably all been disturbed in the past, but as they now form a discrete vegetation community were sampled systematically for fauna.

Sand Heath

Vegetation Communities Included*:* Coastal Sand Mantle Heath and Coastal Sandplain Heath.
Corresponding Statewide Class*:* Wallum Sand Heaths.
Sand Heath occupies 25.93% of the study area, occurring where loose sand dune overlies the sandstone bedrock. The sand ranges from a shallow mantle (most of that in La Perouse Precinct and north of Tabbigai Gap) to sand dunes of up 40 metres deep (south of Tabbigai Gap). This habitat group is an open to closed heath mostly of one to two metres high but with patches reaching up to five metres or more. The most common species on the shallower sand are Heath-leaved Banksia (*Banksia ericifolia*), Coast Tea-tree, Wallum Banksia (*Banksia aemula*) and Scrub She-oak (*Allocasuarina distyla*), while on the deeper dunes stunted Old-man Banksia and Scrub She-oak dominate. At times clumps of low eucalypts may be present. The remainder of the dense shrub layer comprises a wide variety of woody species such as grevilleas, geebungs, peas and wattles. The composition of the ground layer varies with moisture from forbs and ferns on drier sites to sedges where drainage is impeded.

Sandstone Heath

Vegetation Communities Included*:* Coastal Headland Banksia Heath and Coastal Headland Cliffline Scrub.
Corresponding Statewide Class*:* Sydney Coastal Heaths.
This group differs from the Sand Heath by occurring on sandstone rock platforms with only a skeletal layer of soil. It includes the low wind-blown open to dense heath at the top of the sea cliffs and

headlands as well as the taller closed heath further inland. It occupies 22.92% of the study area. In the most exposed locations stunted Bracelet Honey-myrtle (*Melaleuca armillaris*), Scrub She-oak, Heath-leaved Banksia and Coastal Rosemary (*Westringia fruticosa*) are the most common woody shrubs, with the low shrub *Baeckea imbricata* also very common near the cliff edge or where the water table is close to the surface. As distance away from the cliff edge increases typically Heath-leaved Banksia and Scrub She-oak form the dominant upper strata, sometimes with Tick Bush (*Kunzea ambigua*), Wattle (*Acacia longifolia*), Needlebush (*Hakea teretifolia*) and Pink Tea-tree (*Leptospermum squarrosum*). These larger shrubs may be over-topped by a sparse cover of emergent mallee-form eucalypts. Many sites have impeded drainage because the sandstone bedrock is very close to the surface. The ground cover can at times have a sparse cover of sedges amongst clumps of forbs. Areas of bare sandstone are patchily exposed through the heath. This habitat type is most extensive between the Kurnell Reservoir and Tabbigai Gap with smaller patches between the road to Tabbigai Gap and Potter Point, on the cliff tops north of Cape Solander, and the clifftops and headlands of the La Perouse Precinct.

Swamp Sedgeland

Vegetation Communities Included: Coastal Sand Swamp Sedgeland, Coastal Sand Swamp Paperbark Scrub and Coastal Sand Swamp Scrub.
Corresponding Statewide Class*:* Coastal Freshwater Lagoons.
Swamp Sedgelands occur in the swales between sand dunes where the proximity of the sandstone bedrock impedes drainage and promotes pooling of water. Occurrences are small and scattered, occupying 2.63% of the study area. The most characteristic sedgelands are scattered through the Sand Heaths south of Tabbigai Gap. These sites carry a complex of reedlands, rushlands and herbfields which fringe open water or cover shallower soaks. Generally there is little woody vegetation with only scattered individuals of emergent small trees and shrubs. A complex array of sedgelands may be found including Twig-rushes (*Baumea* spp.), Saw-sedges (*Gahnia* spp.), and tall Spike Rush (*Eleocharis sphacelata*). These sedgelands can remain dry for long periods depending on recent weather and the level of the water table. The margins of the swamps/sedgelands support thickets of Paperbark with a mix of species often including Prickly-leaved Paperbark (*Melaleuca nodosa*) and Heath-leaved Banksia. In the south of the Kurnell Precinct, east of the road to Potter Point, an elongated swamp occurs that is mapped as Coastal Sand Swamp Scrub. This swamp holds water in its northern end for extended periods and in that end supports a mat of Coral Fern (*Gleichenia* sp.) and Cumbungi (*Typha orientalis*) with swampy areas containing Saw Sedge (*Gahnia sieberiana*), Swamp Banksia (*Banksia robur*) and Bottlebrush (*Callistemon* sp.). A deep small water body carrying Cumbungi also occurs near Yena car park. In the La Perouse Precinct a wetland occurs on Henry Head, though it has dried out in recent times (A. White pers. comm.) and has been invaded by weeds. Construction of the Coast Hospital Cemetery appears to have altered the local hydrology and now effectively bisects a complex of Coastal Sand Swamp Paperbark Scrub. Finally the drainage line above Cruwee Cove supports sedges and areas of Common Reed (*Phragmites australis*) with fringing patches of Coastal Rosemary and Paperbarks.

Swamp Forest

Vegetation Communities Included*:* Coastal Sand Swamp Mahogany Forest and in tact parts of Coastal Flats Swamp Mahogany Forest
Corresponding Statewide Class*:* Coastal Swamp Forests.
The Swamp Forests of the Kurnell Precinct have been greatly modified and are a shadow of their former glory. Commemoration Flat once supported a grassy open swamp forest which has now largely been replaced by picnic areas and park facilities. The upper reaches of Cooks Stream supported an area of open sedge-swamp that was substantially impacted by the construction of Cape Solander Drive in the 1960s (Benson and Eldershaw 2007). The area now mapped as Coastal Sand Swamp Mahogany Forest incorporates this former sedge-swamp and the drier margins of the former more extensive open swamp forest. The patch straddles Cape Solander Drive from the edge of the sand dune to the east, around the car parks and buildings to the edge of the picnic areas to the west. The picnic areas are not included in this habitat group as they are highly modified and incorporated as parkland below. However, a small patch of relatively in tact Coastal Flats Swamp Mahogany Forest occurs to the east of the Commemoration Flats picnic area, inland of Sutherland Point, which hence has been included in this Swamp Forest habitat group. The Swamp Forest habitat group is an open eucalypt forest with a dry to moist shrub layer and a ground cover of sedges, scramblers, forbs and ferns. Swamp Mahogany (*Eucalyptus robusta*) dominates the canopy layer above a low cover of Sweet Pittosporum, Banksias and Cheese Tree. The systematic fauna survey site established in this habitat group was centred in a stand of tall Broad-leaved Paperbark (*Melaleuca quinquenervia*).

Shoreline

Vegetation Communities and Other Environments Included: Beach Spinifex Grassland, Cliff-edge marsh and Grassland, Clifftop Sedges and Grasses (Unclassified) and shoreline habitats not mapped in DECCW (2009) being rocky shoreline, intertidal rock platforms and sandy beaches and foreshores.
This habitat group incorporates the variety of environments along the immediate shoreline of the study area. A very small narrow and long patch of Beach Spinifex Grassland is mapped at the northern end of Silver Beach, just south of Captain Cook Obelisk. This maritime grassland is sparse in cover and is dominated by the Hairy Spinifex (*Spinifex sericeus*), together with other species such as Pigface (*Carpobrotus glaucescens*) and Knobby Club-rush (*Ficinia nodosa*). The 'Cliff-edge marsh and Grassland' and 'Clifftop Sedges and Grasses' mapping units included in the vegetation mapping of DECCW (2009) are unclassified types that occur in small patches along the shoreline. They encompass patches of very low and scattered vegetation on exposed rock platforms, such as on Cape Banks 'island', on Henry Head and around seepages and soaks between Point Long Nose and Boat Harbour. As they only occur along the shoreline and are interspersed with bare rock platforms they have been included in this shoreline habitat group.

Parklands

Vegetation Communities and Other Environments Included: Estuarine Swamp Oak Forest, Coastal Flats Swamp Mahogany Forest where only canopy trees occur above mown turf, and open introduced turf/grasslands without a canopy (not mapped in DECCW 2009).
Commemoration Flat (north and north-west of the Discovery Centre) once supported a swamp forest or woodland with large Swamp Mahogany and a grassy understorey that probably inspired Cook's famous comment *the woods are free from under wood of every kind and the trees are at such a distance from one another that the whole Country or at least part of it might be cultivated without being oblig'd to cut down a single tree* (taken from Benson and Eldershaw 2007). This land however has been subject to cattle grazing, removal of trees for timber and firewood, alteration of drainage systems, mowing and lack of replacement tree recruitment (Benson and Eldershaw 2007). Today these forests are largely replaced by mown introduced grassland and park facilities, with the majority of areas patchily mapped as Coastal Flats Swamp Mahogany Forest and Estuarine Swamp Oak Forest primarily representing just canopy trees. For this reason Coastal Flats Swamp Mahogany Forest and Estuarine Swamp Oak Forest were not surveyed systematically and have been included in the Parkland habitat group. The exception is the patch of Coastal Flats Swamp Mahogany Forest inland from Sutherland Point which is relatively in tact and has therefore been included in the Swamp Forests habitat group. The remainder of the parkland habitat group is comprised of largely treeless mown turfed areas including north of Polo Street and west of Anzac Parade. Additionally, it includes buildings and associated gardens within high use areas.

Unassigned communities and map units

A number of vegetation communities do not fall into the habitat groups described above and are either: mapped within the study area at too small an extent to warrant inclusion as separate habitat types available to fauna; highly disturbed and comprised of a mosaic of habitat types and therefore do not represent a discrete mappable habitat group. These include: Coastal Sand Littoral Forest (6.88 hecs), Coastal Upland Wet Heath Swamp (0.16 hecs), Coastal Upland Damp Heath Swamp (0.25 hecs), Coastal Foredune Wattle Scrub (0.14 hecs), Coastal Freshwater Swamp Forest (0.17 hecs) and Beach Spinifex Grassland (0.21 hecs). Mapping units that have also been left out of the habitat groupings are 'Regenerating Shrubs', 'Urban' and 'Weeds and Exotics'. Similarly the incised rocky gorges that occur at Blue Hole and Tabbigai Gaps have not been allocated to a habitat group.

Coastal Sand Littoral Forest is mapped on sandy knolls west of Cape Solander Drive, south of Alpha Farm and inland from Inscription Point. These knolls would once have supported a low-growing scrub or low woodland of three to eight metres high dominated by Coast Banksia and Tree Broom-heath (Benson and Eldershaw 2007). The area however has been subject to a great amount of modification since European settlement including clearing, grazing, mowing, weed invasion, absence of fire, planting of exotic species such as the Norfolk Island Pine (*Araucaria heterophylla*) and planting of non-local native species such as Tallowwood (*Eucalyptus microcorys*) (Benson and Eldershaw 2007). Now a towering canopy of between twenty and twenty-five metres tall occurs (Benson and Eldershaw 2007). For a variety of reasons this vegetation type was not systematically sampled for fauna. Patches could be fit into the Parklands habitat group, but other patches essentially form a Wet Sclerophyll Forest. This vegetation community is classed as Kurnell Dune Forest in DECCW 2009, and endangered ecological community under the *TSC Act*. In order to profile the vertebrate fauna that currently inhabits this section of the park, further systematic surveys would be required.

Table 6: Summary of habitat groups and their relation to vegetation communities, statewide formations and statewide classes.

Habitat group label	Statewide formation (Keith 2004 as allocated in DECCW 2009)	Statewide class (Keith 2004 as allocated in DECCW 2009)	Vegetation community (DECCW 2009)
Littoral Rainforest	Rainforests	Littoral Rainforest	Coastal Dune Littoral Rainforest
Dune Forest	Dry Sclerophyll Forests	Coastal Dune Dry Sclerophyll Forest	Coastal Sand Apple-Bloodwood Forest
Dune Forest	Dry Sclerophyll Forests	South Coast Sands Dry Sclerophyll Forests	Coastal Sand Bangalay Forest
Sandstone Forest	Dry Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests	Coastal Sandstone Foreshores Forest
Sand Scrub	Heathlands	Coastal Headland Heaths	Coastal Tea-tree-Banksia Scrub
Sand Heath	Heathlands	Wallum Sand Heaths	Coastal Sand Mantle Heath
Sand Heath	Heathlands	Wallum Sand Heaths	Coastal Sandplain Heath
Sandstone Heath	Heathlands	Sydney Coastal Heaths	Coastal Headland Banksia Heath
Sandstone Heath	Heathlands	Sydney Coastal Heaths	Coastal Headland Cliffline Scrub
Swamp Sedgeland	Freshwater Wetlands	Coastal Freshwater Lagoons	Coastal Sand Swamp Paperbark Scrub
Swamp Sedgeland	Freshwater Wetlands	Coastal Freshwater Lagoons	Coastal Sand Swamp Sedgeland
Swamp Sedgeland	Freshwater Wetlands	Coastal Freshwater Lagoons	Coastal Sand Swamp Scrub
Swamp Forest	Forested Wetlands	Coastal Swamp Forests	Coastal Sand Swamp Mahogany Forest
Swamp Forest/Parkland	Forested Wetlands	Coastal Swamp Forests	Coastal Flats Swamp Mahogany Forest
Shoreline	Grasslands	Maritime Grasslands	Beach Spinifex Grassland
Shoreline	Unallocated	Unallocated	Cliff-edge marsh and Grassland
Shoreline	Unallocated	Unallocated	Clifftop Sedges and Grasses (Unclassified)
Parkland	Forested Wetlands	Coastal Floodplain Wetlands	Estuarine Swamp Oak Forest
Unassigned communities and map units	Various	Various	Coastal Foredune Wattle Scrub Coastal Freshwater Swamp Forest Coastal Sand Littoral Forest Coastal Upland Damp Heath Swamp Coastal Upland Wet Heath Swamp Regenerating Shrubs Weeds and Exotics

3.2.2 Assessing the relative conservation significance of fauna habitats

The Rapid Fauna Habitat Assessment of the SMCMA (DECC 2008a) identified 'Priority Fauna Habitats' in the Sydney area based on their '*exceptional importance for the conservation of vertebrate fauna, particularly threatened and regionally significant species and their restricted occurrence within the CMA'*. As a means of assessing the relative priority of habitats in KBBNP to the conservation of native fauna, the habitat groups defined herein were compared to the DECC (2008a) 'Priority Fauna Habitats' and assigned as priority habitat where a suitable match occurred. A course assessment was also made of the conservation value of other habitats present in the park that do not fall into a habitat group, such as artificial structures.

3.3 THREATS TO FAUNA

3.3.1 Identifying threats to native fauna

Effective management of the native fauna species and habitats in the reserve requires an understanding of the threats currently posed to these values. This project aimed to identify the threats currently acting in the study area, as well as threats that have the potential to emerge in the near future. Threats were identified on the following basis: Key Threatening Processes listed under the *TSC Act* and/or the *EPBC Act*; observations made during the 2007 and 2010 field surveys; expert knowledge of the vulnerabilities of particular fauna species; threats noted in published or unpublished literature; threats mentioned during discussions with park staff and naturalists during the course of the project.

3.3.2 Setting priorities for threats

To enable management to be targeted towards threats that pose the greatest risk to native fauna in the study area, all of the threats identified during the course of the project were classed and ranked as follows. These classes and rankings were derived from expert knowledge rather than quantitative assessment, and will require review and revision in the future when more comprehensive information on the local and regional conservation status of, or further research on threats posed to, each species becomes available.

Key Current Threats

A key current threat is one that currently threatens one or more High or Moderate Priority fauna species. Key current threats are prioritised as follows.

Very High*:* Known or potentially impacting more than half of the High Priority fauna species.

High: Known or potentially impacting less than half of the High Priority fauna species and/or over half of the Moderate Priority fauna species.

Moderate: Known or potentially impacting just one High or Moderate Priority fauna species.

Other Current Threats

Threats that currently have the potential to impact on fauna species not identified as High or Moderate priority species.

Future Threats

Threats that do not currently act within the study area but have the potential to become significant in the short to medium term future.

4 THE SPECIES INVENTORY

4.1 DOUBTFUL, UNCONFIRMED, NOT ESTABLISHED OR SPATIALLY INACCURATE SPECIES RECORDS

Following the field surveys and the review of fauna records undertaken for this study, several species previously recorded for the reserve were found to not currently exist therein. In order to make the species inventories provided in this report as accurate as possible, these species were removed from the inventory tallies. Table 7 provides a list of all non-pelagic species considered never to have had established populations within the study area (or a particular Precinct) and the reason they have been omitted from the inventories provided in this report. These species are only represented by records with high spatial inaccuracy, by unconfirmed sightings, probable mis-identifications or database errors, as well as introduced and non-local species that do not have established wild populations within the study area. They are presented here for reference, as the records remain in the Atlas of NSW Wildlife and it is possible that some of the species will be confirmed to be in the study area in the future.

Table 7: Doubtful, unconfirmed or spatially inaccurate non-pelagic species records, and non-local species that do not have established wild populations within the study area, that have been removed from the species inventories provided in this report.

Common Name	Scientific Name	Reason for omission from species inventory
Wallum Froglet – La Perouse Precinct Only	*Crinia tinnula*	This species is **well known from the Kurnell Precinct** where it currently occurs in the majority of Coastal Sand Swamp Sedgelands in the south of the park. However, a single record also exists in the Atlas for the La Perouse precinct, and it is this record that is in question. A single individual is recorded to have been observed near Henry Head in 1997. However the species is very difficult to identify without a call and this may be a misidentification or database error. A. White, an expert on the species, has undertaken targeted survey in the La Perouse precinct but never recorded the species. It is therefore considered not to currently occur in La Perouse.
Bibron's Toadlet	*Pseudophryne bibronii*	Single record from wetland near Henry Hill in 1997 in the Atlas. Species not detected during current surveys or during several years of surveys by A. White. Although potential habitat is present the species is not considered to currently occur.
Lesueur's Frog	*Litoria lesueuri*	Single record of low spatial accuracy in Kurnell Precinct on Atlas of NSW Wildlife from 1981. Not recorded on Kurnell Peninsula by White (in press) or during current surveys. More often associated with flowing streams. Possible mis-identification or database error.
Mountain Dragon	*Rankinia diemensis*	Three records from the early 1980s in the Atlas. Species not detected during current surveys or by White (in press). Probable mis-identification of the Jacky Lizard.
Common Pheasant	*Phasianus colchicus*	Recorded once in the Atlas in 1950 at Henry Head. Morris (1989) noted that an aviary escapee is regularly observed in the Congwong Bay – Henry Head area, with only males seen. A resident population is not currently known to exist in the park.
American Golden Plover	*Pluvialis dominicus*	Single record from 2009 falls within the study area but the locality is actually Boat Harbour. The species is a very rare vagrant to Australia.
Cockatiel	*Nymphicus hollandicus*	Single bird observed near the Discovery Centre during BSP surveys in February 2010. Presumably an aviary escapee.
White-cheeked Rosella	*Platycercus adscitus*	Small numbers present at Captain Cook's Landing Place (Morris 1989). A cross with Eastern Rosella has also been recorded. These birds are aviary escapees.
Western Rosella	*Platycercus icterotis*	Single aviary escapee seen near picnic area in Kurnell Precinct, 2010.
Superb Parrot	*Polytelis swainsonii*	Recorded once in 1995. Probably an aviary escapee.
Red-rumped Parrot	*Psephotus haematonotus*	Seen with rosellas near Discovery Centre (G. Ross pers. comm.). These sightings probably comprised aviary escapees.

Common Name	Scientific Name	Reason for omission from species inventory
Blue Bonnet	*Northiella haematogaster*	Seen with Rosellas near Discovery Centre (G. Ross pers. comm.). Aviary escapees.
Bourke's Parrot	*Neopsephotus bourkii*	Seen with Rosellas near Discovery Centre (G. Ross pers. comm.). Aviary escapees.
Indian Ringneck	*Psittacula krameri manillensis*	Seen in southern part of Kurnell Precinct in December 2010 (G. Steenbeeke pers. com.). Aviary escapee.
Star Finch	*Neochmia ruficauda*	Recorded at Henry Head in 1986 and noted in Morris (1989) at Cape Banks cemetery also in 1986. Aviary escapee.
Pig	*Sus scrofa*	Individuals occasionally released (G. Ross pers. comm.) but no wild population established.
Goat	*Capra hircus*	Individuals occasionally released (G. Ross pers. comm.) but no wild population established.
Sheep	*Ovis aries*	During the 2010 survey remains of Sheep were identified from a Fox/Dog scat collected south of Potter Point. However a wild population does not occur.

In addition to the species presented in Table 7 there are several old Museum records for the La Perouse and Kurnell areas which do not fall within KBBNP, but due to their low spatial accuracy could possibly have referred to sightings made within the study area. Records for the generic "Kurnell" area (spatial accuracy ten kilometres) include Tyler's Toadlet (*Uperoleia tyleri*) and Freycinet's Frog. Undated records for the generic "La Perouse" area include Greater Glider (*Petauroides volans*), Bandy-bandy (*Vermicella annulata*), Broad-headed Snake (*Hoplocephalus bungaroides*), Lowland Copperhead (*Austrelaps superbus*), Cunningham's Skink (*Egernia cunninghami*) and a record from 1974 of Spotted Grass Frog (*Limnodynastes tasmaniensis*). In addition to these records there are historical accounts of Spotted-tailed Quoll (*Dasyurus maculatus*) (Le Souef and Burrell 1926), Koala *(Phascolarctos cinereus*) (Salt 2000) and Dingo (*Canis lupus dingo*) (Salt 2000) for the Kurnell area, though again the specific location of these sightings is not known. Similarly there are historical reports of Red-backed Button-quail in the neighbourhoods of Botany and La Perouse (Hoskin 1991). Whether or not any of these species records refer to sightings made within the study area was not researched for this report.

4.2 PATTERNS OF LOCAL FAUNA LOSS AND DECLINE

Table 8 presents a list of species that are thought to have once been resident but are now considered to have been lost from the study area, together with justification for the assessment. These species are not included in the inventory tallies provided in this report. Of these species, those which have formal records from within the reserve boundaries are presented in Appendix B as *suspected species loss*; those which never had confirmed formal records from within the reserve have not been added to Appendix B, but are presented in Table 8 only. It must be noted that this list is derived from an assessment of current knowledge and is by no means definitive. There is little documentation of species present at the time of European settlement, so this list is likely to be an underestimate of what once occurred.

In addition to the fauna listed in Table 8, there are some species that are thought to have been lost from the La Perouse Precinct but still occur in the Kurnell Precinct. These include: Green and Golden Bell Frog (known from the Precinct during the 1960s but not recorded since 1993); Southern Emu-wren (no known record for the Precinct but known from Little Bay until 1935); Blackish Blind-snake (no formal record for the Precinct but considered by J. Cann (pers. comm.) to have occurred in the past but probably now gone); Small-eyed Snake (no formal record for the Precinct but considered by J. Cann (pers. comm.) to have occurred in the past but probably now gone) and Lace Monitor (no known records but can be assumed to have once occurred). There are two records of Tawny-crowned Honeyeater for the La Perouse Precinct on the Atlas of NSW Wildlife (from 1986 and 2002), but the species was not recorded during 2007 or 2010 surveys.

The failure to detect Brown Thornbill and Eastern Spinebill during the 2010 surveys is puzzling. Both of these species are known from urban bushland remnants, and the latter also occurs in urban parks and gardens. The only record of Brown Thornbill on the Atlas of NSW Wildlife is from Kurnell in 1950, though Morris (1989) notes the bird as an uncommon resident on the southern headlands and known

from Little Bay (near La Perouse) until 1935. Given the large amount of time spent surveying in suitable habitat for this species during the 2007 and 2010 surveys, yet the absence of any evidence of the bird, coupled with the fact that it would be a resident not a visitor, the Brown Thornbill is considered to lost from both Precincts of the park. The Eastern Spinebill is noted by Morris (1989) as being more common in the woodland and tall heath of the southern headland than on the northern headland. This contrasts with the results of the 2007 and 2010 surveys and other Atlas of NSW Wildlife records, where the bird has been recorded in low numbers in the La Perouse Precinct but not at all in the Kurnell Precinct. Hoskin (1991) notes the Eastern Spinebill to be less common across Sydney than formerly. The status of the Eastern Spinebill in the Kurnell Precinct thus remains uncertain, and though it may once have been more common and now declined in numbers, it is possible that it is still a seasonal visitor that was not present at the time of recent surveys but may still visit on occasion (A. Morris pers. comm.). Hence it has been retained in the species inventory for the Kurnell Precinct. The Yellow-rumped Thornbill is another species not recorded during the 2007 or 2010 surveys. This bird is not currently known from La Perouse Precinct, but was recorded at Little Bay up until 1929 (Morris 1989) and may still be found on the adjacent golf courses. It has been recorded once on the Atlas of NSW Wildlife in the Kurnell Precinct in 1981 and is noted by Morris (1989) as an uncommon resident. However, given the lack of recent records, the known declines across the Sydney area (Hoskin 1991) and the minimal amount of marginal habitat, this species is likely to only now occur as a rare visitor, if at all. As its status is uncertain it has been retained in the species inventory for the Kurnell Precinct, though a continued lack of records into the future would justify its removal from the list.

Table 8: Species suspected to have been lost from Kamay Botany Bay National Park

Common Name	Scientific Name	Reason for calling the species lost from the study area
Freycinet's Frog	*Litoria freycineti*	No known records on park but historic records for "Kurnell" area. Suitable habitat exists and the frog is common in similar habitats in Royal and Heathcote NPs. Considered likely to have once been established but now lost.
Rosenberg's Goanna	*Varanus rosenbergi*	No known record for KBBNP but suitable habitat existed and species still occurs in Royal NP. Considered possible to have once inhabited the park but now lost.
Common Death Adder	*Acanthophis antarcticus*	No known record for KBBNP but suitable habitat existed and species still occurs in the Royal/Heathcote/Garawarra reserves. Considered possible to have once inhabited the park but now lost.
Broad-headed Snake	*Hoplocephalus bungaroides*	No known records accurately attributed to within the park boundary, but historic records for "La Perouse" area. Potential habitat likely to once have occurred in the La Perouse Precinct. Considered possibly to have once been established in La Perouse Precinct but now lost.
King Quail	*Coturnix chinensis*	No records on Atlas of NSW Wildlife but was known from Botany Dunes (A. Morris pers. comm.). Suitable habitat occurs in small patches of wet heath and sedgeland. Considered likely to have once inhabited the park but now lost.
Painted Button-quail	*Turnix varius*	Known from a single record in the Kurnell Precinct from 1949. Morris (1989) considered that the species formerly may have been more common. Not recorded in recent decades and considered lost.
Red-backed Button-quail	*Turnix maculosa*	No known records from the park but is noted in Hoskin (1991) as not uncommon in the neighbourhood of Botany and La Perouse, up until the early 1900s. Suitable habitat occurred (A. Morris pers. comm.). Considered likely to have once occurred but now lost.
White-fronted Chat	*Epthianura albifrons*	Morris (1989) lists this bird as an uncommon resident while the Atlas of NSW Wildlife holds low spatial accuracy records for "Kurnell Peninsula" (1971), "Kurnell sand dunes" (1965) and Caltex oil refinery (1981). Would have once occurred in low numbers in the park but is now known to survive in only two locations in Sydney, one being Towra Point NR where less than 50 birds are thought to occur. Confidently considered lost from KBBNP.
Eastern Bristlebird	*Dasyornis brachypterus*	Morris (1989) lists this species as previously rare but now probably absent, with the last local confirmed record at Little Bay in 1921. Closest known surviving population is on the Woronora Plateau. Confidently considered lost from KBBNP.

Common Name	Scientific Name	Reason for calling the species lost from the study area
Superb Lyrebird	*Menura novaehollandiae*	Listed in Morris (1989) as a species that has "surely been extirpated since the time of first European settlement in the late 18th century".
Red-browed Treecreeper	*Climacteris erythrops*	Listed in Morris (1989) as a species that has "surely been extirpated since the time of first European settlement in the late 18th century".
Satin Bowerbird	*Ptilonorhynchus violaceus*	Listed in Morris (1989) as a species that has "surely been extirpated since the time of first European settlement in the late 18th century".
Rockwarbler	*Origma solitaria*	Listed in Morris (1989) as a species that has "surely been extirpated since the time of first European settlement in the late 18th century".
Spotted Quail-thrush	*Cinclosoma punctatum*	Listed in Morris (1989) as a species that has "surely been extirpated since the time of first European settlement in the late 18th century".
Eastern Ground Parrot	*Pezoporus wallicus wallicus*	No known records for KBBNP but suitable habitat exists (including some sedge species that are favoured food (M. Schulz pers. comm.)) and the species is known to have once occurred in similar habitats in Royal National Park and Malabar headland. Considered likely to have once inhabited the park but now lost.
Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*	Listed in Morris (1989) as a vagrant from a single record in Kurnell Precinct in 1962. The extent to which this species inhabited KBBNP in the past is not known, however given the abundance of the bird in similar habitats in Royal NP it is considered likely to have once been established but now lost.
Beautiful Firetail	*Stagonopleura bella*	No known record for KBBNP but suitable habitat exists and species still occurs in similar habitat in Royal NP. Considered likely to have once inhabited the park but now lost.
Brown Thornbill	*Acanthiza pusilla*	Listed in Morris (1989) as an uncommon resident in the southern headlands but only a single Atlas of NSW Wildlife record from 1950 and not recorded during the 2007 or 2010 surveys from either Precinct. Was known from Little Bay up to 1935 (Morris 1989). Considered to now be lost from both Precincts of the park. Loss is puzzling as it is known from many other urban bushland remnants.
Spotted-tailed Quoll	*Dasyurus maculatus*	Known from a report of an animal fighting with and killing a Cat in the Kurnell area (Le Souef and Burrell 1926). The species occurs in similar habitat elsewhere on the NSW coast (D. Andrew pers. comm.) and is considered likely to have once inhabited the Kurnell Precinct, but now lost.
Eastern Quoll	*Dasyurus viverrinus*	No known records from park but historical record from "Botany Swamp" which suggests the species may once have ventured into the Kurnell Precinct. Now presumed extinct from the Australian mainland.
Koala	*Phascolarctos cinereus*	Historical record from the Kurnell area; Salt (2000) states 'once so prolific on the Kurnell Peninsula, Koalas were shot as sport'. However there have been 'no Koalas living at Kurnell for nearly fifty years' (Salt 2000). There are no formal records from within KBBNP itself. Marginal habitat may once have occurred in the Swamp Forests of the Kurnell Precinct. Considered possibly to have once inhabited the park in low numbers but now lost.
Eastern Pygmy-possum	*Cercartetus nanus*	No known records but suitable habitat exists and the mammal is abundant in similar habitats in Royal NP. Considered likely to have once been established but now lost.
Sugar Glider	*Petaurus breviceps*	No known records but suitable habitat exists and the mammal is common in forest and woodland habitats in the Royal/Heathcote/Garawarra reserves. Considered possibly to have once been established but now lost.
Feathertail Glider	*Acrobates pygmaeus*	No known records but suitable habitat exists and the mammal occurs in forest and woodland habitats in the Royal/Heathcote/Garawarra reserves. Considered possibly to have once been established but now lost.

Common Name	Scientific Name	Reason for calling the species lost from the study area
Southern Brown Bandicoot	*Isoodon obesulus obesulus*	No known records from park but historical record from "Botany Swamp" which suggests the species may once have also utilised the Kurnell Precinct. Potential habitat occurs in heathland of both Precincts. The mammal has undergone dramatic decline in the southern Sydney region, but has recently been rediscovered on the Woronora Plateau. Considered likely to have once occurred but now lost.
Long-nosed Bandicoot	*Perameles nasuta*	No known records from park but potential habitat occurs and species is well known from Royal NP and the eastern Woronora Plateau. Considered likely to have once occurred but now lost.
Swamp Wallaby	*Wallabia bicolor*	No known records but suitable habitat exists and the mammal is abundant in similar habitats in Royal/Heathcote/Garawarra reserves and the Woronora Plateau. Considered likely to have once occurred but now lost
Native small ground mammal assemblage	Any of the following: *Sminthopsis murina, Pseudomys novaehollandiae, Antechinus stuartii, Rattus fuscipes*	No known records but potential habitat for these species exists. It is possible that some of these species never occurred in the Kurnell Precinct since the peninsula was an island until the deposition of the sand isthmus connected it to the mainland, however it is more likely that at least some native ground mammal species did occur and have since been lost.
Dingo	*Canis lupus dingo*	Historical records of Dingoes killing thousands of sheep set to graze in the Holt Estate in the 1860s and 1870s (Salt 2000). There are no formal records from within KBBNP itself, but the species is considered likely to have once occurred but now lost.

In addition to the species in Table 8 there are several wide ranging and/or nomadic fauna species that have suffered declines across their known range and hence are no longer recorded, or are far less frequently recorded, in the study area than they possibly once were. These species have largely been impacted by factors outside of the study area. These species, termed 'declining visitors', are not considered to be locally lost from the park as they may continue to visit habitats therein in the future, even if only sporadically or very infrequently. The species that fall into this category are: Regent Honeyeater, Swift Parrot, Lesser Sand-plover, Red-capped Plover, Pacific Golden Plover, Little Tern and Double-banded Plover. These species have been retained in the inventories provided in this report. The range of the Pacific Gull has contracted southwards with it being common on the Sydney beaches in the 1920s but now just a rare visitor, with most records attributed to mis-identifications of the similar-looking Kelp Gull (Higgins and Davies 1996). It is worth noting, however, that both Pacific and Kelp Gull have recently been observed (December 2010) at Sandringham during the wader counts (D. Andrew pers. comm.).

Another species worthy of note here is the Tawny Grassbird. Morris (1989) notes a record from the Kurnell refinery swamp in the early 1980s, while an individual was seen in Lantana dominated disturbed vegetation adjacent to the Potter Point car park during the 2010 surveys. The past and present status of this bird is uncertain. The study area is towards the southern limit of the species distribution, with reasonable numbers north of Wyong but relatively few records south of Sydney Harbour (A. Morris pers. comm.). Populations were known from the Illawarra, but these are known to have declined (Higgins *et al.* 2006). Whether a resident population of the Tawny Grassbird once occurred in the Kurnell area, or whether it was only ever a visitor, the species appears to have largely disappeared with only occasional individuals now seen. Also of note is the loss of the nesting site of Little Penguin from Cape Banks, where a 'sizeable' colony occurred until 1958 when the area ceased to be a military reserve (NPWS 2000). The Little Penguin is still, however, commonly heard from near coastal waters of both Precincts.

4.3 FAUNA SPECIES INVENTORY

A total of 190 native vertebrate fauna species are currently known to be residents in or visitors to the study area. This total is comprised of ten frogs, 28 reptiles, 138 native birds and 14 native mammals. In addition, seven introduced birds and seven introduced mammals have been confirmed to occur within the area.

Table 9 presents the total numbers of native, threatened and introduced fauna species recorded in the La Perouse and Kurnell Precincts separately. A complete list of all terrestrial vertebrate fauna species known to occur in each precinct is provided in Appendix B.

Table 9: Number of vertebrate fauna species known to occur in each Precinct.

	Kurnell Precinct	La Perouse Precinct
Total no. native fauna species known to occur	182	118
No. species listed as threatened on *TSC Act*	17	5
No. species listed as threatened on *EPBC Act*	4	1
No. introduced mammals	7	5
No. introduced birds	6	7

A total of 133 and 93 fauna species were recorded respectively in the Kurnell and La Perouse Precincts during the systematic surveys conducted in 2007 and 2010. The surveys resulted in the addition of 26 species not previously been recorded on the Atlas of NSW Wildlife for the study area. The systematic surveys resulted in the addition of approximately 1250 records to the fauna survey database, more than doubling the number of records for KBBNP.

4.3.1 Amphibians

The first frogs collected by Europeans on the Australian mainland were from Kurnell, probably the Green and Golden Bell Frog. Now a total of ten species of frog are known to occur in KBBNP. The four systematic nocturnal streamside searches and six pitfall trapping sessions that were undertaken in 2010 detected only five of these species, all ground frogs, reflecting the less than ideal conditions for frog activity during the time of the surveys. The remaining species were detected during diurnal herpetofauna searches, site spotlighting or incidentally during the DECCW surveys or during other surveys conducted by Dr. Arthur White.

Eastern Banjo Frog were captured in pitfall traps and also heard calling in several of the Swamp Sedgelands. Photo © D. Andrew/DECCW

The range of habitats available to frogs in the study area is small in comparison to some other reserves in the region, such as the Royal/Heathcote/Garawarra complex, limiting the frog fauna to species that will occupy ephemeral coastal sand swamp sedgelands, ephemeral soaks, or shallow ephemeral creek lines, as well as species that temporarily use the study area as peripheral non-breeding habitat. Ground frogs are the most frequently encountered, while the five species of tree frog have only been recorded on very few occasions. As elsewhere in the region, the most commonly recorded species is the Common Eastern Froglet which occurs almost everywhere that water pools for any length of time. Also common are the Brown-striped Frog, to a lesser extent the Eastern Banjo Frog, and in the Kurnell Precinct the Wallum Froglet. The Wallum Froglet is listed as Vulnerable under the *TSC Act* and reaches the southern extremity of its distribution at the Kurnell Peninsula. The study area has high conservation significance to this species and is considered critical to its ongoing occurrence in the Sydney Basin (see species profile in Section 5.2). The Green and Golden Bell Frog is also listed under the *TSC Act*, however it has only very rarely been detected in the study area in recent times with former sites no longer supporting the frog (see species profile in Section 5.2). High quality breeding habitat for the Green and Golden Bell Frog is well documented elsewhere on the Kurnell Peninsula with the Kurnell Precinct of KBBNP currently only providing potential foraging and movement habitat.

4.3.2 Reptiles

Twenty-eight species of reptile are known to utilise the study area, ranging from common resident species to rarely recorded species. This total includes one turtle, two geckoes, one legless lizard, thirteen skinks, two dragons, one monitor and eight snakes. The 27 systematic diurnal herpetofauna searches detected 21 of these species while the six pitfall trapping sessions detected just four. Two additional species were recorded incidentally during the 2010 surveys, while five species (Eastern Long-necked Turtle, Eastern Water Dragon, Blackish Blind Snake, Tiger Snake and Eastern Brown Snake) were not detected during the 2007 or 2010 systematic surveys.

None of the reptile species currently known to occur in the study area are listed as threatened under state or federal legislation. However, a number of the species have been identified as regionally

Lace Monitor was recorded for the park on the Atlas of NSW Wildlife for the first time during the 2010 surveys. Photo © N. Williams/DECCW

significant, including the Eastern Snake-necked Turtle, Lesueur's Velvet Gecko, Common Scaly-foot, Lace Monitor, Mainland She-oak Skink, Common Tree Snake, Black-bellied Swamp Snake and Tiger Snake (DECC 2008a).

The most frequently encountered reptiles in KBBNP are the Dark-flecked Garden Sunskink (53% of systematic herpetofauna searches), Jacky Lizard (33% of searches) and Copper-tailed Skink (30% of searches); the last species being particularly abundant in the La Perouse Precinct. These species will each occupy a range of the habitat types present and therefore are widespread across the park. The Three-toed Skink is more restricted in its habitat preferences, being common only in the open forest and wet forest habitat types, such as in the vicinity of the Discovery Centre in the Kurnell Precinct (recorded in 23% of systematic searches). The Eastern Water-skink was also detected during 23% of systematic reptile searches, and is widespread across the park particularly near drainage channels, sedgelands and seepage areas along the coastal zone.

The 2010 surveys resulted in the addition of seven reptile species for the study area to the Atlas of NSW Wildlife. The two species of Gecko recorded for the first time each appear to be relatively uncommon in the park. Interestingly, Lesueur's Velvet Gecko was recorded in high numbers right on the coast of the La Perouse Precinct, where it utilises cracks and crevices in the coastal cliffs and boulder piles. The Lace Monitor was also recorded for the first time on the Atlas of NSW Wildlife during the 2010 surveys, when single individuals were seen between Cape Solander Drive and the Discovery Centre in February and April. This species is rare on the Kurnell Peninsula, not having been observed during over thirty years of observations by local herpetologists and fauna consultants (White in press). The closest large population known is in Royal National Park to the south. The occurrence of Lace Monitor in the study area is therefore significant and suggests that KBBNP is important to the survival of the Lace Monitor in the southern suburbs of Sydney.

Lesueur's Velvet Gecko was found to be abundant around boulders and rock crevices of the La Perouse Precinct. Photo © E. Magarey/DECCW

The five species of reptile not detected during the 2007 or 2010 systematic surveys are each relatively rare in the study area. The Eastern Long-necked Turtle has only been recorded once in 1982 in the Atlas of NSW Wildlife and due to the lack of permanent pools is likely to only use the study area as a movement corridor or as transitory habitat after rain. In contrast the Eastern Water Dragon is probably resident in the La Perouse Precinct, but is restricted to the drainage lines on the western side of the peninsula. The Blackish Blind-snake is difficult to detect and may be more abundant than records indicate, though only where sufficient terrestrial shelter sites, such as rocks or logs, occur. The Blackish Blind-snake and Small-eyed Snake did once occur in the La Perouse Precinct also, but are now probably gone (J. Cann pers. comm.). The Tiger Snake is rare in the La Perouse Precinct but definitely still persists, having recently been seen on the headland near the Golf Course by the local Aboriginal community (J. Cann pers. comm.). Despite being a conspicuous species the Eastern Water Dragon has not been recorded from the Kurnell Precinct suggesting it is absent from this section of the park. Similarly no records exist in the Precinct for the Eastern Brown Snake, yet the species is noted in the Fire Management Plan (NPWS 2001a) suggesting that it occurs in very low numbers if at all. In contrast the Yellow-faced Whip Snake, Red-bellied Black Snake and Black-bellied Swamp Snake are each commonly encountered in the Kurnell Precinct, the latter particularly in the vicinity of Swamp Sedgelands.

Copper-tailed Skink is commonly seen around rocky areas of KBBNP. Photo © N. Williams/DECCW

4.3.3 Native birds

Southern Emu-wren are common in the Sand and Sandstone Heaths south of Tabbigai Gap. Photo © DECCW

One hundred and thirty-eight native bird species utilise the habitats in KBBNP to some extent, excluding aviary escapees, pelagic species and species considered lost from the park. The 38 systematic bird censuses detected 77 of these species, with an additional 31 species recorded incidentally during the 2007 and 2010 surveys. Several species previously known from the study area were not detected during the systematic survey periods. These species fall into four broad categories: shorebirds; visitors that were not present at the time of the survey but may still occur in the park from time to time; uncommon species that are likely to still be resident but went undetected; and species considered lost from the park. In general shorebirds (such as Plovers, Terns, Tattlers, Stints and Godwits) were poorly represented in the 2007/2010 data set as intertidal habitat was not targeted for systematic survey and one-off surveys are an inadequate way of sampling this group, with cumulative lists collected over extended periods being much more informative. Raptors and freshwater aquatic birds made up a number of the visiting species that were not detected during the systematic surveys, with additional examples including the White-naped Honeyeater (a rare winter migrant, Morris 1989), Scarlet Honeyeater (a rare visitor to southern headlands, Morris 1989), Olive-backed Oriole (rare occasional visitor, Morris 1989), Rufous Fantail which is likely to occur as a passage migrant, Brown Gerygone and potentially Regent Honeyeater or Swift Parrot the latter being most likely to occur between late autumn to early spring. Shining Bronze-cuckoo has not been recorded in the Kurnell Precinct since 1950; however this is a migratory species most plentiful in Sydney in spring (Hoskin 1991) and hence is likely to have been missed due to the timing of the recent surveys, but still be a visitor to both Precincts. Eastern Whipbird is an example of a species that is likely to still be resident (in this case in dense heathland and moist forested habitats) but so uncommon it is rarely detected. The inventory lists presented in Appendix B are annotated to distinguish species that are uncommon.

Nankeen Kestrel are commonly seen over the heathlands of KBBNP. Photo © M. Schulz/DECCW

A recent review of bird records across the nation identified numerous species that appear to have declined in numbers in recent years (Barrett *et al.* 2003). Of the species identified, Pacific Golden Plover, Double-banded Plover and Tawny-crowned Honeyeater occur in KBBNP. In addition, a number of species identified as regionally significant in DECC (2008) occur (though many only infrequently) including the Brown Quail, Eastern Reef Egret, Whistling Kite, White-bellied Sea-eagle, Swamp Harrier, Peregrine Falcon, Buff-banded Rail, Lewin's Rail, Spotless Crake, Latham's Snipe, Bar-tailed Godwit, Whimbrel, Grey-tailed Tattler, Ruddy Turnstone, Red-necked Stint, Red-capped Plover, Common Tern, Pheasant Coucal, White-throated Nightjar, Southern Emu-wren, Yellow-rumped Thornbill, Fuscous Honeyeater, Australian Pipit, Golden-headed Cisticola and Tawny Grassbird. As discussed in Section 5, of these species the Southern Emu-wren and Tawny-crowned Honeyeater have been identified as priorities for KBBNP. The most significant habitat types for these species within the park are the Sand Heaths, Sandstone Heaths and Swamp Sedgelands, which support good populations of both the Southern Emu-wren and Tawny-crowned Honeyeater and thus make an important contribution to the regional conservation of these species. These habitat types also

Lewin's Rail was detected using infra-red cameras in both the Kurnell and La Perouse Precincts including away from their typical sedgeland habitat. Photo © M. Schulz

provide habitat for smaller populations of some of the other regional significant species, particularly the Pheasant Coucal (located in Sand Heath and Swamp Sedgeland), Lewin's Rail (located in Swamp Sedgeland, Sandstone Heath and Sand Heath), Buff-banded Rail and Golden-headed Cisticola, while the raptor species commonly hunt over the heaths and swamps.

Double-banded Plover and Pacific Golden Plover were not included as priority species despite their listing by Barrett *et al.* (2003) as the study area does not support a regionally significant amount of potentially suitable habitat. Both these species are commonly encountered in the Boat Harbour/Merries Reef area and only infrequently range into the KBBNP. It is worth noting here the importance of the rocky reef and intertidal rock platform of Boat Harbour and Merries Reef as a high tide roost for migratory and non-migratory shorebirds. This site, immediately to the south of the study area, has high regional and statewide conservation significance for numerous shorebird species including a variety of threatened species, such as the Sooty Oystercatcher, Pied Oystercatcher, Lesser and Greater Sand-plovers, Great Knot, and Sanderling as well as a variety of Tern and Gull species (NSW Wader Study Group count data). This area was also used in the past as a nesting site by the endangered Little Tern (DECC 2008a). As discussed in Section 8 the proposed addition of Boat Harbour/Merries Reef to KBBNP is recommended.

This photo of Brown Quail was taken by an infra-red camera set up in the south of the Kurnell Precinct. Photo © DECCW. Brown Quail were very common at the time of the 2010 surveys.

Also of note are the several bird species which visit the park that are listed under the Japan-Australia Migratory Birds Agreement (JAMBA) and or the China-Australia Migratory Birds Agreement (CAMBA). These species are: Fork-tailed Swift, Ruddy Turnstone, Red-necked Stint, Lesser Sand-plover, White-bellied Sea-eagle, Grey-tailed Tattler, Caspian Tern, Bar-tailed Godwit, Whimbrel, Pacific Golden Plover, Little Tern and Common Tern.

The 2007/2010 surveys of the sedgeland, heath, woodland and forest habitats provided an informative snapshot of the composition of the diurnal terrestrial bird assemblage. As would be expected the most commonly recorded species were those that are abundant in both heath and woodland/open forest and are conspicuous and/or highly vocal including the New Holland Honeyeater (recorded during 82% of systematic censuses), Welcome Swallow (71%), Little Wattlebird (66%), Silvereye (66%), Australian Raven (63%) and Pied Currawong (61%). Also frequently detected during the systematic diurnal bird censuses were the White-browed Scrubwren (45% of sites), Australian Magpie (42%), Spotted Pardalote (39%), Superb Fairy-wren (39%), Grey Butcherbird (37%) and Rainbow Lorikeet (37%).

The diversity of raptors that have been recorded in the study area is worthy of mention as this group of birds is readily observed by park users as individuals soar along the coast line or hover above the heathlands in search of prey. Eleven species have been observed to date, the most commonly recorded being Nankeen Kestrel, followed by White-bellied Sea-eagle and Black-shouldered Kite. A Sea-eagle nest has been seen in the Kurnell Precinct (C. Ramsay pers. comm.), while Peregrine Falcons are likely to use the sea cliffs for nesting and roosting.

The nine Grass Owl pellets collected during the 2010 surveys were found to contain Black Rat, House Mouse and Brown Quail as prey items. Photo © E. Magarey/DECCW

The ten systematic nocturnal call playback censuses undertaken in 2007 and 2010 failed to detect any nocturnal birds, indicating the apparent scarcity of these species. The most exciting and significant discovery of the 2010 surveys, however, was of a Grass Owl which was detected during targeted searching of sedgelands west of Cape Baily lighthouse in the Kurnell Precinct. The species, listed as Vulnerable under the *TSC Act*, had been reported on NSW Birdline in July 2009. The recent re-sighting of an individual confirms the species ongoing use of the study area; the role the park plays for this species requires further investigation since the owl is very rarely observed in the Sydney Basin. Characteristic Grass Owl runways and pellets of varying age were detected in three sedgelands in the vicinity of Cape Baily (see map in Section 5.2). These locations were revisited in mid-April 2010, however at this time the owl was not seen nor were any new pellets found.

Interestingly, the BSP surveys of Royal National Park also resulted in the detection of a Grass Owl in March 2010 in dense coastal upland swamp. The Grass Owl is a poorly understood species, particularly within the Sydney Basin Bioregion which is located at the southern edge of its range. Therefore, these sightings contribute important information to knowledge of the species' ecology and distribution. The Powerful Owl, also listed as Vulnerable on the *TSC Act*, is much more common in the Sydney Basin Bioregion, with its ecology and habitat preferences well researched and understood (e.g. DECC 2007a). This species does not appear to be resident in KBBNP, though it has been recorded on three occasions in the taller forest near the Discovery Centre. Of the four other species of nocturnal bird that have been recorded in the study area the Southern Boobook and Tawny Frogmouth appear to be restricted to the forest and woodland habitats, being respectively detected during four and two of the spotlighting censuses in the north west of the Kurnell Precinct, and the Tawny Frogmouth also in dry sclerophyll forest in the La Perouse Precinct. The White-throated Nightjar on the other hand has been detected in the heaths as well as in woodland habitats (recorded on two occasions including on the road to Potter Point during the 2010 surveys). An Eastern Barn Owl has been seen on several occasions in the La Perouse Precinct, including near the Anzac Parade gate and near the houses in March 2010 (K. Donavan pers. comm.), while two individuals were seen in the Kurnell Precinct west of Alpha Farm in 2009 (G. Ross pers. comm.).

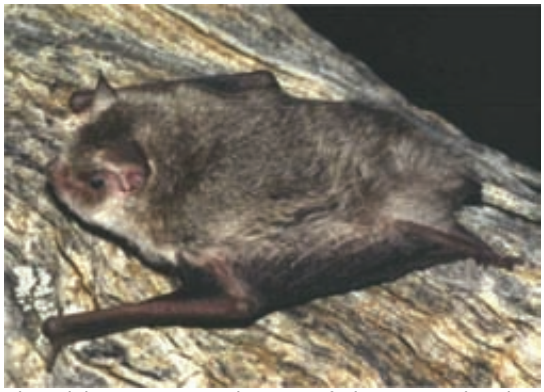
The Eastern Bentwing-bats that roost in the gun emplacements at Henry Head and Cape Banks also utilise tunnels at Malabar, where this photo was taken. Photo © M. Schulz/DECCW

Several marine bird species are included in the inventory of fauna species for the study area, though strictly pelagic species that do not come to shore to roost have been excluded. Some of these species can be readily and frequently observed as they roost or forage in the intertidal flats all year round, including Silver Gull, Crested Tern and various Cormorant species. The majority of other species occur either irregularly or when higher quality habitat elsewhere is disturbed. Rocky intertidal flats and exposed rocky reefs along the shoreline of the park, particularly around and to the south of Potter Point, at Sutherland Point, around Cape Banks, between Cape Banks and Henry Head and around Bare Island, provide foraging and roosting habitat for a number of shorebird species that have declined in numbers in the region and together with the reef and intertidal rock platform of Boat Harbour and Merries Reef would benefit from entire inclusion within KBBNP. The beach and intertidal areas on the north side of the Kurnell Precinct provide potentially suitable habitat for wader species and other waterbirds. However, due to the high level of public disturbance, including by Dogs and fishermen, currently these areas only support peripheral habitat. A 'sizeable' colony of Little Penguin formerly nested at Cape Banks until 1958 when the site ceased to be a military reserve (NPWS 2000). Pelagic species occasionally wash ashore in the study area and a variety of species can be seen off shore from vantage points such as Cape Solander (Appendix A).

There is the potential for further bird species to be discovered in the reserve in the future, or for species currently thought to be lost from the park to return. The fact that the Eastern Ground Parrot has recently been rediscovered in similar habitat elsewhere, including in 2006 in Malabar (two and a half kilometres to the north of the La Perouse Precinct) and in 2006/07 in the water catchment lands on the Woronora Plateau, lends hope to the possibility of the Eastern Ground Parrot being either rediscovered or recolonising KBBNP in the future. Potential habitat still exists in the Sand Heath, Sandstone Heath and Swamp Sedgeland habitat groups. It also possible that the Australasian Bittern (*Botaurus poiciloptilus*) may visit the Kurnell Precinct on rare occasions, since it is occasionally recorded visiting wetlands elsewhere on the Kurnell Peninsula (e.g. DECC 2008a, Morris 1989). The wetlands within the reserve are probably not extensive or permanent enough to regularly support this Bittern, however (A. Morris pers. comm.).

4.3.4 Native mammals

Fourteen species of native mammal are currently known to utilise KBBNP including one monotreme, two possums, nine bats and two seals. The manner in which these species use the park varies greatly, from resident animals such as the Common Brushtail Possum to rare visitors such as the Yellow-bellied Sheathtail-bat and animals that temporarily occur on a seasonal basis such as the Australian and New Zealand Fur-seals. The park's mammalian fauna was sampled by a variety of techniques during the 2007 and 2010 surveys. Systematic spotlighting searches detected the two possum species



The Little Forest Bat is one of the most abundant resident native mammals in the study area. Photo © N. Williams

and two bats, harp trapping for microbats detected five species, while bat ultrasonic call recording detected a different set of five species. The thirteen infra-red camera traps detected only one native mammal, the Common Brushtail Possum, while the 484 nights of Elliott trapping and 60 nights of pitfall trapping failed to capture any native mammals at all. This is a significant finding in itself which suggests that, with the exception of the Short-beaked Echidna, native terrestrial ground mammals do not currently occupy the study area. The fact that the Grass Owl pellets that were analysed in 2010 also did not contain any native mammal remains adds further weight to this suggestion.

Kamay Botany Bay National Park contains significant habitat for two threatened bat species, the Grey-headed Flying-fox and the Eastern Bentwing-bat. Of particular note are the roost sites for the Eastern Bentwing-bat in the old gun emplacements at Cape Banks and Henry Head (see Section 5.2 for further details). Six other bat species inhabit the study area; the most commonly detected being the Little Forest Bat and Gould's Wattled Bat. All six of these species roost in trees (Churchill 1998), though Gould's Wattled Bat has also been recorded roosting in storm water pipes near the gun emplacements (A. White pers. comm.). The occurrence of the Lesser Long-eared Bat is interesting as this species is not generally regarded to be common on the coastal sea board; in the Sydney region it is most frequently detected on the Cumberland Plain. During fauna surveys of the SMCMA the Lesser Long-eared Bat was found to occur in association with Swamp Oak (M. Schulz pers. comm.), while the species is rare in Royal NP where it has only been recorded adjacent to Bundeena (DECCW 2011). Recent surveys across the Kurnell Peninsula have found microbat species to be relatively abundant and to inhabit many small patches of remnant vegetation, postulated to be due to their ability to negotiate disturbed and modified environments (UBM Ecological Consultants 2009). This partly explains why the bat assemblage remains relatively rich while the ground mammal assemblage is extremely depauperate in the study area.

Only two species of arboreal mammal are known to be resident in the study area and only the Common Brushtail Possum appears to occur in significant numbers. During the 2007 and 2010 surveys this species was frequently detected in the vicinity of the Discovery Centre, where the Swamp Forest, Dune Forest and Sandstone Forest habitat groups provide suitable habitat. Common Brushtail Possums have not been detected in the Sand Heath or Sandstone Heath habitat types, although the species occupies moderate height heath on North Head (J. Dawson pers. comm.) and it is possible that it occurs in low densities here. The Common Ringtail Possum was not recorded on the Atlas of NSW Wildlife until the current project, when a single individual was seen during a spotlighting census in Dune Forest in the La Perouse Precinct and historical sightings were reported in the vicinity of the Discovery Centre in the Kurnell Precinct (G. Ross pers. comm.). This species is also known from nearby Towra Point NR (DECC 2008a). These results indicate that the Common Ringtail Possum is less common than the Brushtail on the southern headland, though further surveys on the northern headland may find the animal to be more numerous than records currently indicate, in the sheltered habitats on the western side of the peninsula. Both Common Brushtail and Common Ringtail Possums will occupy dense urban areas and hence are not isolated in the study area. They are, however, susceptible to predation by Foxes and to road mortality, both of which would keep their numbers in check in the locality.

The 2007 and 2010 surveys did not detect a number of the mammal species previously recorded on the Atlas of NSW Wildlife including the Yellow-bellied Sheathtail-bat, two Fur-seal species or the Short-beaked Echidna. The reasons for this are different for each animal. As described in Section 5 below, the Yellow-bellied Sheathtail-bat, listed as Vulnerable under the *TSC Act*, is considered to be a very rare visitor to the area and the park does not provide significant habitat for the species. The Australian and New Zealand Fur-seals, also listed as Vulnerable under the *TSC Act*, are seen irregularly when they haul out in the rocky intertidal and coastal zones of both the La Perouse and Kurnell Precincts. Records for these animals were added to the Atlas of NSW Wildlife as part of this survey project, from incident reports held by park staff. The seals usually come ashore simply to rest, though some are entangled in marine debris (K. Donavan, pers. comm.).

The Short-beaked Echidna, recognised as regionally significant in Sydney Metropolitan CMA (DECC 2008a), has been recorded just twice on the Atlas of NSW Wildlife, once in the La Perouse Precinct in

1996 (observed on Cape Banks Road) and once in the Kurnell Precinct in 2000 (tracks or scratchings seen on Tabbigai Trail). In addition Short-beaked Echidnas are reported to be intermittently released by locals into the La Perouse Precinct (P. Ibbetson pers. comm.). The fact that Short-beaked Echidna has not been recorded in the last decade does not necessarily mean it does not naturally occur, as this pattern of detection is fairly typical of the species which can easily go undetected when at low densities. The Short-beaked Echidna is capable of inhabiting a broad range of habitats as long as ants and termites are in plentiful supply (Augee 2008). However, it is threatened in urban areas by road mortality, habitat loss and fragmentation. The possibility that the Short-beaked Echidna is extant in the park, most likely occurring naturally in the Kurnell Precinct (as well as introduced in the La Perouse Precinct), has local conservation significance as the species is unlikely to persist through much of densely suburban Sydney. Therefore, the park (together with Towra Point NR) may provide important refuge habitat that may be key to its survival in southern Sydney. The Short-beaked Echidna is common in the Royal complex of reserves to the south (DECCW 2011).

The current mammalian assemblage in KBBNP is depauperate in comparison to the Royal/Heathcote/Garawarra reserve complex. As Grass Owls are predominantly hunters of small ground mammals the analysis of the nine pellets collected in 2010 was considered an excellent way of understanding which ground mammal species occurred within this section of the study area. Alas, only introduced rodents were identified from the pellets. The results of the current surveys, as well as fauna surveys elsewhere on the Kurnell Peninsula (e.g. UBM Ecological Consultants 2009), suggest that no native terrestrial ground mammals are extant in the study area, with the probable exception of the Short-beaked Echidna. There have been unconfirmed sightings of the Long-nosed Bandicoot near the Discovery Centre (obs. by J. Visser) and on Calsil Dune (Lesryk 1997), but no definite sightings or traces have been recorded. Other species that could once have occurred include Eastern Pygmy-possum (*Cercartetus nanus*), Brown Antechinus (*Antechinus stuartii*), Bush Rat (*Rattus fuscipes*), Swamp Rat (*Rattus lutreolus*), and possibly the Common Dunnart (*Sminthopsis murina*), New Holland Mouse (*Pseudomys novaehollandiae*) and Swamp Wallaby (*Wallabia bicolor*). In addition to these species, very old Museum records exist for the Eastern Quoll (*Dasyurus viverrinus*) and Southern Brown Bandicoot (*Isoodon obesulus obesulus*) at “Botany Swamp”, so there is potential that these species once also occupied the study area. The reason for the depauperate state of the mammal assemblage in the park has not been fully explored, but is likely to be a combination of habitat fragmentation and isolation, fire regime, predation by Foxes, predation by Greyhounds (G. Ross pers. comm.) and impacts from introduced rodents.

4.3.5 Introduced birds

Several species of introduced bird occur within the study area, including some that are widespread and well established and others that only exist at the urban-park interface. The Common Starling and Common Myna are the most frequently recorded and widespread residents across both precincts (Map 6). The Common Starling is abundant in the coastal zone of both precincts, with flocks often seen from the walking track between Cape Baily and Cape Solander, and birds recorded nesting in the sea cliffs. The Common Myna on the other hand is largely restricted to the dry woodlands and open forests in the vicinity of the Discovery Centre in the Kurnell Precinct, while in the La Perouse precinct it appears to be restricted to disturbed areas and the urban-bushland interface. As will be discussed in Section 8, both of these species are aggressive to hollow-dependent animals and thus have the potential to impact on native wildlife.

The remaining introduced bird species are more localised in their occurrence and are not currently well established in the Kurnell Precinct, although the Rock Dove roosts and probably nests in some parts of the sea cliffs between Cape Solander and Cape Baily. The La Perouse Precinct is much more susceptible to invasion by introduced birds due to its disturbance history, the prevalence of weeds and its small size in a highly modified local environment. The Eurasian Blackbird is currently only known from the La Perouse Precinct where it is a common resident in heathlands and woodlands, feeding on Bitou Bush and Lantana fruits (Morris 1989). Atlas of NSW Wildlife records for the species occur in the Jennifer Street portion, north of Henry Head and along the walking track

Both Australian Fur-seal and New Zealand Fur-seal (above) occasionally haul out in KBBNP including in highly visited public areas such as here at the Captain Cook Obelisk. Photo © G. Ross

that runs north from the main road linking Anzac Parade and the Golf Course. The primary threat that Eurasian Blackbirds pose to native wildlife is through preying on native invertebrates (Garnett and Crowley 2000). It is also implicated in the spread of invasive weed species such as Blackberry, Bitou Bush, Boneseed and African Olive (Cuneo and Leishman 2006, Loyn and French 1991, Dodkin and Gilmore 1984). The House Sparrow also appears to currently be absent from the Kurnell Precinct, but is resident in the La Perouse Precinct with records in the Jennifer Street portion and near Congwong Bay. The Red-whiskered Bulbul occurs in the Kurnell Precinct, but more commonly on the urban-bushland interface and disturbed areas in the La Perouse Precinct. Similarly, the Spotted Turtle-dove is restricted in its occurrence in the Kurnell Precinct to the Park edges, although it has been observed further inside the park boundary in dry woodlands along Yena Track. These two species and the Rock Dove have infiltrated the La Perouse Precinct to a greater extent, each being common residents (Morris 1989) that forage and breed in the park.

Records of Black Rat were collected at all of the infra-red camera points set up in the Kurnell and La Perouse Precincts. Photo © DECCW

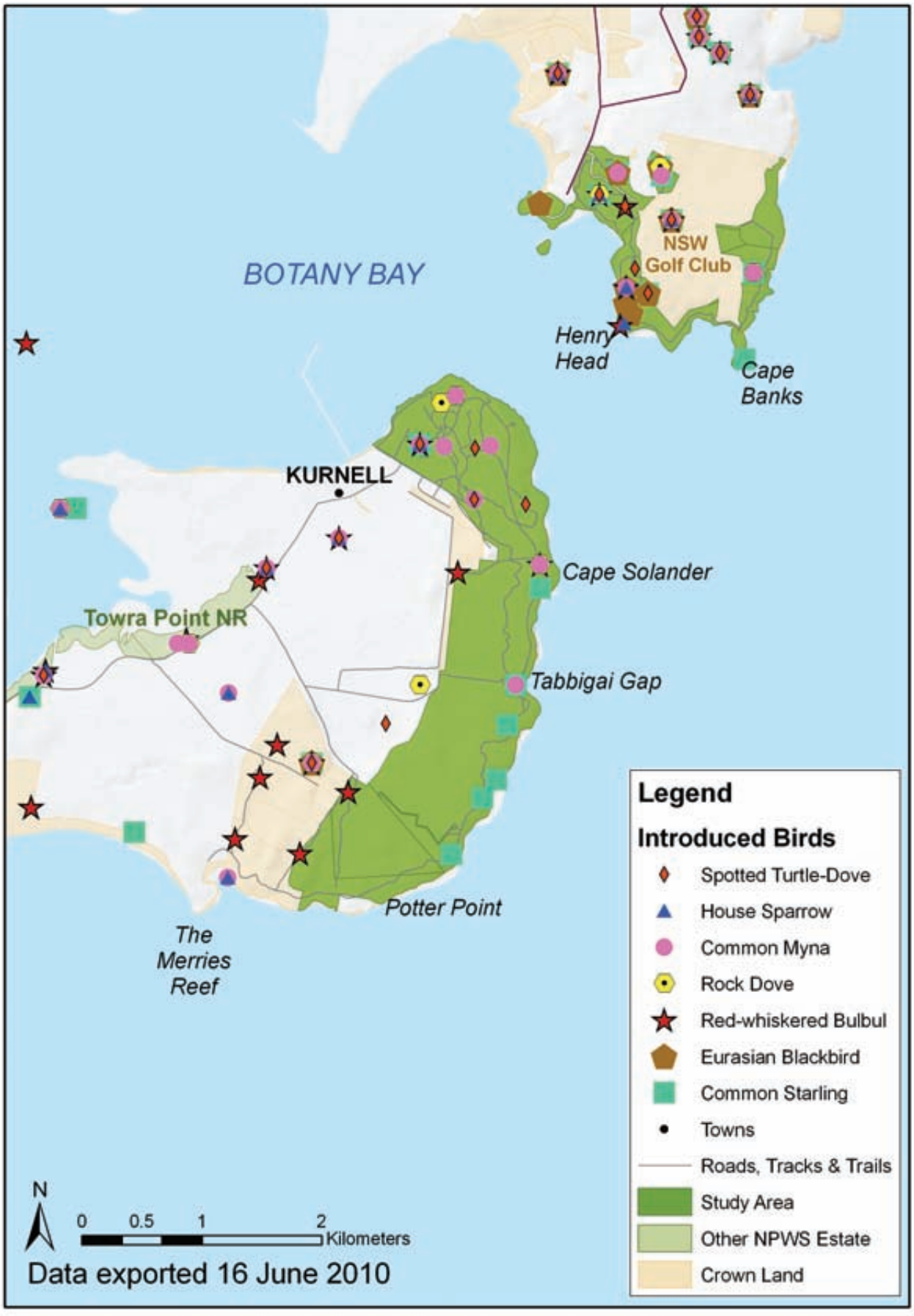
4.3.6 Introduced mammals

Seven species of introduced mammal are known from KBBNP including two species of rodent (House Mouse and Black Rat), two canids (Dog and Fox), Cat, Rabbit and Deer (presumably Rusa Deer). The Elliott and pitfall trapping and infra-red camera surveys undertaken in 2010 revealed the House Mouse and Black Rat to be very densely and widely distributed through the study area (Map 7). These animals were the only prey species detected in the Fox scats and Owl pellets analysed for the current survey, suggesting that their high numbers are largely responsible for sustaining both threatened and threatening predator species. Foxes are widespread and abundant in the reserve, regularly sighted by park staff and visitors in the La Perouse Precinct, and easily traced by their scats in the Kurnell Precinct. Predation by the Fox, listed as a Key Threatening Process, would be a contributing factor to the depauperate state of the native mammalian fauna in the park.

The problem of unsupervised Dogs in the park has abated somewhat in recent years. In the past Greyhounds roamed off leash in the Kurnell area, probably contributing to the decline of small native mammals (G. Ross pers. comm.). A decade ago Dogs were regularly seen in the La Perouse Precinct in packs of 4-5 individuals. Trapping and shooting by neighbouring landowners and police appears to have been successful in reducing Dog numbers, as in recent times only individuals or pairs of Dogs from neighbouring houses are seen intermittently (P. Ibbetson pers. comm.). Local Area staff continue to set traps from time to time in the La Perouse Precinct, but no Dogs have been captured for approximately five years (P. Ibbetson pers. comm.). Cats have been recorded in both the La Perouse and Kurnell Precincts through the location of footprints, trapping and incidental sightings, including during the 2007 and 2010 surveys. The extent to which these records are of widely ranging domestic Cats or feral Cats is not known. Presumed feral Cats are regularly seen in the La Perouse Precinct, while domestic Cats from neighbouring properties are frequently spotted near the edges of the park (P. Ibbetson pers. comm.). Cats are intermittently trapped and removed from this precinct, with the last concerted effort in 2008 capturing 13 animals in two and a half weeks, including both feral individuals and locally owned domestics (P. Ibbetson pers. comm.). Domestic Cats have also been seen near the edges of the Kurnell Precinct, such as at Polo Street (M. Hand pers. comm.), while feral Cats also exist through the Precinct, presumably moving between the park and surrounding industrial areas.

Rabbits are frequently seen near the edges of the La Perouse Precinct, feeding on the neighbouring Golf Courses (P. Ibbetson pers. comm.), but are also occasionally reported from deeper within the park such as on the track to Congwong Beach. Similarly, records exist near the boundaries of the Kurnell Precinct, but animals have also been seen near Yena Track and on the coastal fringe (G. Ross pers. comm.). Deer have been reported from the Kurnell Precinct and it is thought that at least two individuals occur including a large stag (C. Ramsay pers. comm., C. Shephard pers. comm.). These individuals are presumably Rusa Deer that are likely to have moved through Caringbah and Cronulla via Grays Point from Royal National Park, where a well established wild population occurs. Deer do not currently appear to be established in the study area but ongoing prevention of their expansion is a high priority management issue.

In addition to these species, Horse prints can readily be observed on the walking trails in the Kurnell Precinct, left by domestic animals that are ridden through the study area by local residents. Similarly, domestic Dogs are commonly brought into the park illegally. The impact that these domestic animals have on native fauna is unquantified, but domestic Dogs in particular are known to threaten the survival of shorebirds in other areas. This threat will be discussed further in Sections 5 and 7 below. Finally, Goat and Pig have occasionally been released into the Kurnell Precinct, however neither of these species have established wild populations.



Map 6: Distribution of introduced bird records in Kamay Botany Bay National Park

Map 7: **Distribution of introduced mammal records in Kamay Botany Bay National Park, excluding those listed as a Key Threatening Process**

5 PRIORITY SPECIES

5.1 FORMAT OF THE SPECIES PROFILES

Colour of the heading correlates to that used for animal groups in DECC (2007a) being amphibians, reptiles, diurnal birds, nocturnal birds, terrestrial mammals, arboreal mammals, bats and introduced species. Marine mammals are coloured differently as they are not included in DECC (2007a).

COMMON NAME		*Scientific name*
***EPBC Act*: Current listing**	***TSC Act*: Current listing**	**Study Area: Management priority ranking**

Photo of the species

Occurrence in the Study Area

This section details the species status in the study area, the findings of the current survey, a summary of other existing records, and a summary of habitat use and key locations.

Regional Conservation Significance

This section includes an assessment of the significance of the habitat within the study area to conservation of the species in the Sydney Basin Bioregion.

A map of known records of the species in the study area is provided; with only records having spatial accuracy of less than 100 metres, or an accurate place name, incorporated. Records with a low reliability of identification have not been incorporated on the maps.

Threats within the Study Area

In this section key threatening processes listed under the *TSC Act* 1995 and other threats relevant to the conservation of the species within the study area are identified. For species that are rare visitors or are unconfirmed in occurrence no threats are identified.

Management Considerations

A summary of key management considerations are provided. For species that are rare visitors or are unconfirmed in occurrence no management is identified.

5.2 NATIVE SPECIES

WALLUM FROGLET		*Crinia tinnula*
***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: High Priority**

Photo © M. Schulz

Occurrence in the Study Area

The Wallum Froglet is a common breeding resident of the Kurnell Precinct of KBBNP. It occurs in at least 13 sites, five of which were confirmed during the 2010 surveys of which three locations had not previously been documented. Within the park the frog is confined to the Coastal Sand Swamp Sedgelands south of Tabbigai Gap. There is no evidence to suggest a decline in the numbers of the Wallum Froglet on the Kurnell Peninsula. A recent study in the study area found the species to prefer ponds with a lower pH, higher temperature and higher salinity than the con-generic Common Eastern Froglet (Pyke and White in press).

A single record of Wallum Froglet occurs in the Atlas of NSW Wildlife in the La Perouse Precinct at the Henry Head wetland. However, the record is based on a sighting rather than from call identification. Since this species is extremely difficult to distinguish from the Common Eastern Froglet in the hand the record must be regarded as unconfirmed. Furthermore, the Henry Head site does not provide good quality habitat for the species (A. White pers. comm.). Dr. Arthur White, an expert on the Wallum Froglet, has searched La Perouse on several occasions in the last decade, especially Jennifer Street wetland and the wetland along the back of St Michaels Golf Course (where potential habitat does occur), and has never detected the species. Records do not exist in the neighbouring lands. Wallum Froglet is therefore not considered to occur in the La Perouse Precinct.

Regional Conservation Significance

The Wallum Froglet occurs in coastal swamps of southern Queensland and the northern half of NSW. The populations(s) at Kurnell form the southern limit of the species distribution and are somewhat of an outlier, not being discovered until 1995. Within the Sydney Metropolitan Area only a single other site is recorded on the Atlas of NSW Wildlife at the Landing Lights/Eve Street wetlands at Arncliffe. No other populations are known until near Gosford to the north (DECCW 2010a). Outside of the study area on the Kurnell Peninsula the Wallum Froglet occurs from just south of Continental Carbon north through wetlands on lands owned by Caltex (DECCW 2010a, A. White personal data). Together with the sites in KBBNP this population(s) and habitat are key to the survival of the species in the Sydney Basin Bioregion.

Threats within the Study Area

Silting up/infilling of water bodies; weed invasion (e.g. spread of Bitou Bush, overgrowth of ponds by aquatic plants); low water table; alteration of water table characteristics due to surrounding land activities; herbicide spraying; Chytrid fungus; changes to the physical/ chemical properties of the water; and possibly introduced predators e.g. Plague Minnow, Fox and Cat.

Management Considerations

As the species appears to currently be stable in the study area active management is not required. Key factors to instigate at this stage are: regular monitoring at known sites to ensure populations remain stable; scheduled survey of habitats to monitor key elements/threats such as water level, weed invasion and presence of the Plague Minnow.

GREEN AND GOLDEN BELL FROG *Litoria aurea*

EPBC Act: Vulnerable	*TSC Act*: Endangered	Study Area: High Priority

Photo © M. Schulz

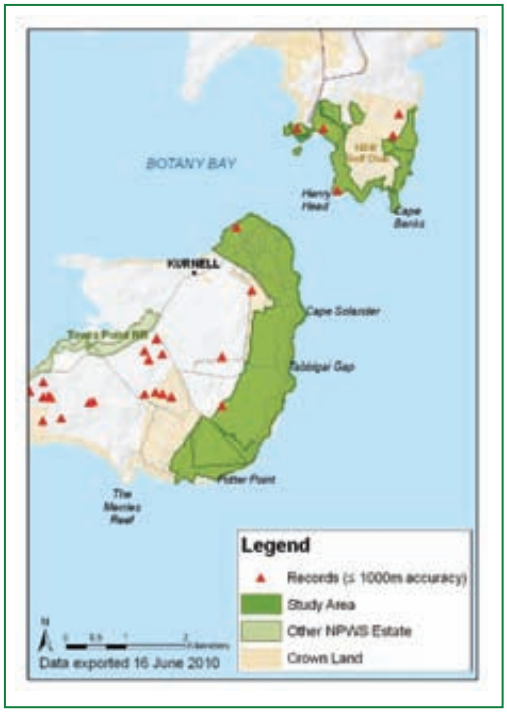
Occurrence in the Study Area

The Green and Golden Bell Frog was not detected during the 2007 or 2010 surveys, though survey conditions and timing were not ideal. This species has been the subject of extensive survey and study on the Kurnell Peninsula. Aerial photos of the Peninsula from 1954 show much more extensive lagoons and wetlands than currently exist, notably a large swamp complex immediately adjacent to the park where the Caltex oil refinery now stands. These swamps and lagoons would have supported a large population of Green and Golden Bell Frogs. In the 1970s, 22 breeding sites were known from the Peninsula but numbers declined during the late 1970s and 1980s and only five sites are known to remain today, all on private land and all in the south-western part of the Peninsula (A. White pers. comm., White in press). The Kurnell Precinct supported a component of the north-eastern sub-population of GGBF as recently as the mid 1990s (five males were collected near Solander Hill in 1993), but this sub-population is now locally extinct (DECC 2007b). Frogs may still visit the Precinct on a very irregular basis as they are capable of travelling large distances to forage or disperse; the frog found in the basement of Alpha Farm house in 1997 was likely to be a dispersing individual. A small amount of breeding habitat is still available to the GGBF in the semi-permanent and ephemeral waterbodies of the Kurnell Precinct.

Green and Golden Bell Frogs were once common in the La Perouse area, as they were throughout Sydney. In particular, records occur for St Michael's Golf Course (1965), the wetland near Henry Head (1965) and most recently a soak between Congwong Bay and the road to the Golf Course where calling was heard in 1993. The wetland at Henry Head was the most significant site in recent times, with calling heard there on more than one occasion during the late 1960s and early 1970s, though no spawn, tadpoles or froglets were ever observed (A. White pers. comm.). These latter sites are now often dry and the species is considered lost from the La Perouse Precinct (A. White pers. comm.).

Regional Conservation Significance

The Kurnell population is the second largest in Sydney and is key to the survival of the GGBF in the Sydney Basin Bioregion. Sites located on property owned by Australand are currently considered the most important, followed by those at Cronulla Sewage Treatment Plant (A. White pers. comm.). KBBNP is not currently considered critical to the regional conservation of the frog, however sections of the Kurnell Precinct do provide potential habitat (primarily as a movement corridor) that is likely to at times support the Kurnell population, and may play a greater role as foraging or breeding habitat in the future if unreserved sites are lost. The La Perouse Precinct does not contribute to regional conservation of the GGBF and is unlikely to do so in the future unless the frog is re-introduced and artificial habitat created.



Threats within the Study Area

Silting up/infilling of water bodies; weed invasion (e.g. spread of Bitou Bush, overgrowth of ponds by aquatic plants); low water table; herbicide spraying; native predators e.g. Red-bellied Black-snake; Chytrid fungus; introduced predators e.g. Plague Minnow, Fox and Cat.

Management Considerations

The Kurnell Precinct should be managed in accordance with the *Management Plan for the Green and Golden Bell Frog Key Population at Kurnell* (DECC 2007b). The La Perouse Precinct does not require any management actions unless the species is re-discovered or re-introduced.

SQUARE-TAILED KITE *Lophoictinia isura*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: Low Priority**

Photo © T. Tarrant/DECCW

Occurrence in the Study Area

Though a record for Square-tailed Kite falls just within the boundaries of the Kurnell Precinct of KBBNP, the flying bird was actually seen from Joseph Banks Drive. A second record from the same period (in 1996) exists for Captain Cook Drive, which is likely to have been an observation of the same individual. The species was not recorded during the 2007 or 2010 surveys. Square-tailed Kite is considered to be a very rare visitor to the area, but may occasionally forage over the habitats located in the park.

Regional Conservation Significance

The Square-tailed Kite is rarely detected in the Sydney Basin Bioregion, with most records from the greater Sydney area from the Cumberland Plain (DECCW 2010a). The study area does not contribute to the regional conservation of this species.

Threats in the Study Area

No threats identified.

Management Considerations

No management required.

OSPREY *Pandion haliaetus*

EPBC Act: Not Listed	*TSC Act*: Vulnerable	Study Area: Low Priority

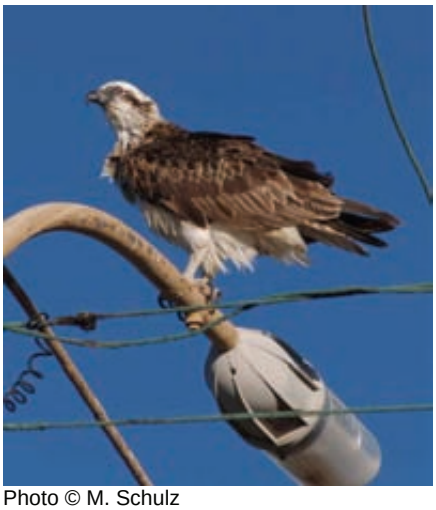


Photo © M. Schulz

Occurrence in the Study Area

Morris (1989) classed the Osprey as a rare visitor to KBBNP, with just a single bird recorded in January 1973. This record does not have associated location details other than a generic description of 'Botany Bay National Park' (and hence this record is not displayed in the map). The species was not detected during the 2007 or 2010 surveys. However, it is regularly observed in the lower reaches of the Georges River, such as around the junction of the Woronora River (DECC 2008a, D. Andrew pers. comm.) and occasionally in Port Hacking (DECC 2008a, DECCW 2011). A pair of Osprey has regularly been observed at Towra Point NR over the last couple of years, including at Quibray Bay and Stinkpot Bay (D. Andrews pers. comm.). Therefore the species would be expected to range into the Park on occasion. On such occasions it would utilise the Shoreline habitats including beaches, reefs and sea cliffs.

Regional Conservation Significance

The Osprey occurs infrequently in the Sydney Basin Bioregion, mainly as single individuals in coastal estuaries and waterways. There are few nesting records, with the exception of a pair that has nested on a number of occasions in the Narrabeen Lake area (DECC 2008a). More locally, the Osprey is regularly observed on the lower reaches of Georges River and along the ocean shoreline and in Port Hacking (DECCW 2011).

The study area does not contribute significantly to the regional conservation of this species.

Threats in the Study Area

No threats identified.

Management Considerations

No management required.

SOOTY OYSTERCATCHER *Haematopus fuliginosus*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: High Priority**

Photo © M. Schulz

Occurrence in the Study Area

The Sooty Oystercatcher regularly occurs on rocky intertidal areas and occasionally adjacent ocean beaches of both the La Perouse and Kurnell Precincts. It was recorded at four locations during the 2007 and 2010 surveys: Cape Banks, east of Henry Head, Sutherland Point and north of Potter Point. On previous occasions the species has been encountered between Henry Head and Congwong Bay and on Bare Island. The Sooty Oystercatcher is most commonly seen, however, in the far south of the study area, south of Potter Point, in numbers of up to 16 individuals (D. Andrew pers. comm.). Immediately south of the study area, on the rocky reef and intertidal rock platform of Boat Harbour and Merries Reef, is an important high tide roost for migratory and non-migratory shorebirds. Up to 23 Sooty Oystercatcher have been recorded at this location, which together with the rocky intertidal areas within KBBNP form important feeding and roosting habitat for the species (D. Andrew pers. comm.). Numbers of this species at this site are monitored as a component of the Botany Bay Wader Monitoring Program by the NSW Wader Study Group (WSG) and as part of the Birds Australia National Shorebird Monitoring Program. Morris (1989) classed the Sooty Oystercatcher as an uncommon resident, but it does not breed in KBBNP. The Sooty Oystercatcher that occur around Botany Bay are non-breeding visitors, probably originating from the nearest nesting site at Five Islands off Port Kembla (Straw 1996).

Regional Conservation Significance

The rocky reef and platforms at Merries Reef/Boat Harbour is the location where Sooty Oystercatcher are most frequently observed in the Botany Bay-Bate Bay area and provide foraging and roosting habitat that is critical to the regional conservation of the species. Though smaller numbers of Sooty Oystercatcher have been recorded within the park itself, the rocky shores of both the Kurnell and La Perouse Precincts nevertheless provide important supporting habitat which can also be considered significant to the species regional conservation.

Threats in the Study Area

Disturbance of birds by the public; bait and food collection of intertidal invertebrates by the public and fisherman; disturbance and predation by domestic Dogs facilitated by visitors in off-road vehicles to Boat Harbour (though Boat Harbour is outside the study area, this is a threat to birds that also utilise the park); pollution of inshore waters which impacts on intertidal invertebrates.

Management Considerations

- Erect signs similar to those erected by Wollongong City Council at key foraging/resting sites, in particular Cape Banks, Bare Island, Sutherland Point, and the rock platforms between Potter Point and Boat Harbour.
- Regular enforcement to reduce Dog disturbance between Boat Harbour and Potter Point.
- Continue to support monitoring of shorebirds at Boat Harbour/Merries Reef and other sites in Botany Bay by the NSW WSG.
- Extend the boundaries of KBBNP to include the rocky intertidal areas that border the park, particularly those at Boat Harbour/Merries Reef, as well as at Cape Banks and Cape Solander.

PIED OYSTERCATCHER *Haematopus longirostris*

EPBC Act: Not Listed	*TSC Act*: Endangered	Study Area: Moderate Priority

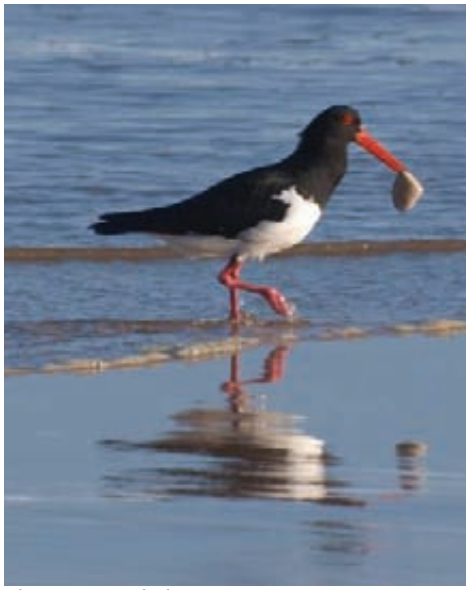


Photo © M. Schulz

Occurrence in the Study Area

The Pied Oystercatcher occurs in association with ocean beaches and estuarine sand and mudflats (Smith 1991) and is uncommon in KBBNP. It is not included in the bird list of Morris (1989) and has only been recorded on four occasions in the Atlas of NSW Wildlife including once during the 2010 surveys at Sutherland Point. The other three records have low spatial accuracy but are likely to derive from 'the vicinity of the Discovery Centre' in the Kurnell Precinct, most likely also from near Sutherland Point (note these three records have not been included on the map due to their low spatial accuracy). The species is not known from the La Perouse Precinct.

The Pied Oystercatcher does not nest in the study area, with records from March, May and June outside the breeding season (which is primarily between October and January).

Regional Conservation Significance

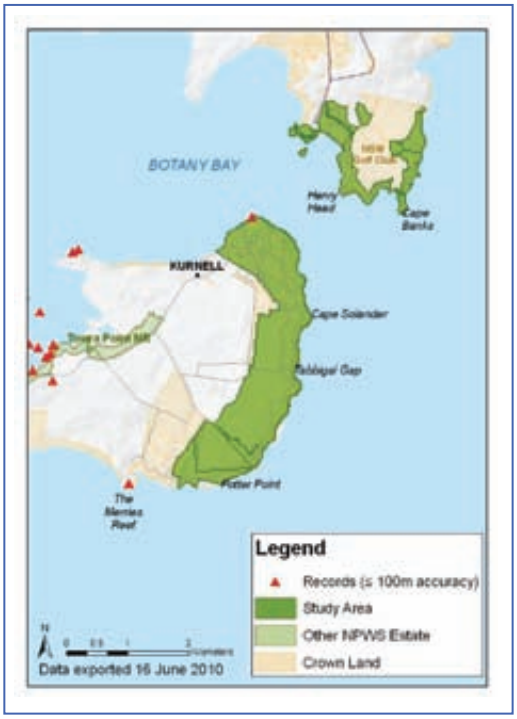
The Pied Oystercatcher has declined through much of its range in NSW, probably as a result of human disturbance. The species disappeared from beaches around Sydney at the turn of the century, but recolonised Botany Bay in 1973 (Rogers 1974). Numbers observed in Botany Bay increased dramatically during monitoring undertaken between 1972 and 1996 (Straw 1996). In Botany Bay numbers peak between mid-autumn and winter with a maximum of 71 individuals counted (NSW Wader Study Group count data). Most of these birds are non-breeding individuals, but members of the species do regularly nest in the Bay, such as at Towra Spit Island (Straw 1996). A minimum of three pairs and possibly up to six pairs nest regularly in the Botany Bay area (D. Andrew pers. comm.). The breeding population in Botany Bay comprises a significant component of the NSW population and has high regional and state-wide conservation significance. Intertidal areas in KBBNP provide supporting foraging habitat to this population, particularly in the Sutherland Point area.

Threats in the Study Area

Disturbance of birds by the public, particularly people with Dogs and fishermen; Fox predation; collection of intertidal shellfish such as pipis and cockles.

Management Considerations

- Continue to support monitoring of shorebirds in Botany Bay by the New South Wales WSG.
- In the event of nesting follow the best-practice guidelines for managing threatened beach-nesting shorebirds in NSW (DECC 2008b).



LESSER SAND-PLOVER *Charadrius mongolus*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: Low Priority**

Photo © T. Sugiyama/DECCW

Occurrence in the Study Area

The Lesser Sand-plover (or Mongolian Plover) is classed by Morris (1989) as an uncommon summer migrant, occurring from September to April in numbers of between 20 and 30 individuals on the rock platforms between Potter Point and Boat Harbour. The species has been recorded on two occasions in the Atlas of NSW Wildlife from the park, both between Potter Point and Doughboy Head (30 birds in 1950 and four birds in 1995). It was not detected during the 2007 or 2010 surveys. Morris (1989) and Straw (1996) noted that numbers of the species are declining in the local area, while numbers seen at Boat Harbour during NSW WSG surveys are low (1 to 3 individuals) compared to the numbers observed in the late 1980s and early 1990s (between 19 and 26 individuals). Such declines correspond to declines noted elsewhere within the state. Given this decline it is considered that the species is now likely to occur as a very rare visitor to the study area. The Lesser Sand-plover has not been recorded from the La Perouse Precinct (DECCW 2010a).

Regional Conservation Significance

Botany Bay is listed as a site of national and international importance to the Lesser Sand-plover with counts of over 200 birds in the past. However, numbers have gradually declined due to the loss of habitat (Hoskin 1991 in Straw 1996). The small numbers that now visit the Bay roost at Penrhyn Inlet and Boat Harbour and feed on the intertidal flats in the northern part of the Bay (Straw 1996). The coastline between Potter Point and Boat Harbour provides supporting habitat to the Botany Bay population. However, given that the species has not been recorded in the park since 1996 and may no longer be using this area, the contribution this habitat makes to regional conservation of the species is low.

Threats in the Study Area

Disturbance by the public, particularly rock fishermen, and potentially disturbance by domestic Dogs; and pollution of inshore waters which impacts on intertidal invertebrates. The primary threat to the species in Botany Bay, namely habitat loss, occurs outside the boundary of the study area.

Management Considerations

- Regular enforcement to reduce Dog disturbance between Boat Harbour and Potter Point.
- Continue to support monitoring of shorebirds at Boat Harbour/Merries Reef and other sites in Botany Bay by the NSW WSG.
- Extend the boundaries of KBBNP to include the rocky reef and intertidal areas of Boat Harbour/Merries Reef.

LITTLE TERN *Sternula albifrons*

EPBC Act: Not Listed	*TSC Act*: Endangered	Study Area: Moderate Priority

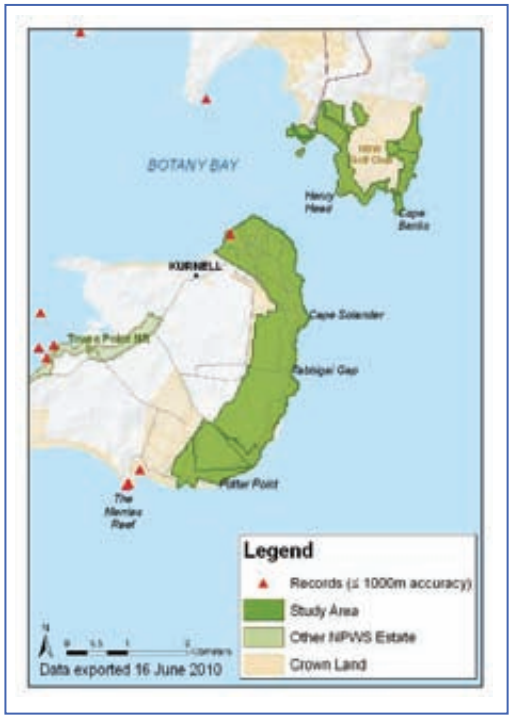
Photo © G. Ross

Occurrence in the Study Area

Only a single record of the Little Tern exists for the study area in the Atlas of NSW Wildlife, being of 11 birds seen near Captain Cook Obelisk in 2009. Morris (1989) lists the species as an uncommon summer vagrant to the park from September to April, though it does not meet the definition of the term 'vagrant' that is used in this report. The species was not recorded during the 2007 or 2010 surveys. In NSW the species nests on the ground in open areas on sandy substrate including on sand-spits, sand islands or beaches within or adjacent to river estuaries, creeks, coastal lakes and occasionally on ocean beaches (NPWS 2003a). Suitable breeding habitat does not exist within the park and the Little Tern has never been known to breed therein. Larger numbers of the species use Boat Harbour; Little Tern have been recorded there most years between 2002 and 2009 with a maximum of 37 individuals in November 2002 (NSW Wader Study Group count data), but nesting has not been recorded there since 1958/59 (NPWS 2003a). It is likely that individuals from Boat Harbour may temporarily rest on the rock platforms south of Potter Point including when subjected to disturbance at Boat Harbour/Merries Reef.

Regional Conservation Significance

Breeding Little Terns of the subspecies *sinensis* from eastern Australia and south-eastern Asia migrate southwards to NSW arriving between September and November, nest from October through to February then leave again from March to May, with winter records being very rare (NPWS 2003a). Non-breeding Little Terns from other Asian populations also migrate to Australia each spring and summer, however these populations are considered stable and do not require management (NPWS 2003a). Botany Bay supports one of the largest and most successful breeding colonies of the eastern Australian population of Little Tern remaining in NSW and is listed as a Priority Site for the Sydney region (NPWS 2003a). Currently the main nesting site in the Bay is Towra Spit Island. As mentioned above the species previously nested in low numbers on the sand spit at Boat Harbour, but this has not occurred for over fifty years (NPWS 2003a). As the study area does not provide any nesting habitat and birds only visit on an irregular basis, it is not considered to significantly contribute to the regional conservation of the Little Tern. The role that the study area does play is provision of potential temporary refuge habitat when birds get disturbed from other sites in Botany Bay and Merries Reef/Boat Harbour.



Threats in the Study Area

The primary threats posed to the Little Tern in Botany Bay are factors that reduce breeding success, including disturbance to nesting adults and chicks and nest predation (NPWS 2003a). As the species does not nest within the study area these threats do not operate herein. Birds may move to shorelines of the Kurnell Precinct when disturbed from adjacent sites such as Boat Harbour, for example by 4WD vehicles, fishermen or domestic Dogs. Individuals are likely to be impacted by pollution of inshore waters.

Management Considerations

- Regular enforcement to reduce Dog disturbance between Boat Harbour and Potter Point.
- Continue to support monitoring of shorebirds at Boat Harbour/Merries Reef and other sites in Botany Bay by the NSW WSG.
- Extend the boundaries of KBBNP to include the rocky intertidal areas of Boat Harbour/Merries Reef.

LITTLE LORIKEET *Glossopsitta pusilla*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: Low Priority**

Photo © H. Cook

Occurrence in the Study Area

The Little Lorikeet has not been recorded in KBBNP on the Atlas of NSW Wildlife or by Morris (1989), but is reported on the Birding Aus website by F. Hemmings who observed flocks of up to 30 birds feeding in Swamp Mahogany in the La Perouse Precinct in May 2007 (Birding-Aus 2010). Hemmings noted that this is the first time he had seen the species in the district for four years. The species was not recorded during the 2007 or 2010 surveys. However, it was recorded from nearby areas, such as Caringbah and Sylvania in April and May 2010 (M. Schulz pers. comm.). In the Sydney region the Little Lorikeet primarily feeds in the canopy of flowering eucalypts and avoids profusely flowering Banksias (Higgins 1999). Important flowering trees within the study area include Red Bloodwood and Swamp Mahogany (taken from Higgins 1999). Movements of Little Lorikeet are irregular with number of individuals present in a given area varying between years depending on the prevalence of key flowering trees. The Little Lorikeet is an irregular visitor to the study area since movements of this species are highly nomadic, sometimes with the species not returning to the same locality for a number of years. Foraging habitat occurs in Dune Forest, Sandstone Forest and Swamp Forest in the Kurnell Precinct, in stands of Swamp Mahogany in the La Perouse Precinct, and in Parkland areas where Swamp Mahogany trees remain.

Regional Conservation Significance

The Little Lorikeet has only recently been listed in NSW due to analysis of data collected between 1981 and 2005 that suggests at least a moderate reduction in population size over the last 15 years (NSW Scientific Committee 2009a). The species remains relatively common and widespread in the Sydney Basin Bioregion, including in the sandstone reserves west of the Cumberland Plain, such as Nattai and Blue Mountains NPs (DECC 2007a). It is a regular visitor in small numbers to Royal NP (DECCW 2011). Since the species has only been recorded on a single occasion to date, the study area is not considered to significantly contribute to the regional conservation of this species.

Threats in the Study Area

The major threats to the Little Lorikeet are loss of breeding sites and food resources from land clearing, which does not apply within KBBNP. However loss of feed trees, particularly the Swamp Mahogany is a key threat within the area, through loss of trees around picnic areas due to public safety concerns, death without regeneration, suppression of regeneration by weeds, altered soil hydrology and disturbance due to proximity to highly visited areas. Anything that inhibits flowering e.g. drought or timing of fire would reduce the availability of foraging resources. Infection by Beak and feather Disease is a Key Threatening Process.

Management Considerations

This species does not require any specific management action in the reserve other than ongoing protection of foraging habitat, in particular habitats that contain Red Bloodwood and Swamp Mahogany.

- Ensure the ongoing health of stands of Swamp Mahogany through maintenance of natural hydrology and assisting natural regeneration.
- Where necessary undertake prescribed burns in Dune Forest and Swamp Forest only when Swamp Mahogany and Red Bloodwood are not in flower and always leave patches of these habitat types unburnt.

SWIFT PARROT *Lathamus discolor*

***EPBC Act*: Endangered**	***TSC Act*: Endangered**	**Study Area: High Priority**

Photo © DECCW

Occurrence in the Study Area

There is a single record of the Swift Parrot in the Atlas of NSW Wildlife for 'Botany Bay National Park' from 1975 (spatial accuracy of ten kilometres and hence this record is not displayed in the map). Morris (1989) classes the Swift Parrot as a rare winter visitor, potentially coming to the study area in small flocks between June and September. The species spends spring and summer in Tasmania where it breeds, returning to the mainland for autumn and winter where it feeds predominantly on flowering eucalypts. The most important food tree species within KBBNP is the Swamp Mahogany (taken from Higgins 1999), although it may also feed on flowering Bangalay as observed in Royal National Park (Anyon-Smith 2006). The species was not recorded during the 2007 or 2010 surveys but only two visits were made to flowering Swamp Mahogany in early autumn. Potential foraging habitat occurs in Swamp Forest, Dune Forest and Parkland in Kurnell, and in La Perouse in patches of Swamp Mahogany. The number of individuals present at a given site varies greatly between years depending on the prevalence and distribution of key flowering trees, and thus it is possible that the Swift Parrot may return to the study area in the future even though it has not been seen there for many years.

Regional Conservation Significance

The total Swift Parrot population is estimated to be no more than 1000 pairs and is at best stable but may be continuing to decline, given the continued mortality of birds and the ongoing loss of habitat (Swift Parrot Recovery Team 2001). The Swift Parrot is relatively rare and patchily distributed in the Sydney Basin Bioregion, with important foraging areas including the Illawarra Coastal Plain, the Cumberland Plain, Burragorang Valley (DECC 2007a) and Narrabeen Lakes-Warriewood areas (2008). Few records of Swift Parrot occur within reserves. In the southern Sydney area the species is known to annually visit Bundeena (K. Madden pers. comm.) and one-off records exist for Cronulla Golf Course and Canberra Avenue Oval in Sylvania (DECCW 2010a). Although only a small number of old records exist for KBBNP, due to the fact that the species continues to visit other parts of southern Sydney it is considered that the park may still contribute to its regional conservation in some years.

Threats in the Study Area

The loss of key feed trees, particularly the Swamp Mahogany, is a key threat within the area through the loss of trees around picnic areas due to public safety concerns, death without regeneration, suppression of regeneration by weeds, altered soil hydrology and disturbance due to proximity to highly visited areas. Anything that inhibits flowering e.g. drought or timing of fire would reduce the availability of foraging resources to the species. Infection by Beak and Feather Disease is a Key Threatening Process.

Management Considerations

- Follow relevant management actions in the national recovery plan (Swift Parrot Recovery Team 2001).
- Ensure the ongoing health of stands of Swamp Mahogany through maintenance and restoration of natural hydrology and assisting natural regeneration.
- Where prescribed burns are necessary only undertake them when Swamp Mahogany and Red Bloodwood are not in flower and always leave patches of these habitat types unburnt.
- Survey areas of Swamp Mahogany and Bangalay during the Birds Australia annual Swift Parrot census.

POWERFUL OWL *Ninox strenua*

EPBC Act: Not Listed	*TSC Act*: Vulnerable	Study Area: Low Priority

Photo © N. Williams

Occurrence in the Study Area

The Powerful Owl has been recorded on three occasions within KBBNP, each near the Discovery Centre in the Kurnell Precinct. These sightings were made between 1995 and 1997. The species was also recorded just outside the boundary of the La Perouse Precinct at the NSW Golf Course in 2003. It is likely that this latter individual would have been foraging in the park at the time. The bird was not detected during the 2007 or 2010 systematic surveys, despite 10 nocturnal call playback censuses.

Characteristically Powerful Owls breed and roost in dense forest types, including rainforest and wet sclerophyll forest, but hunt in more open forests on arboreal mammals, particularly the Common Ringtail Possum in this area. Powerful Owl may also prey on Grey-headed Flying-fox and Sulphur-crested Cockatoo in the study area, the latter being recorded by B. Sullivan at Royal NP. It is possible that the species may occasionally roost in Littoral Rainforest, Swamp Forest and Sandstone Forest in the park, but no individuals appear to be resident (G. Ross pers. comm.) or breeding. KBBNP instead provides a small amount of foraging habitat for the species, though this is not of particularly high quality. The density of preferred prey species is relatively low. It is possible that the individuals recorded have been immatures or dispersing birds from further west where this species is relatively common, such as in the Engadine-Loftus areas.

Regional Conservation Significance

The Powerful Owl has not been recorded in the Atlas of NSW Wildlife elsewhere on either the northern or southern peninsulas, though an individual was reported in Caringbah in March 2010. However, it is known to nest in the Gymea Bay area and is common further west in the Loftus-Engadine area (DECC 2008a). Powerful Owls are well known from remnant bushland in both the southern and northern suburbs of Sydney, and have been recorded roosting for several weeks in highly urbanised areas such as the Royal Botanic Gardens. KBBNP provides a limited amount of habitat for the species which is likely to be used on a temporary or seasonal basis. However, given the lack of recent records, the restricted extent and relatively low quality of habitat, and the low density of arboreal mammals, the park is not considered to be of high regional conservation significance to this owl.

Threats in the Study Area

Low density of hollow-bearing trees is likely to affect this species, due to past clearing as well as the potential future loss of hollow-bearing trees as a result of hazard reduction burns and other management activities. In addition, the foliage roosts of the Powerful Owl are vulnerable to regular hazard reduction burning. The low density of prey species, particularly the Common Ringtail Possum, reduces the quality of potential foraging habitats within the park. If Powerful Owls did breed in the area, fledglings would be at risk of predation by Foxes.

Management Considerations

The Powerful Owl does not require any specific management actions in KBBNP other than ongoing habitat protection such as retention of hollow-bearing trees.

GRASS OWL *Tyto capensis*

EPBC Act: Not Listed	*TSC Act*: Vulnerable	Study Area: High Priority

Photo © J. Winter/DECCW

Occurrence in the Study Area

The detection of a Grass Owl in the Kurnell Precinct was the most exciting result of the 2010 surveys. This species can easily be overlooked due to its nocturnal habits, the fact that it uses wetland/sedgeland habitats that are difficult to access, and its probable highly sporadic occurrence. The bird had not previously been recorded in the Atlas of NSW Wildlife, but a sighting had been reported on line in July 2009 (Birdline NSW 2010). The sighting of an individual (flushed from dense sedgeland west of Point Long Nose) in February 2010 confirms the species ongoing use of the study area, or at least that it should not be considered a vagrant. The species roosts on the ground in the shelter of dense tussocks, sedges or reeds with regular roosting sites showing flattened vegetation littered with pellets and connecting tunnels through the grass (Higgins 1999). These characteristic runways were recorded in three sedgelands between Cape Baily and Blue Hole Gap in February 2010, while pellets of varying age were collected from the same locations. The locations were revisited in mid-April 2010, however at this time the owl was not seen nor were any new pellets found. The sedgeland near the lighthouse was revisited in December 2010, at which time one pellet was collected, considered to be reasonably fresh. This site was again visited in March 2011, when three very old pellets were located and collected. Analysis of the 13 pellets collected revealed remains of Black Rat (in 12 pellets), House Mouse (in two pellets) and Brown Quail (in one pellet). In NSW the Grass Owl breeds between March and May (Higgins 1999). No evidence of breeding was seen in 2010, however the sighting near the Lighthouse in 1999 was made in July when there is a chance the bird may have been nesting (Birdline NSW 2010). Interestingly, the BSP surveys of Royal NP also resulted in the sighting of a Grass Owl in March 2010 in coastal upland swamp.

Regional Conservation Significance

The Grass Owl is very rare in the Sydney Basin Bioregion with records from Homebush Bay and St Albans (Higgins 1999). In north-eastern NSW where this species is locally common it primarily occurs in rank pastureland, in addition to wet heaths, sedgelands on sandy infertile soils, in reedbeds and saltmarsh (Debus *et al.* 2001). The species can be irruptive in habit, moving into areas following influxes of rodents or quail. Due to the scarcity of records in the region, the species occurrence in the study area, even if only sporadic must be considered as highly significant. Further survey and monitoring would provide more information about the nature of its use of KBBNP, but in the mean time the study area, in conjunction with parts of Royal NP to the south and possibly around Magic Point to the north should be considered significant to the regional conservation of this species.

Threats in the Study Area

Predation by Fox or feral Cat; alteration of wetland hydrological characteristics; road mortality; use of rodenticides; potential disturbance to individuals and habitat areas if known sites become regularly visited by bird twitchers; inappropriate fire regime.

Management Considerations

- Conduct regular monitoring of sedgelands between Tabbigai Gap and Cape Baily to assess occupation rate and season, habitat usage, prey composition and whether the species breeds in the park.
- Ensure the current hydrological regime of Coastal Sedgelands Swamps is maintained.
- Avoid the use of rodenticides.
- In the event of nesting conduct targeted Fox control around the nest site(s).

SOUTHERN EMU-WREN *Stipiturus malachurus*

***EPBC Act*: Not Listed**	***TSC Act*: Not Listed**	**Study Area: High Priority**

Photo © H. Cook

Occurrence in the Study Area

The Southern Emu-wren is a common breeding resident of the Kurnell Precinct. During the 2007 and 2010 surveys the bird was abundant through the Sand Heath and Sandstone Heath habitat groups between Tabbigai Gap and Potter Point. North of Tabbigai Gap it was recorded on just two occasions. The Southern Emu-wren does not currently occur in the La Perouse Precinct, nor has it been recorded there in recent times, with it known from the Little Bay up until 1935 (Morris 1989).

Regional Conservation Significance

The Southern Emu-wren is not listed as a threatened species. It has been identified as a regionally significant species in the greater southern Sydney region (DECC 2007a) and Sydney Metropolitan CMA Area (DECC 2008a) due to a decreased rate of reporting in the Sydney Basin Bioregion (Barrett *et al*. 2003). The species has a patchy distribution in the southern Sydney area, mostly found in Upland Swamps and coastal heathland of the Woronora Plateau and Royal NP (DECC 2007a). The Kurnell Precinct of KBBNP provides a significant amount of habitat for the Southern Emu-wren and a sizeable population in a regional context, and thus is identified as priority species for the study area. The species also occurs in saltmarsh and sedgeland in Towra Point NR, while a single record exists for Magic Point to the north (DECCW 2010a). Due to the abundant status of this species in the study area compared to most other localities within the region, the Kurnell Precinct contributes significantly to the regional conservation of this species.

Threats in the Study Area

Habitat isolation/fragmentation leaving the species vulnerable to local extinction from stochastic events such as severe fire; predation by Fox, Cat and Black Rat; alteration of wetland and heathland hydrological characteristics.

Management Considerations

- Continue support for the development of wildlife corridors between Towra Point NR and the Kurnell Precinct as part of the Kurnell 2020 project.
- Ensure a mosaic of age classes of Sand Heath and Sandstone Heath and in the event of severe fire, where possible ensure that patches of this habitat type remain unburnt.
- Ensure the current hydrological regimes of Swamp Sedgeland, Sand Heath and Sandstone Heath are maintained.
- Control wide-ranging domestic Cats adjoining urban areas and maintain ongoing control of feral Cats.

EASTERN BRISTLEBIRD *Dasyornis brachypterus*

***EPBC Act*: Endangered**	***TSC Act*: Endangered**	**Study Area: Nil as Species Loss**

Photo © M. Schulz

Occurrence in the Study Area

There are no records of Eastern Bristlebird for KBBNP in the Atlas of NSW Wildlife and the species was not detected during the 2007 or 2010 surveys. Morris (1989) notes that the species was rare and is now absent from the area, with the last local record being from Little Bay in 1921. The bird may once have occurred in tall Sand Heath or Sandstone Heath in both the Kurnell and La Perouse Precincts, but given the lack of records it is considered to be lost from the reserve.

Regional Conservation Significance

The Eastern Bristlebird has undergone a severe range retraction and fragmentation, with only four major populations known to remain in the state, two of which occur in the Sydney Basin Bioregion (in the vicinity of Barren Grounds NR and in the Jervis Bay area, Chafer *et al.* 1999). No confirmed sightings have been made in the greater southern Sydney area for many years, despite extensive surveys of suitable habitat in protected areas such as Royal NP and the Woronora Plateau, and the species is regarded as locally extinct (DECC 2007a). Kamay Botany Bay NP does not contribute to the regional conservation of this species.

Threats in the Study Area

The Eastern Bristlebird is likely to always have been rare in the study area with its local extinction most likely attributable to a catastrophic event, such as severe wildfire, coupled with the inability to recolonise. It is also susceptible to predation by Foxes and Cats (Garnett and Crowley 2000), road mortality and invasion of habitat by weeds such as Bitou Bush (DEC 2005a).

Management Considerations

No management currently required.

WHITE-FRONTED CHAT *Epthianura albifrons*

EPBC Act: Not Listed	*TSC Act*: Vulnerable, Endangered Population in the Sydney Metropolitan Catchment Authority area	Study Area: Nil as Species Loss

Photo © M. Schulz

Occurrence in the Study Area

The White-fronted Chat has not been recorded in the Atlas of NSW Wildlife for the study area but is listed in Morris (1989) as an uncommon resident on the southern headlands in dune scrub and wetlands. The nearest records on the Atlas are from Little Bay (where breeding was recorded from 1929-1935 but no individuals have been recorded since that time); an Australian Museum record from 'Kurnell sand dunes" with a ten kilometre location accuracy from 1956; a record from 1971 for the "Kurnell Peninsula" again with a 10 kilometre accuracy; and finally a record of five individuals in 1981 in the wetlands south of Caltex oil refinery with a one kilometre spatial accuracy (DECCW 2010a). The closest known current population is in Towra Point NR. The White-fronted Chat is likely to have once occurred in low to moderate numbers within the park, utilising open habitats such as sedgelands, low heath, coastal areas and park edges. However, since it has not been recorded for several decades it is now considered to be lost from the reserve.

Regional Conservation Significance

The populations of the White-fronted Chat in the Sydney Metropolitan Area has severely declined and consequently have been listed as Endangered under the *TSC Act* with only two isolated sub-populations remaining, one at Newington NR near Homebush Bay and the second at Towra Point NR. The status of the Towra Point sub-population is uncertain, but has probably declined in the last 30 to 40 years (NSW Scientific Committee 2010). Given the lack of recent records from elsewhere on the Kurnell Peninsula and the lack of high quality habitat (saltmarsh) in KBBNP the study area is not considered to contribute to the regional conservation of the White-fronted Chat.

Threats in the Study Area

The White-fronted Chat's local extinction is most probably attributable to habitat isolation and fragmentation in combination with nest predation from feral Cats, Foxes, rodents and native predators, and human disturbance (taken from NSW Scientific Committee 2010).

Management Considerations

No management currently required. If the species is rediscovered within the study area it would warrant the Highest Conservation Management Priority.

The White-fronted Chat is vulnerable to human disturbance and is not found in built up areas (NSW Scientific Committee 2010). It is therefore unlikely that proposed wildlife corridors between Towra Point NR and the Kurnell Precinct would encourage the species to recolonise the study area.

TAWNY-CROWNED HONEYEATER *Gliciphila melanops*

***EPBC Act*: Not Listed**	***TSC Act*: Not Listed**	**Study Area: High Priority**

Photo © M. Schulz

Occurrence in the Study Area

The Tawny-crowned Honeyeater is a common breeding resident of the Kurnell Precinct. During the 2007 and 2010 surveys the bird was abundant through the Sand Heath and Sandstone Heath habitat groups between Tabbigai Gap and Potter Point. The Tawny-crowned Honeyeater is much rarer in the La Perouse Precinct with just two records in the Atlas of NSW Wildlife, at Henry Head (2002) and Congwong Bay (1986). The species was not recorded in La Perouse during the 2007 or 2010 surveys, with the only other recent records in the neighbourhood being from Magic Point in 1999 (DECCW 2010a). Morris (1989) notes the bird to be a rare visitor to the northern headlands, preferring low heathland. Recent surveys in Royal NP found the Tawny-crowned Honeyeater to be most prevalent in low coastal heathlands near sea cliffs (DECCW 2011). It appears that the Tawny-crowned Honeyeater does not currently occur in the La Perouse Precinct, possibly because habitat has become unsuitable for it. Being a mobile species, however, it could return in the future (A. Morris pers. comm.), potentially for example if the heath height is reduced by fire, and hence has been retained in the species list for the Precinct.

Regional Conservation Significance

The Tawny-crowned Honeyeater is not listed as a threatened species. It has been identified as a regionally significant species in the greater southern Sydney region (DECC 2007a) and Sydney Metropolitan CMA Area (DECC 2008a) due to a decreased rate of reporting across its range (Barrett *et al*. 2003). The species has a patchy distribution in the southern Sydney area, mostly found in coastal heathland of the northern Woronora Plateau and Royal NP (DECC 2007a). The Kurnell Precinct of KBBNP provides a significant amount of habitat for the Tawny-crowned Honeyeater and a sizeable population in a regional context, and thus is identified as priority species for the study area. Due to the abundant status of this species in the study area compared to most other localities within the region, the Kurnell Precinct contributes significantly to the regional conservation of this species

Threats in the Study Area

Predation from introduced mammalian carnivores and/or avian nest predators (Birds Australia 2003) including the Fox, feral and domestic Cat and Black Rat; inappropriate fire regimes including loss of a mosaic of different ages in heathlands; alteration in wetland and heathland hydrological characteristics; habitat fragmentation.

Management Considerations

- Ensure a mosaic of age classes of Sand Heath and Sandstone Heath and in the event of severe fire, where possible ensure that patches of this habitat type remain unburnt.
- Ensure the current hydrological regimes of Swamp Sedgeland, Sand Heath and Sandstone Heath are maintained.
- Control wide-ranging domestic Cats adjoining urban areas and maintain ongoing control of feral Cats.

REGENT HONEYEATER *Xanthomyza phrygia*

***EPBC Act*: Endangered**	***TSC Act*: Critically Endangered**	**Study Area: Low Priority**

Photo © DECCW

Occurrence in the Study Area

Small numbers of Regent Honeyeater have been recorded twice within the Kurnell Precinct in the Atlas of NSW Wildlife in August 1973 and May 1974. Morris (1989) classed the species as a rare visitor, but given the decline of the species across its range and the lack of recent records from the southern Sydney area, the likelihood that the Regent Honeyeater continues to visit the study area is very low. Key eucalypt food trees present within the region (i.e. Mugga Ironbark *Eucalyptus sideroxlyon* and White Box *E. albens*) do not occur within KBBNP (adapted from Higgins *et al*. 2001). However, less frequently used feed tree species including the Smooth-barked Apple and Swamp Mahogany do occur in both precincts of the park. If the Regent Honeyeater were to visit the study area again in the future it would be to Dune Forest, Sandstone Forest or Swamp Forest habitat types, most likely in the vicinity of the Discovery Centre.

Regional Conservation Significance

The Regent Honeyeater has severely declined in abundance across its range, including within the Sydney Basin Bioregion. Within the bioregion the species is principally recorded in the Capertee, lower Hunter and Burragorang Valleys and Central Coast with occasional sightings elsewhere (DECC 2007a, 2008). It is a sporadic visitor to the region with its occurrence dependent on the concentration of flowering of key tree species, and the absence of flowering elsewhere within its range. Due to the lack of sightings of the Regent Honeyeater from the park and neighbouring areas for several decades it is concluded that the study area does not contribute to the regional conservation of this species. However, KBBNP does provide peripheral habitat for the Regent Honeyeater in the form flowering food trees such as the Swamp Mahogany and Smooth-barked Apple. This habitat may be used if primary key eucalypt species fail to flower elsewhere within the bioregion or in other parts of NSW, such as during drought.

Threats in the Study Area

The primary cause of the decline in Regent Honeyeater numbers in NSW is land clearing elsewhere in the state. The main threat to the birds in the study area is a reduction in the quality of habitat for foraging, particularly associated with the loss of Swamp Mahogany around picnic areas due to public safety concerns, altered soil hydrology, inhibited regeneration or disturbance. Anything that inhibits flowering e.g. timing of fire would reduce the availability of foraging resources.

Management Considerations

- Survey areas of flowering Swamp Mahogany during the Birds Australia annual Regent Honeyeater census, particularly during times of drought.
- Follow relevant management recommendations outlined in the national recovery plan (Menkhorst *et al.* 1999).
- Ensure the ongoing health of stands of Swamp Mahogany through maintenance and restoration of natural hydrology and assisting natural regeneration.
- Where necessary undertake prescribed burns in Dune Forest and Sandstone Forest and Swamp Forest only when Swamp Mahogany and Smooth-barked Apple are not in flower and always leave patches of these habitat types unburnt.

GREY-HEADED FLYING-FOX *Pteropus poliocephalus*

EPBC Act: Vulnerable	*TSC Act*: Vulnerable	Study Area: High Priority

Photo © M. Schulz

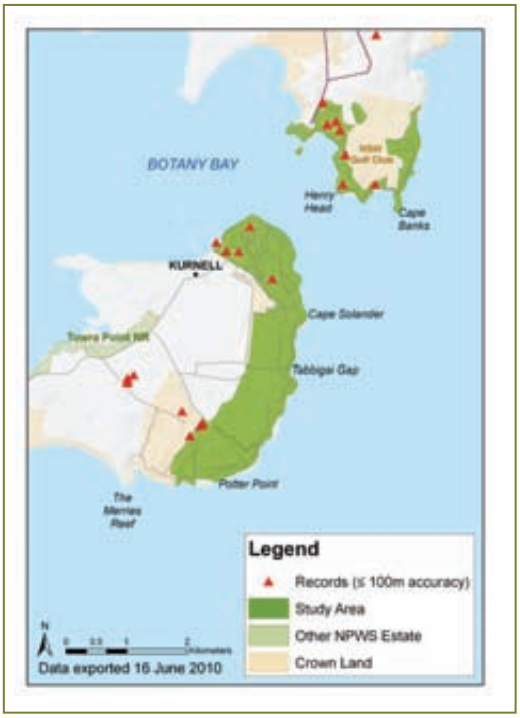
Occurrence in the Study Area

Somewhat surprisingly the Grey-headed Flying-fox had not been recorded for KBBNP in the Atlas of NSW Wildlife prior to the 2007 and 2010 systematic surveys. This reflects the low rate of public visitation to the park between dusk and dawn. During the 2007 and 2010 surveys the species was observed on 20 occasions and heard on an additional four, usually in ones or twos. Most notably in February 2007 approximately 100 bats were seen flying into the park near the Kurnell Precinct main entrance, while in 2010 ten individuals were seen in the gully line west of the Discovery Centre.

There are no Grey-headed Flying-fox camps in KBBNP; instead individuals formerly commuted from the camp at the Desalination Plant site and currently from the camp at Kareela and possibly from other camps at Oatley, the Royal Botanic Gardens and Cabramatta. The study area provides important foraging habitat for the species, particularly when key plants are in flower such as the Red Bloodwood, Smooth-barked Apple, Coast Banksia, Swamp Mahogany, Heath-leaved Banksia and various fruiting rainforest canopy and subcanopy trees. In the Kurnell Precinct records are restricted to the forest and woodland habitat types, namely Dune Forest and Littoral Rainforest and habitat supporting Coast Banksia and have not been detected in the coastal heathlands. However, foraging Grey-headed Flying-foxes in Royal NP in 2010 switched from targeting flowering Red Bloodwoods in forested habitats prior to April, to heathland areas between April and June where they targeted the nectar-abundant Heath-leaved Banksia, to Coast Banksia after late May (M. Schulz pers. comm.). It is therefore likely that the Sand Heath and Sandstone Heath in KBBNP also provides important foraging habitat to the species at different times of the year. In La Perouse the Grey-headed Flying-fox has been observed in the forest and woodland patches as well as in Sand Heath, and has specifically been observed feeding in flowering Coast Banksia.

Regional Conservation Significance

The Grey-headed Flying-fox is widespread across the Sydney Basin Bioregion, with approximately 16 camps present (Eby *et al*. 1999). A seasonal camp site occurs on the Desalination Plant Site at Kurnell, with total camp estimates at this location ranging from 1000 (April 2001) to 9700 (May 2007) (DECCW 2010a, DECC 2008a). This camp site is significant to the regional conservation of the species, though many individuals are currently using a camp at Kareela. As much of the high quality coastal foraging habitat for the Grey-headed Flying-fox in the Sydney Basin Bioregion is not located within conservation reserves KBBNP is considered important to the regional conservation of the species, particularly when there are food shortages elsewhere in the state.



Threats in the Study Area

Electrocution on powerlines; road mortality in the park and adjacent areas; loss of key flowering trees and shrubs.

Management Considerations

- Continue closure of the park between dawn and dusk and enforce road speed limits.
- Check electrocuted individuals for the presence of young (which can survive for a time even if the mother has been electrocuted) and seek help from wildlife carers as necessary.
- Encourage DECCW staff and park users to report electrocutions and identified hot spots which can be addressed.

YELLOW-BELLIED SHEATHTAIL-BAT *Saccolaimus flaviventris*

EPBC Act: Not Listed	*TSC Act*: Vulnerable	Study Area: Low Priority

Photo © H. Cook

Occurrence in the Study Area

The Yellow-bellied Sheathtail-bat has only been recorded once in KBBNP, when in April 2000 an apparently uninjured individual was found on the ground being attacked by birds near the Discovery Centre (DECCW 2010a). A specimen of the Yellow-bellied Sheathtail-bat is held at the Australian Museum that was collected in Torres Street, Kurnell (approximately one kilometre west of the main gate of the park) in March 1965. There is certainly no doubt about the identity of these individuals and the fact that the species can occur in the locality. However, the Yellow-bellied Sheathtail-bat is commonly considered to be a very rare visitor/vagrant in the Sydney area (DECC 2007a, 2008). There are no other records in neighbouring southern Sydney suburbs on the Atlas of NSW Wildlife, but one individual was found dead in Royal NP (DECCW 2011). Given the paucity of records for the study area and the region the Yellow-bellied Sheathtail-bat could at best be considered a very irregular visitor.

Regional Conservation Significance

The Yellow-bellied Sheathtail-bat is rarely captured in harp traps due to its rapid, high-flying behaviour. However, it is relatvely easily identified by its ultrasonic call which is partially audible to humans (Pennay *et al.* 2004). Very few individuals have been captured in the greater southern Sydney region while records based on Anabat identificationa are scattered across the area, particularly around the Holsworthy Military Area (DECC 2007a). However, a number of these records are of low or uncertain quality. The distribution, habitat preferences and status of the species in the Sydney Basin Bioregion therefore remains poorly understood. The species has been suggested to undertake a winter migration north to warmer areas, with reports from southern Australia existing only between January and June (Richards 1995, Shelley 2004). Habitat preferences for the species elsewhere in the region have been found to be fairly broad, but include fertile low-elevation open forests and woodlands of plains and valleys (DECC 2006). Given the uncertain status of the species within the region and the fact that only a single record exists for the park, the study area does not contribute significantly to the regional conservation of this species.

Threats in the Study Area

No threats identified.

Management Considerations

No management currently required.

EASTERN BENTWING-BAT *Miniopterus schreibersii oceanensis*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: High Priority**

Photo © N. Williams

Occurrence in the Study Area

The most important roost sites for the Eastern Bentwing-bat within the study area are the decommissioned gunnery emplacements on Henry Head where the species regularly roosts. The species has been observed at this location on several occasions since 1995, with between 30 and 40 individuals detected at the site during the DECC surveys in March 2007 (DECC 2008a). The Eastern Bentwing-bat also irregularly roosts in smaller numbers in the gun emplacements at Cape Banks (White 2007). The bats that utilise these gun emplacements move between these sites and tunnels at Malabar Headland; the latter being used more frequently (A. White pers. comm.). The Eastern Bentwing-bat has been recorded on two occasions in the Kurnell Precinct; three individuals were captured in a harp trap at Blue Hole Gap during the 2007 surveys and one record was obtained from an ultrasonic call recording west of the Discovery Centre during the 2010 surveys. The species is likely to forage more widely across the study area than these records suggest, although it has only infrequently been detected elsewhere on the Kurnell Peninsula (DECCW 2010a) suggesting the species is not very common there. Roost sites have not been located in the Kurnell Precinct but it is possible that the roosts exist in the sea caves or in tunnels or other structures associated with industrial facilities adjacent to the site. The Eastern Bentwing-bat does not breed within the study area, but travels to congregate at maternity roosts up to 300 kilometres away (DECC 2009a).

Regional Conservation Significance

The Eastern Bentwing-bat is widespread across the Sydney Basin Bioregion, occurring in a wide range of habitats including in urban areas (DECC 2007a, 2008). There are no confirmed maternity roost sites in the bioregion. Due to the existence of the regularly used non-maternity roost site at Henry Head, the irregularly used site at Cape Banks and the possibility of further roost sites in sea caves, the study area is considered to be significant to regional conservation of the Eastern Bentwing-bat.

Threats in the Study Area

The primary threat posed to the Eastern Bentwing-bat in the study area is disturbance of the roost sites at Henry Head and Cape Banks by members of the public. Incorrect gating of the gunnery tunnels has the potential to cause the bats to abandon the sites. Roosting bats are also vulnerable to predation from Foxes and feral Cats.

Management Considerations

- Any gating installed in the gunnery emplacements should follow guidelines in the *Australian handbook for conservation of bats in mines and artificial cave-bat habitats* (Thomson 2002) and to be done in consultation with the Australasian Bat Society.
- Discourage public access to the gun emplacements by erection of signs or barriers that do not obstruct bat access (see first point).

AUSTRALIAN FUR-SEAL *Arctocephalus pusillus*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: Low Priority**

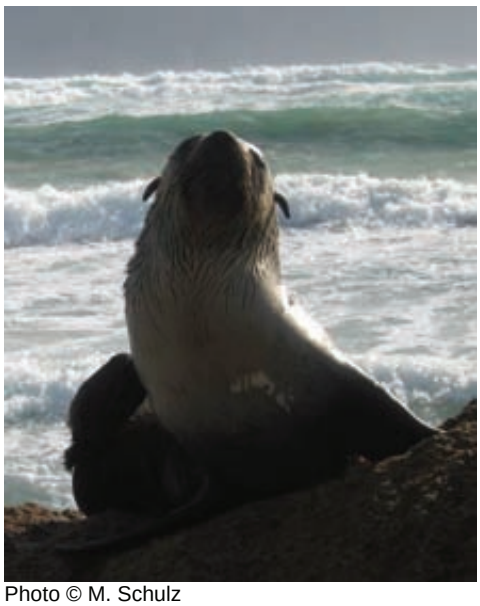


Photo © M. Schulz

Occurrence in the Study Area

Australian Fur-seals are infrequently recorded in the study area by park residents, rangers and field officers; records from these sources were added to the Atlas of NSW Wildlife as part of the current project. This species was not recorded during the 2007 or 2010 surveys. Examples of haul outs sites include Yena Picnic Area, indicating that the species will use areas subject to high public visitation. Most Fur-seals that come ashore do so just to rest (G. Ross pers. comm.). In addition to the animals that come ashore, unidentified Fur-seals can be seen loafing in the water just off the rocks of the sea cliffs (Appendix A). Rock shelves and flat coastal areas within the study area may be significant to the survival of individuals using coastal waters offshore of the study area as they provide a relatively safe environment to temporarily rest.

Regional Conservation Significance

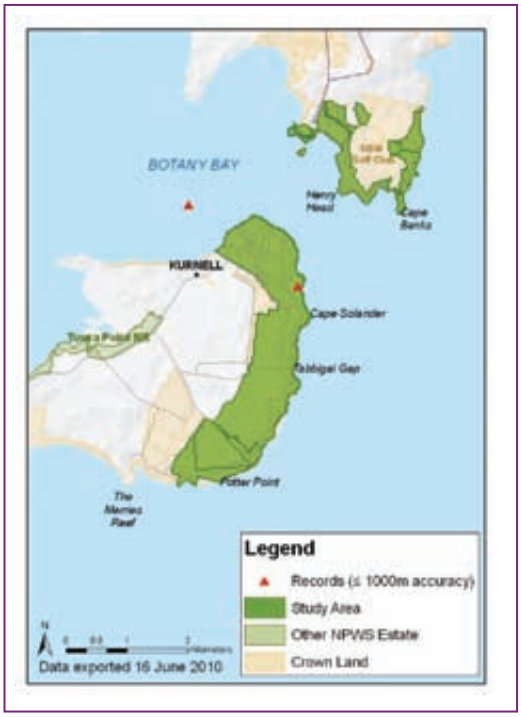
The Australian Fur-seal is a non-breeding visitor to coastal waters of the Sydney Basin Bioregion. The species comes ashore (known as haul-out) irregularly at various locations along the coast, but no places in the bioregion constitute key haul-out sites (the closest regularly used site is at Steamers Beach, south of Jervis Bay, NSW Scientific Committee 2008d). Given that the species does not haul-out in the study area in large numbers or on a regular basis, KBBNP is not considered to significantly contribute to bioregional conservation of the species.

Threats in the Study Area

Threats to the species on or near the shore of the study area include: accidental entanglement in fishing gear; public disturbance and harassment; collision with boats and other marine traffic.

Management Considerations

- For Seals found ashore follow the *Standard Operating Procedures for Pinniped Haul Outs* (DECCW 2010b).
- Ensure records of Seal sightings and haul-out situation report forms are stored in a central location to enable monitoring of numbers over time, and add records to the Atlas of NSW Wildlife periodically.



NEW ZEALAND FUR-SEAL *Arctocephalus forsteri*

***EPBC Act*: Not Listed**	***TSC Act*: Vulnerable**	**Study Area: Low Priority**

Photo © M. Schulz

Occurrence in the Study Area

New Zealand Fur-seals are infrequently recorded in the study area by park residents, rangers and field officers; records from these sources were added to the Atlas of NSW Wildlife as part of the current project. This species was not recorded during the 2007 or 2010 surveys. Examples of haul out sites include Captain Cook Obelisk, indicating that the species will use areas subject to high public visitation. Most Fur-seals that come ashore do so just to rest (G. Ross pers. comm.), but some are entangled in fishing debris (K. Donavan pers. comm.). In addition to the animals that come ashore, unidentified Fur-seals can be seen loafing in the water just off the rocks of the sea cliffs (Appendix A). Rock shelves and flat coastal areas within the study area may be significant to the survival of individuals using coastal waters offshore of the study area as they provide a relatively safe environment to temporarily rest.

Regional Conservation Significance

The New Zealand Fur-seal is a non-breeding visitor to coastal waters of the Sydney Basin Bioregion. The species comes ashore (known as haul-out) irregularly at various locations along the coast, but no places in the bioregion constitute key haul-out sites (NSW Scientific Committee 2008e). Given that the species does not haul-out in the study area in large numbers or on a regular basis, KBBNP is not considered to significantly contribute to bioregional conservation of the species.

Threats in the Study Area

Threats to the species on or near the shore of the study area include: accidental entanglement in fishing gear; public disturbance and harassment; collision with boats and other marine traffic.

Management Considerations

- For Seals found ashore follow the *Standard Operating Procedures for Pinniped Haul Outs* (DECCW 2010b).
- Ensure records of Seal sightings and haul-out situation report forms are stored in a central location to enable monitoring of numbers over time, and add records to the Atlas of NSW Wildlife periodically.

5.3 INTRODUCED SPECIES

DOG *Canis lupus familiaris*

EPBC Act: Not Listed	*TSC Act*: Key Threatening Process

Photo © M. Schulz

Occurrence in the Study Area

Records of Dog in the study area in the Atlas of NSW Wildlife do not distinguish between roaming domestic Dogs and feral Dogs. While the listing of predation by Dogs as a Key Threatening Process refers to feral animals, since domestic Dogs can also have an impact in urban parks such as KBBNP, unsupervised domestic and feral animals will be discussed together here. There are currently seven records of Dogs in the KBBNP, spread across the Kurnell and La Perouse Precincts; all of these were derived from scats or tracks with no actual sightings entered. The pattern of Dog use of the park is better understood by local park staff. A decade ago Dogs were regularly seen roaming the La Perouse Precinct in packs of 4 to 5 individuals. Trapping and shooting by neighbouring landowners and police appears to have been successful in reducing Dog numbers, as in recent times only individuals or pairs of Dogs from neighbouring houses are seen intermittently (P. Ibbetson pers. comm.). Local Area staff continue to set traps from time to time in the La Perouse Precinct, but no Dogs have been captured for approximately five years (P. Ibbetson pers. comm.). In the past Greyhounds roamed off leash in the Kurnell area, but this no longer occurs (G. Ross pers. comm.). Wandering Dogs have not been noted in the Kurnell Precinct in recent years (M. Hand pers. comm.), though people continue to walk domestic Dogs in the park illegally, particularly in the Potter and Sutherland Point areas (e.g. observed in current survey).

Impacts in the Study Area

Predation and hybridisation by feral Dogs is listed as a Key Threatening Process under the *TSC Act*, though it is only predation by Dogs that is relevant to the study area. Dogs, both those that are feral and some that are associated with human habitation, can exert a high intensity of predation pressure on native fauna, especially medium to large macropods (Mitchell and Banks 2005 in NSW Scientific Committee 2009b). Even domestic Dogs that are heavily reliant on humans for sustenance nonetheless may hunt native fauna in nearby bushland and nature reserves and can be a serious problem to native fauna if uncontrolled (NSW Scientific Committee 2009b). Species in the study that are known to be threatened from predation by Dogs include the Pied Oystercatcher and Little Penguin, and possibly in the past the Eastern Ground Parrot. Dogs that roamed in the Kurnell area in past decades probably contributed to the decline of small native mammals (G. Ross pers. comm.). Domestic Dogs that are allowed to roam off-leash by visitors to the Boat Harbour/Merries Reef area cause major disturbance to shorebirds and roosting birds such as the Little Tern in that vicinity and the same would be true for Dogs let off the leash in the vicinity of Potter Point and to a lesser extent in the Sutherland Point area.

Management Considerations

- Continue trapping program for wild Dogs as necessary.
- Regular enforcement to stop domestic Dogs being brought into the park.
- Raise public awareness of the impact that free roaming domestic Dogs have on native fauna and encourage neighbours to always keep their Dogs under control.

Fox *Vulpes vulpes*

EPBC Act: Key Threatening Process	*TSC Act*: Key Threatening Process

Photo © M. Schulz

Occurrence in the Study Area

The Fox is common and widespread in KBBNP. The large majority of records in the Atlas of NSW Wildlife are derived from scats and tracks, though individuals are commonly sighted by park staff and users, particularly in the La Perouse Precinct. During the 2007 and 2010 surveys the species was detected in all habitat groups except Littoral Rainforest and Swamp Forest though it is known to occur in these habitats too and appears to be ubiquitous across the study area. The analysis of 32 scats collected during the 2007 and 2010 surveys revealed the presence of Common Brushtail Possum and Black Rat as mammalian prey species.

Impacts in the Study Area

Predation by the Fox is listed as a Key Threatening Process due to the major threat posed to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5 500 grams and ground-nesting birds at greatest risk (NSW Scientific Committee 2008a). Reptiles and amphibians are also preyed upon, although the impact of this predation on the herpetofauna present within the park is unknown. Predation by the Fox is most likely one of the factors that has contributed to the apparent extirpation of almost all native ground-dwelling mammal species from the study area. Threatened species that continue to be particularly at risk include the Little Tern and Grass Owl if either were to nest in the study area as well as roosting Eastern Bentwing-bats and the regionally significant Southern Emu-wren and Tawny-crowned Honeyeater.

Management Considerations

- Continue the current Fox control programme on the Kurnell Peninsula with ongoing focus on key sites and habitats. For KBBNP Kurnell Precinct key habitats include: along the shoreline in the Potter Point area and in the Sutherland Point area; wetland areas between Cape Baily and Tabbigai Gap; nesting sites of the Grass Owl should they be discovered; Sand Heath and Sandstone Heath habitat types.
- For La Perouse Precinct focus Fox management on Sand Heath and Sandstone Heath habitat types and around the entrance of the Henry Head and Cape Banks gun emplacements to protect roosting Eastern Bentwing-bats.
- Support a cross-tenure approach to Fox management through cooperation and integration of programmes with neighbouring landholders.
- Undertake feral Cat control in concert with any Fox baiting programmes.

CAT *Felis catus*

***EPBC Act*: Key Threatening Process**	***TSC Act*: Key Threatening Process**

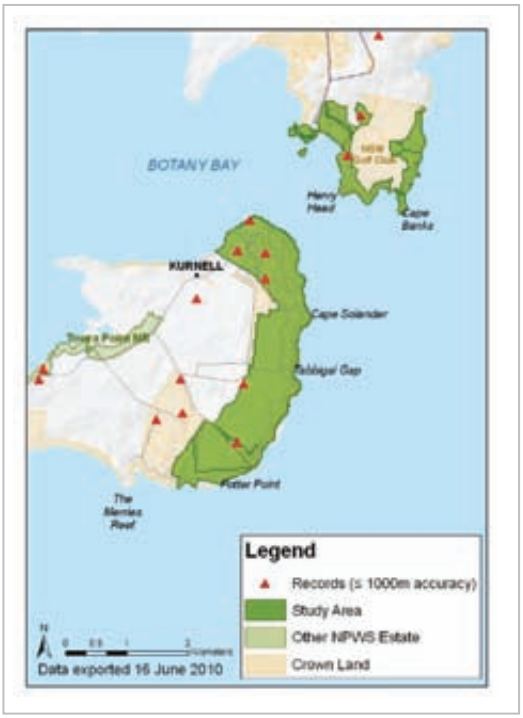
Photo © M. Schulz

Occurrence in the Study Area

Records of Cats in the study area on the Atlas of NSW Wildlife do not distinguish between roaming domestic Cats and feral Cats. While the listing of predation by Cats as a Key Threatening Process refers to feral animals, since domestic Cats can also have an impact in urban parks such as KBBNP, unsupervised domestic and feral animals will be discussed together here. Ten records for the Cat exist in the Atlas of NSW Wildlife for the study area, including three sightings, two trappings, one photo captured on an infra-red camera, three sets of tracks and one hair sample. The species is more widespread and common than these records indicate, however, as they are notoriously cryptic and bury their faeces making them less readily detected than Foxes. Presumed feral Cats are regularly seen in the La Perouse Precinct by park staff, while domestic Cats from neighbouring properties are frequently spotted near the edges of the park (P. Ibbetson pers. comm.). Cats are intermittently trapped and removed from this precinct, with the last concerted effort in 2008 capturing 13 animals in two and a half weeks, including both ferals and locally owned domestics (P. Ibbetson pers. comm.). Domestic Cats have also been seen near the edges of the Kurnell Precinct, such as at Polo Street (current survey), and Cats are occasionally captured around the Discovery Centre (M. Hand pers. comm.). Ferals also presumably exist through the Kurnell Precinct, moving between the park and surrounding industrial areas. The Cat is a generalist species capable of occupying a wide range of habitats and is unlikely to show a preference for any particular habitat group within the study area.

Impacts in the Study Area

Predation by the feral Cat is listed as a Key Threatening Process as it has been implicated in the extinction and decline of many species of mammals and birds in Australia and other parts of the world (NSW Scientific Committee 2008b). The species is listed by the World Conservation Union as among 100 of the 'World's Worst Invaders' (IUCN 2005). Cats may have already had an impact on the fauna of KBBNP by potentially contributing to the loss of some ground-nesting birds such as Eastern Bristlebird and possibly Eastern Ground Parrot as well as that of small native mammals. Several species such as Southern Emu-wren, Tawny-crowned Honeyeater and Little Tern remain under threat of predation from Cats. The impact of Cats on frogs and reptiles within the Park is currently unknown.



Management Considerations

- Continue the intermittent trapping programme for feral and roaming domestic Cats in both La Perouse and Kurnell Precincts.
- Undertake feral Cat control in concert with any Fox baiting programmes.
- Raise public awareness of the impact that free roaming domestic Cats have on native fauna and encourage neighbours to always keep their Cats inside at night.
- Support a cross-tenure approach to feral Cat management through cooperation and integration of programmes with neighbouring landholders.
- Encourage members of the public to report cat sightings made within the park.

RABBIT *Oryctolagus cuniculus*

EPBC Act: Key Threatening Process	*TSC Act*: Key Threatening Process

Photo © M. Schulz

Occurrence in the Study Area

The Rabbit prefers grassy areas with little shrubbery and some of level of disturbance. Such habitat is patchily distributed through the La Perouse Precinct and thus Rabbits are frequently seen, particularly near the boundary between the park and the neighbouring Golf Courses but also deeper within the park such as on the track to Congwong Beach and near Henry Head gun emplacements. Much of the Kurnell Precinct does not present prime habitat for the Rabbit, but the species has been seen near the boundaries of the park, near Yena Track, and on the coastal fringe (G. Ross pers. comm.). There is potential for Rabbits to occur in the picnic areas around the Discovery Centre, but they have not been sighted there (M. Hand pers. comm.). The species is unlikely to occur through the dense coastal heathlands that cover much of the Kurnell Precinct.

Impacts in the Study Area

Competition and grazing by the feral European Rabbit is listed as a Key Threatening Process and the species is also listed by the World Conservation Union as among 100 of the 'World's Worst Invaders' (IUCN 2005). Potential threats posed in the study area include: altering the structure and composition of vegetation communities through removing plant biomass, preventing plant regeneration and ring-barking of trees and shrubs; soil erosion through burrowing; and elevation of feral predator numbers resulting in increased pressure on native fauna when sharp declines in Rabbit numbers occur. Rabbit occurrence in the study area is currently restricted in extent and the species is not posing a direct threat to any threatened or regionally significant priority fauna species.

Management Considerations

- On site control of Rabbits is not currently a high management priority.
- If Rabbits increase in numbers or distribution in the reserve then targeted management through trapping or shooting should be considered. Any control programme must be undertaken in conjunction with neighbouring landholders, particularly the Golf Courses adjacent to the La Perouse Precinct in order to be effective.

DEER *Cervus sp.*

***EPBC Act*: Not Listed**	***TSC Act*: Key Threatening Process**

Rusa Deer stag. Photo © M. Schulz

Occurrence in the Study Area

No traces of Deer were detected during the 2007 or 2010 surveys. However, Deer have been sighted in the Kurnell Precinct by park staff in recent years, including once near Yena picnic area during an aerial weed spraying exercise (C. Ramsay pers. comm.) and once on the road near the Discovery Centre (C. Shephard pers. comm.). The species of Deer is highly unlikely to be anything except the Rusa Deer (*Cervus timorensis*). It is thought that at least two individuals occur, including a large stag (C. Shephard pers. comm.). In addition to these records Deer have been reported by members of the public elsewhere on the Kurnell Peninsula and near Miranda (DECCW 2010a) and are known from Loftus and Grays Point (DEC 2005b). The Deer that occur on the Kurnell Peninsula would derive from the well established wild population centred in Royal National Park, individuals moving north through Gymea, Caringbah and Cronulla possibly via Grays Point. Rusa Deer do not currently appear to be established in the Kurnell Precinct, but the species is capable of utilising habitats present and could potentially become more populous in the future. Deer have never been recorded in the La Perouse Precinct and are unlikely to become established there.

Impacts in the Study Area

Herbivory and environmental degradation by feral Deer is listed as a Key Threatening Process in NSW. Documented disturbances include overgrazing, trampling, ring-barking, weed dispersal, acceleration of erosion, concentration of nutrients, degradation of water quality (NSW Scientific Committee 2004) and at high densities alteration of the structure and composition of vegetation communities (Keith and Pellow 2005). Deer are not currently having a detectable impact in KBBNP due to their low numbers. If a population were to become established on the Kurnell Peninsula the greatest threat posed to native fauna would be via trampling of sensitive wetland and heathland habitats including creation of well-defined pads that Foxes could then use for access.

Management Considerations

- Undertake a targeted survey programme including new field survey and collection of existing and future sightings in a centralised database.

- Prevent feral Deer from becoming established in the study area by the removal of individuals as soon as possible after they are sighted. As long as sightings remain in ones and twos this should be sufficient to abate the threat to native wildlife in KBBNP. Control techniques should follow the protocols set out in the *Deer Management Plan for Royal National Park and Reserves in the Sydney South Region* (DEC 2005b).

- Should Deer become more numerous or a population become established on the Kurnell Peninsula then a more comprehensive management plan should be adopted in consultation with the Royal National Park Deer Working Group.

6 FAUNA HABITATS

6.1 FORMAT OF THE HABITAT GROUP PROFILES

Colour of the heading conforms to the colouration of Keith (2004) formations used in DECCW (2009).

HABITAT GROUP LABEL

EPBC Act: Whether the vegetation communities current confirm to any federally listed EEC	*TSC Act*: Whether the vegetation communities current confirm to any state listed EEC	Study Area: Whether the habitat group has been designated as a Priority Fauna Habitat for the study area.

This section provides a brief description of the structure, location and disturbance history of the habitat group.

A photo of typical habitat for the group

The species lists in the habitat profiles are primarily derived from a quantitative assessment of records collected during the systematic and targeted fauna survey techniques undertaken in 2007 and 2010. This information was augmented by a qualitative assessment of all fauna records for the study area, results of a similar study for the Royal, Heathcote and Garawarra reserve complex (DECCW 2011), and in the case of the priority species expert knowledge of likely habitat preferences.

Commonly Observed Herpetofauna

This section provides a list of frogs and reptiles that are commonly encountered in the habitat group.

Commonly Observed Birds

This section provides a list of diurnal and nocturnal birds that are commonly encountered in the habitat group.

Commonly Observed Mammals

This section provides a list of native and introduced terrestrial and arboreal mammals and bats that are commonly encountered in the habitat group.

Priority Species for Which Habitat Is Provided

This section provides a list of Priority fauna species for which the habitat group provides potential habitat. This list and the 'Relative Importance of this Habitat Group' categories are based upon a calculation of the percentage of records of each Priority species in each habitat group (using only records with a high degree of spatial accuracy collected during the 2007 and 2010 surveys), augmented by knowledge of species habitat preferences as well as an assessment of potential habitat usage for species not recorded during the recent surveys.

Common name	Relative importance of this habitat group
	Predominant – species more closely associated with one to three habitat groups than with the other habitats available in the study area
	General – species that are wide ranging and use this habitat to a similar extent as several other habitats
	Infrequent – species that have been (or have the potential to be) recorded in this habitat type but only infrequently and are not considered to depend on features located therein.

Potential Threats to Native Fauna

This section provides a list of current potential threats to native fauna that utilise the habitat group and to the integrity of the habitat itself.

6.2 HABITAT GROUP PROFILES

LITTORAL RAINFOREST

EPBC Act: Not Listed	*TSC Act*: Part of the Littoral Rainforest EEC	Study Area: Not a Priority Fauna Habitat

Photo © DECCW

Littoral Rainforest occurs in a single very thin patch along the freshwater stream (Cook's Stream) west of the Discovery Centre. The vegetation community has been greatly disturbed in the past and the surrounding environment is highly modified. Never-the-less the strip of vegetation along the stream today displays the structure and indicative flora species of rainforest (Benson and Eldershaw 2007) and is undergoing bush regeneration with the aim of approximating its 1770 state.

Commonly Observed Herpetofauna

The single systematic reptile census undertaken yielded eleven Three-toed Skinks, indicating that they occur very densely in the Littoral Rainforest patch. Other species detected were the Weasel Skink, Dark-flecked Garden Sunskink, Barred-sided Skink and Common Tree Snake. Red-bellied Black Snake have been seen by park visitors, while the Common Eastern Froglet can readily be heard calling from pools of water.

Commonly Observed Birds

Due to the small size of the patch only one systematic bird census was undertaken. The species recorded included the Crested Pigeon, Eastern Rosella, Sulphur-crested Cockatoo, Dollarbird, Laughing Kookaburra, Eastern Koel, Magpie-lark, White-browed Scrubwren, Variegated Fairy-wren, Silver Eye, Noisy Miner, Pied Currawong, Australian Raven and Rainbow Lorikeet. These species are all capable of persisting in fragmented environments and indicate the disturbed nature of the site. Other species that may be found with further survey include the Crimson Rosella, Brown Gerygone (in the winter months), Golden Whistler (in the winter months), Rufous Fantail (on passage), and possibly the Black-faced Monarch, while in the past prior to disturbance the rainforest may have supported a range of additional species including the Superb Lyrebird and Satin Bowerbird. Southern Boobook can be heard calling from this patch at night, while the rainforest gully may provide roosting habitat for the Powerful Owl.

Commonly Observed Mammals

Mammals recorded during systematic surveys included the Little Forest Bat, Lesser Long-eared Bat, Gould's Wattled Bat, Chocolate Wattled Bat, Eastern Bentwing-bat, Grey-headed Flying-fox, Common Brushtail Possum, Black Rat and House Mouse.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Powerful Owl	Predominant
Grey-headed Flying-fox	General
Eastern Bentwing-bat	Infrequent

Potential Threats to Native Fauna

Habitat isolation; weed invasion (from exotic species and non-local native species); localised disturbance through high levels of public usage; predation by feral predators; predation by domestic Cats and Dogs; alteration in water quality and flow characteristics of the creek; inappropriate fire regime. Recent projects aimed at restoring the rainforest to its former state may disturb and displace animals in the short term but hopefully benefit the assemblage in the longer term.

DUNE FOREST

EPBC Act: Not Listed	*TSC Act*: Coastal Sand Bangalay Forest is part of the Bangalay Sand Forest EEC	Study Area: Not a Priority Fauna Habitat

Dune Forest is a low to moderate height dry sclerophyll forest that occurs on deep sand dunes in the northern end and western side of the Kurnell Precinct and the western side of the La Perouse Precinct. These forests and woodlands have been subject to relatively little modification since European settlement and remain in good condition.

Photo © DECCW

Commonly Observed Herpetofauna

The Dark-flecked Garden Sunskink is by far the most common reptile followed by Three-toed Skink, Eastern Water-skink and to a lesser extent Pale-flecked Garden Sunskink, Red-throated Skink and Jacky Lizard. Systematic frog survey was not undertaken in this habitat group, but the Common Eastern Froglet and Peron's Tree Frog were heard during other survey techniques.

Commonly Observed Birds

Grey Fantail, New Holland Honeyeater, White-browed Scrubwren, Silvereye, Spotted Pardalote, Pied Currawong, Little Wattlebird, Red Wattlebird, Eastern Yellow Robin, Superb Fairy-wren, Yellow-faced Honeyeater and Fan-tailed Cuckoo.

Commonly Observed Mammals

This habitat group was targeted with harp trapping due to the suitability of siting the traps on the fire trails and walking tracks. The most frequently captured microbats were the Little Forest Bat, Lesser Long-eared Bat and Gould's Long-eared Bat. White-striped Freetail-bat and Grey-headed Flying-fox were also commonly spotlighted or heard. The Common Brushtail Possum is the most frequently encountered arboreal mammal. The Fox and Black Rat are abundant introduced species.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Little Lorikeet	Predominant
Swift Parrot	Infrequent
Powerful Owl	Predominant
Regent Honeyeater	General
Grey-headed Flying-fox	Predominant
Eastern Bentwing-bat	General

Potential Threats to Native Fauna

Habitat fragmentation; inappropriate fire regimes; loss of remaining hollow-bearing trees; predation by feral predators; predation by domestic Cats and Dogs in patches adjacent to urban areas; disturbance from feral birds bordering urban areas, particularly the Common Myna and Common Starling.

SANDSTONE FOREST

EPBC Act: Not Listed	*TSC Act*: Not Listed	Study Area: Not a Priority Fauna Habitat

This habitat type is a dry sclerophyll forest with a moist understorey that occurs in sheltered locations on sandstone between Polo Street and Yena Track (Kurnell Precinct) and between the Golf Course road and Congwong Bay (La Perouse Precinct). The disturbance history for this forest/woodland varies as though much remains in good condition there has been patchy clearing, building and earth works particularly in the southern patch.

Photo © DECCW

Commonly Observed Herpetofauna

Dark-flecked Garden Sunskink, Eastern Water-skink and Three-toed Skink.

Commonly Observed Birds

New Holland Honeyeater, Rainbow Lorikeet, Little Wattlebird, Silvereye, Yellow-faced Honeyeater, Red Wattlebird, Pied Currawong, Spotted Pardalote, Sulphur-crested Cockatoo, Crimson Rosella and Eastern Rosella.

Commonly Observed Mammals

Gould's Wattled Bat, Grey-headed Flying-fox, Little Forest Bat, White-striped Freetail-bat, Common Brushtail Possum and Fox.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Little Lorikeet	Predominant
Powerful Owl	Infrequent
Regent Honeyeater	General
Grey-headed Flying-fox	Predominant
Eastern Bentwing-bat	General

Potential Threats to Native Fauna

Low density of hollows due to past disturbance; habitat fragmentation; inappropriate fire regimes; predation by feral predators; predation by domestic Cats and Dogs; disturbance from feral birds such as the Common Myna and Common Starling.

SAND SCRUB

EPBC Act: Not Listed	*TSC Act*: Not Listed	Study Area: Not a Priority Fauna Habitat

This habitat is a dense tall scrub that occurs on deep sand dunes. The largest patch is in the far south of the Kurnell Precinct with smaller patches scattered through the La Perouse Precinct such as near Henry Head. These patches of Sand Scrub have probably all been disturbed in the past.

Photo © DECCW

Commonly Observed Herpetofauna

Systematic reptile searches detected the Copper-tailed Skink, Jacky Lizard, Dark-flecked Garden Sunskink, Common Scaly-foot and Eastern Blue-tongue Lizard. Systematic frog census was not undertaken in this habitat group but the Common Eastern Froglet was heard calling during spotlighting census.

Commonly Observed Birds

New Holland Honeyeater, Silvereye, Superb Fairy-wren, Red Wattlebird, Yellow-faced Honeyeater, Welcome Swallow, Grey Fantail, White-browed Scrubwren, Pied Currawong and Spotted Pardalote.

Commonly Observed Mammals

Grey-headed Flying-fox, Little Forest Bat, Lesser Long-eared Bat and Black Rat.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Grey-headed Flying-fox	General
Eastern Bentwing-bat	General

Potential Threats to Native Fauna

Dune destabilisation, erosion or blowouts resulting from removal of vegetation, proliferation of tracks, trail bike riding etc; rubbish dumping; inappropriate fire regimes; habitat fragmentation; weed invasion; predation by feral predators; predation by domestic Cats and Dogs adjacent to urban areas.

SAND HEATH

EPBC Act: Patches in La Perouse Precinct are part of the Eastern Suburbs Banksia Scrub EEC	*TSC Act*: Patches in La Perouse Precinct are part of the Eastern Suburbs Banksia Scrub EEC	Study Area: Priority Fauna Habitat

Sand Heath occurs where loose sand overlies the sandstone bedrock ranging from a relatively shallow sand mantle to well developed deep dunes. The heathland is usually a dense layer of sclerophyllous shrubs between one to two metres tall but more open patches and tall patches also occur. Through the Kurnell Precinct this habitat group has been subject to very little disturbance since European settlement and is some of the best preserved wallum sand heath in the Sydney area. That in the La Perouse Precinct has been subject to a higher level of disturbance including clearing, fragmentation and weed invasion.

Photo © DECCW

Commonly Observed Herpetofauna

Jacky Lizards are an extremely common sight through the sand heaths. Other reptiles encountered include the Dark-flecked Garden Sunskink, Copper-tailed Skink, Common Scalyfoot and in the vicinity of the Swamp Sedgelands or dune swales Eastern Water-skink. Snakes encountered included the Red-bellied Black Snake, Black-bellied Swamp Snake and Yellow-faced Whipsnake. The most common frog species are the Common Eastern Froglet and to a lesser extent Brown-striped Frog.

Commonly Observed Birds

New Holland Honeyeaters are abundant in this habitat group and by far the most commonly observed bird species. Brown Quail, Little Wattlebird, Australian Raven, Southern Emu-wren, Superb Fairy-wren and Silvereye are also abundant. Raptors are commonly seen hunting over the heaths including the White-bellied Sea-eagle, Black-shouldered Kite, Nankeen Kestrel and Peregrine Falcon, while Welcome Swallows are also regularly seen hawking for insects above the canopy.

Commonly Observed Mammals

The native mammalian fauna of this habitat group is depauperate, with only bats, such as the Lesser Long-eared Bat and Little Forest Bat, being recorded during the systematic surveys. In contrast, the introduced Black Rat and particularly the House Mouse are abundant through the Sand Heaths.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Wallum Froglet	Infrequent
Grass Owl	Infrequent
Southern Emu-wren	Predominant
Tawny-crowned Honeyeater	General
Grey-headed Flying-fox	General
Eastern Bentwing-bat	General, but note that the Cape Banks Gunnery roost site is surrounded by this habitat group

Potential Threats to Native Fauna

Dune destabilisation, erosion or blowouts resulting from removal of vegetation, proliferation of tracks, trail bike riding etc; walking and cycling tracks providing access points for feral predators; inappropriate fire regimes; habitat fragmentation; weed invasion; predation by feral predators; adjacent land uses in the case of the La Perouse Precinct.

SANDSTONE HEATH

EPBC Act: Not Listed	*TSC Act*: Not Listed	Study Area: Priority Fauna Habitat

This habitat type occurs on sandstone rock platforms with only a skeletal layer of soil. It ranges from a low open to dense wind-pruned heath on the tops of clifflines and headlands to a taller closed heath further inland. Many locations have impeded drainage and hence are interspersed with patches of sedges and forbs and soaks which hold standing water for short periods following rain. Sandstone Heath is most extensive through the centre of the Kurnell Precinct as well as in narrow bands along the clifftops and headlands of both Precincts. This habitat has been subject to minimal disturbance and is in good condition.

Photo © DECCW

Commonly Observed Herpetofauna

The Sandstone Heaths support the greatest richness of reptiles of all the habitat groups. The Copper-tailed Skink and Jacky Lizard were the most abundantly recorded species during the systematic reptile searches. Other species detected were the Common Scaly-foot, White's Skink, Red-throated Skink, Yellow-faced Whip Snake, Lesueur's Velvet Gecko and Broad-tailed Gecko. The Common Eastern Froglet was often heard calling from the edges of small pools, soaks and seepages.

Commonly Observed Birds

Honeyeaters are abundant in the Sandstone Heaths including the New Holland Honeyeater, Tawny-crowned Honeyeater, Yellow-faced Honeyeater and Little Wattlebird. Other species commonly encountered are Brown Quail, White-browed Scrubwren, Southern Emu-wren, Superb Fairy-wren, Silvereye, Rainbow Lorikeet, Willie Wagtail, Australian Magpie, Yellow-tailed Black-cockatoo and Red-browed Finch. As with the Sand Heaths raptors are commonly seen hunting over the Sandstone Heaths including the White-bellied Sea-eagle, Black-shouldered Kite, Nankeen Kestrel and Brown Goshawk. The Welcome Swallow and Common Starling are also regularly seen flying above the canopy.

Commonly Observed Mammals

Fox and Black Rat are the most common mammal species recorded. Native species that use this habitat include the Eastern Bentwing-bat, Gould's Wattled Bat, White-striped Freetail-bat and Little Forest Bat. It is likely this habitat provides important food resources for the Grey-headed Flying-fox, in particular the Heath-leaved Banksia in late autumn. In the La Perouse Precinct Rabbits also occur in this habitat group.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Southern Emu-wren	Predominant
Tawny-crowned Honeyeater	Predominant
Grey-headed Flying-fox	General
Eastern Bentwing-bat	General

Potential Threats to Native Fauna

Habitat fragmentation; weed invasion; predation by feral predators; walking and cycling tracks providing access points for feral predators; inappropriate fire regimes; poaching of reptiles; alteration of drainage and water flow patterns; disturbance from introduced birds including the Eurasian Blackbird, Common Starling and Common Myna.

SWAMP SEDGELAND

EPBC Act: Not Listed	*TSC Act*: Part of the Sydney Freshwater Wetlands EEC	Study Area: Priority Fauna Habitat

Sedgelands primarily occur in the swales between or at the edges of sand dunes where the proximity of the sandstone bedrock impedes drainage and promotes pooling of water. They are a complex of open water, rushlands, sedgelands and herbfields often fringed by Paperbark and Banksia thickets. In KBBNP the majority of sedgelands are scattered through the dunes between Tabbigai Gap and Potter Point, with a few water bodies also occurring in the north of the Kurnell Precinct and the La Perouse Precinct.

Photo © DECCW

Commonly Observed Herpetofauna

Not surprisingly this habitat group supports the richest mix of frog species including the Common Eastern Froglet, Wallum Froglet, Brown-striped Frog, Smooth Toadlet and Eastern Banjo Frog. Reptiles located in and around the Swamp Sedgelands on at least more than one occasion during systematic reptile searches include the Eastern Water-skink, Red-bellied Black Snake, Dark-flecked Garden Sunskink and Eastern Blue-tongue Lizard, while Black-bellied Swamp Snakes were observed opportunistically.

Commonly Observed Birds

Birds recorded during systematic censuses in this habitat group are Brown Quail, Welcome Swallow, Southern Emu-wren, Lewin's Rail, New Holland Honeyeater, Tawny-crowned Honeyeater, Red-browed Finch, White-faced Heron, Pheasant Coucal, Australian Pipit, Australian Raven and Australian Magpie. Though it does not fall into the category of 'commonly observed' it is important to note the presence of Grass Owl in this habitat group as its presence is highly significant and it is restricted to the Swamp Sedgelands and surrounding heaths.

Commonly Observed Mammals

House Mouse was found to be the most abundant ground mammal in this habitat group, followed by the Black Rat and Fox. Bats recorded flying overhead include the Grey-headed Flying-fox, Eastern Bentwing-bat and White-striped Freetail-bat.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Wallum Froglet	Predominant
Green and Golden Bell Frog	General
Grass Owl	Predominant
Southern Emu-wren	Predominant
Tawny-crowned Honeyeater	Predominant
Grey-headed Flying-fox	Infrequent
Eastern Bentwing-bat	General

Potential Threats to Native Fauna

Invasion of the Cane Toad; infection of frogs with amphibian Chytrid fungus; changes to hydrology, water flow patterns and water table level leading to sedgelands permanently drying out; changes to water quality; weed invasion including reducing the ratio of open water to reedlands; predation by Plague Minnow; predation by feral predators; habitat degradation by feral Deer.

SWAMP FOREST

EPBC Act: Not Listed	*TSC Act*: Part of Swamp Sclerophyll Forest on Coastal Floodplains EEC	Study Area: Priority Fauna Habitat

The Swamp Forest habitat group is an open eucalypt forest with a dry to moist shrub layer and a ground cover of sedges and ferns. The canopy is dominated by Swamp Mahogany with localised patches of Broad-leaved Paperbark. This habitat occurs in the Kurnell Precinct between Cape Solander Drive and the picnic areas, extending around the Discovery Centre car parks and facilities. Changes brought about to the hydrology of the area through road and building construction have likely altered the extent and nature of this community and it may be subject to further encroachment of species such as the Red Bloodwood (Benson and Eldershaw 2007).

Photo © DECCW

Commonly Observed Herpetofauna

The single systematic reptile census undertaken yielded fourteen Dark-flecked Garden Sunskink and a single individual each of the Weasel Skink, Three-toed Skink and Eastern Water-skink. It is likely that additional species occur, particularly the Red-bellied Black Snake.

Commonly Observed Birds

Only one systematic bird census was undertaken in this habitat group. The species recorded are Variegated Fairy-wren, Rainbow Lorikeet, Noisy Miner, Pied Currawong, White-browed Scrubwren, Silvereye, White-throated Needletail, Crimson Rosella, Eastern Rosella, Laughing Kookaburra, Spotted Pardalote, Yellow-faced Honeyeater, Black-faced Cuckoo-shrike, Red Wattlebird and Grey Butcherbird.

Commonly Observed Mammals

Mammals captured on the infra-red camera are the Common Brushtail Possum and Black Rat, while Common Ringtail Possum has been seen by DECCW staff (G. Ross pers. comm.). A variety of bat species are likely to occur. Cats and Foxes also occur in this habitat type.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Swift Parrot	Predominant
Powerful Owl	General
Regent Honeyeater	General
Little Lorikeet	Predominant
Grey-headed Flying-fox	General
Eastern Bentwing-bat	Infrequent

Potential Threats to Native Fauna

Habitat fragmentation; loss of native canopy trees through death without regeneration, suppression of regeneration by weeds, altered hydrology or disturbance due to their proximity to highly visited areas; anything that inhibits flowering e.g. drought or timing of fire would reduce the availability of foraging resources; localised disturbance through high levels of public usage; inappropriate fire regimes; predation by feral predators; predation by domestic Cats and Dogs.

SHORELINE

EPBC Act: Not Listed	*TSC Act*: Not Listed	Study Area: Priority Fauna Habitat

This habitat group encompasses environments along the immediate shoreline including Spinifex grassland, marshes and grasslands around seepages on rock platforms, intertidal rock platforms and sandy beaches and foreshores. This habitat type therefore wraps around the ocean perimeter of both the Kurnell and La Perouse Precincts and includes the key locations of Potter Point, Inscription and Sutherland Point, the eastern end of Silver Beach, Cape Banks Island, Bare Island, Congwong Beach and Little Congwong Beach, and between Henry Head and Cape Banks.

Photo © DECCW

Commonly Observed Herpetofauna

Eastern Water-skink occur in the vicinity of rock crevices, overhangs and seepages while Lesueur's Velvet Gecko occurs in high numbers in crevices, boulder piles and under loose rock in this habitat type. The Common Eastern Froglet is commonly heard calling around rock seepages and soaks. Jacky Lizard, Copper-tailed Skink and Dark-flecked Garden Sunskink are less frequently observed.

Commonly Observed Birds

Regularly encountered species include Silver Gull, Crested Tern, Little Pied Cormorant, Sooty Oystercatcher, Great Cormorant and Little Black Cormorant while White-bellied Sea-eagle, Peregrine Falcon, Australian Pelican and Welcome Swallow. Additionally, birds from adjacent vegetation communities can range on to the shoreline, such as the Superb Fairy-wren, Willie Wagtail, Australian Magpie and Australian Raven. Common Starling also utilise the shoreline habitats.

Commonly Observed Mammals

The only mammal species confined to this habitat in the study area are the Australian and New Zealand Fur-seals that irregularly haul out. Some microbats species forage over the shoreline, in particular the Eastern Bentwing-bat, Gould's Wattled Bat and Little Forest Bat. The Black Rat, House Mouse and Fox also occur within this habitat.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Osprey	Predominant
Sooty Oystercatcher	Predominant
Pied Oystercatcher	Predominant
Lesser Sand-plover	Predominant
Little Tern	Predominant
Southern Emu-wren	Infrequent
Tawny-crowned Honeyeater	Infrequent
Eastern Bentwing-bat	General, but note that the Henry Head gun emplacement is surrounded by this habitat group
Australian Fur-seal	Predominant
New Zealand Fur-seal	Predominant

Potential Threats to Native Fauna

Entanglement in fishing debris; bait and food collection of intertidal invertebrates; disturbance and predation by domestic Dogs; disturbance by the public; pollution of inshore waters which impacts on intertidal invertebrates; predation by feral predators; erosion; trail bike riding and weed invasion.

PARKLANDS

EPBC Act: Not Listed	*TSC Act*: Not Listed	Study Area: Stands of native trees are Priority Fauna Habitat

This habitat group includes treeless mown turfed areas (including north of Polo Street and west of Anzac Parade) and mown grassland with native and non-native canopy trees (at Commemoration Flat and around Cooks monument). Additionally, it includes buildings and associated gardens within high use areas.

Photo © DECCW

Commonly Observed Herpetofauna

Frequently observed reptile species away from the edges of this habitat are the Eastern Water-skink and Dark-flecked Garden Sunskink.

Commonly Observed Birds

Crested Pigeon, Eastern Rosella, Crimson Rosella, Laughing Kookaburra, Magpie-lark, Noisy Miner, Pied Currawong, Australian Magpie, Australian Raven, Masked Lapwing, Sulphur-crested Cockatoo, Rainbow Lorikeet, Silvereye, Willie Wagtail, New Holland Honeyeater and Grey Butcherbird. Also occasional aviary escapees and introduced birds including the Common Myna.

Commonly Observed Mammals

No mammals are confined to this habitat though individuals of various species range into it from adjacent vegetation communities and environments, including the Common Brushtail Possum and Grey-headed Flying-fox. A number of microbats species forage over the open habitat, while a number of introduced species including the Black Rat, Fox and Cat have been recorded. The New Zealand Fur-seal is irregularly recorded hauled out in this environment, including adjacent to Cook's monument.

Priority Species for Which Habitat Is Provided

Common name	Relative importance of this habitat group
Little Lorikeet	Predominant where Swamp Mahogany grows in canopy
Swift Parrot	Predominant where Swamp Mahogany grows in canopy
Regent Honeyeater	General where Swamp Mahogany grows in canopy
Grey-headed Flying-fox	General where canopy remains
New Zealand Fur-seal	Infrequent

Potential Threats to Native Fauna

Lack of tree recruitment due to mowing leading to loss of canopy species; disturbance from high rate of human visitation; loss of remaining trees supporting hollows; predation by feral predators; predation by domestic Cats and Dogs.

6.3 RELATIVE CONSERVATION PRIORITY OF FAUNA HABITATS

A set of 'Priority Fauna Habitats' were derived for the Sydney area by DECC (2008a) as part of the SMCMA Rapid Fauna Habitat Assessment. Table 10 compares these 'Priority Fauna Habitats' where they occur within KBBNP to the habitat groups used in this report and presents the priority species for which habitat is provided within the park. Based on this assessment, the following prioritisation of fauna habitats is made.

Swamp Sedgeland is the highest priority fauna habitat group as it supports two of the most significant threatened species for the reserve, being Wallum Froglet and Grass Owl, as well as five other priority species. In addition it provides habitat for several other regionally significant species, including Buff-banded Rail, Lewin's Rail, Pheasant Coucal, Golden-headed Cisticola and Tawny Grassbird. It has a limited occurrence in the Sydney Basin Bioregion and is part of the Sydney Freshwater Wetlands Endangered Ecological Community. Key locations in the study area are between Tabbigai Gap and Cape Baily.

Shoreline is the next priority fauna habitat group as ten threatened or priority species use this habitat to some extent. In addition the nationally declining Double-banded Plover and Pacific Golden Plover occasionally utilise this habitat, while several JAMBA and CAMBA bird species occur. Key locations in the study area are between Potter Point and Boat Harbour, around Sutherland and Inscriptions Points, between Cape Banks and Henry Head, and Bare Island. Part of the Shoreline habitat is managed within the park, part by DECCW as Aquatic Reserve and part by DPI Fisheries as Intertidal Protected Area.

Sandstone Heath and *Sand Heath* are also priority fauna habitat groups as they support healthy populations of two priority fauna species (Southern Emu-wren and Tawny-crowned Honeyeater) and provide important foraging resources for a third priority fauna species (Grey-headed Flying-fox). Furthermore they provide potential habitat for Eastern Ground Parrot and Eastern Bristlebird, though neither of these highly threatened species currently occurs.

Swamp Forest is another priority fauna habitat, providing a foraging resource for four priority species Little Lorikeet, Grey-headed Flying-fox Swift Parrot and Regent Honeyeater. This habitat is highly restricted in extent in the study area and the SMCMA and has been subject to a great amount of disturbance; it forms part of the Swamp Sclerophyll Forest on Coastal Floodplains Endangered Ecological Community. Key locations are in the vicinity of the Discovery Centre from Inscription Point wrapping around the eastern edge of the picnic areas and buildings to Yena Track.

Rainforest has not been designated as a priority fauna habitat within KBBNP as the small, narrow, isolated and highly modified patch that exists does not currently support the characteristic fauna assemblage that is described in DECC (2008a).

In addition to the above, single Swamp Mahogany trees hold high conservation value, even where they stand as isolated patches (such as the trees in the La Perouse Precinct) or as canopy trees above a turfed mown grassland such as at the picnic areas of Commemoration Flat.

Furthermore, the abandoned Henry Head and Cape Banks gun emplacements can be considered priority fauna habitats due to their ongoing use by roosting Eastern Bentwing-bat.

Table 10: Comparison of habitat groups to 'Priority Fauna Habitats' previously identified in the SMCMA

KBBNP habitat group	Corresponding 'Priority Fauna Habitat' (from DECC 2008a)	Area (per cent of study area)	Predominant or general habitat in KBBNP for priority species	Priority fauna habitat for KBBNP?
Littoral Rainforest	Rainforest	0.7 Ha (0.14%)	**Powerful Owl**, Grey-headed Flying-fox	No
Sand Heath	Heathland	129.6 Ha (25.9%)	**Southern Emu-wren**, Tawny-crowned Honeyeater, Grey-headed Flying-fox, Eastern Bentwing-bat	Yes
Sandstone Heath	Heathland	114.5 Ha (22.9%)	**Southern Emu-wren, Tawny-crowned Honeyeater,** Grey-headed Flying-fox, Eastern Bentwing-bat	Yes
Swamp Sedgeland	Freshwater Wetland	13.2 Ha (2.63%)	**Wallum Froglet,** Green and Golden Bell Frog, **Grass Owl, Southern Emu-wren, Tawny-crowned Honeyeater,** Eastern Bentwing-bat	Yes
Swamp Forest	Forested Wetland	6.1 Ha	**Swift Parrot,** Powerful Owl, Regent Honeyeater, **Little Lorikeet,** Grey-headed Flying-fox	Yes
Shoreline	Coastal Shoreline		**Osprey, Sooty Oystercatcher, Pied Oystercatcher, Little Tern, Lesser Sand-plover,** Eastern Bentwing-bat, **Australian Fur-seal, New Zealand Fur-seal**	Yes

7 THREATS TO NATIVE FAUNA

7.1 KEY CURRENT THREATS

7.1.1 Predation by the Fox

Rationale: The Fox is widespread across the study area and poses a threat to a range of native species by preying on them or competing with them for food or other resources. Particularly susceptible are ground-dwelling and semi-arboreal mammals and ground-frequenting birds (Dickman 1996, DECC 2007a). Additionally, this species can aid the spread of some weed species, such as Bitou Bush, through the deposition of seeds in faeces.

Priority species threatened: At least seven High Conservation Management Priority Species and one Moderate Conservation Management Priority Species (see Table 12).

7.1.2 Hydrological changes to Swamp Sedgelands, Sand and Sandstone Heaths, Swamp Forests and seepage lines along the Shoreline.

Rationale: Hydrological changes such as modification of local drainage patterns, alteration to the water table, infilling or silting up of water bodies, and associated changes in physical and chemical properties of the water has the potential to impact on a number of species and priority fauna habitats. These changes can either be direct through the loss of seepages or regular flooding events in low-lying habitats or indirect such as through the loss of the Swamp Mahogany (a key flowering tree for the Swift Parrot, Little Lorikeet, Regent Honeyeater and Grey-headed Flying-fox) that requires a specific hydrological regime. Such hydrological changes may result from local disturbance due to road/management trail construction or other management activities. Construction of roads and visitor facilities in the past has led to major changes in local hydrology, such as in the vicinity of the Discovery Centre. Today changes are more likely to originate from sources outside the survey area, such as from altered drainage as a result of developments in adjoining industrial land and urban areas.

Priority species threatened: At least seven High Conservation Management Priority Species (see Table 12).

7.1.3 Predation by the feral Cat and domestic Cat

Rationale: The impact of the feral Cat is poorly understood due to the difficulty in locating faeces, but in NSW has been implicated in the decline of several mammal and bird species. Wide-ranging domestic Cats are also likely to have significant impacts on fauna, particularly in restricted vegetation communities adjacent to urban areas.

Priority species threatened: At least seven High Conservation Management Priority Species (see Table 12).

7.1.4 Inappropriate fire regime including ecological consequences of high frequency fires

Rationale: Inappropriate fire regimes have the potential to significantly impact an array of fauna through habitat modification and direct mortality. In combination with habitat isolation severe wild fire may already have contributed to the loss of some bird species such as Eastern Bristlebird and possibly Eastern Ground Parrot and Beautiful Firetail. Indirect impacts of fire may include loss of hollow-bearing trees and loss of fallen logs and dead standing trees. Prescribed burns may impact on fauna where they burn remaining unburnt refugia, penetrate into moist forest, burn extensive areas of a single habitat without retaining refugia, are conducted at a time of year that is likely to have maximum impact on fauna (for example during breeding see Table 11), result in the loss of hollow-bearing and standing dead trees or are conducted at frequent intervals that results in a reduction in the diversity of habitats and hence biodiversity.

Priority species threatened: At least five High Conservation Management Priority Species (see Table 12), with unknown impacts on additional species such as the Wallum Froglet and Eastern Bentwing-bat.

Table 11: Main breeding season of priority bird and mammal species known or potentially likely to breed within the study area

Species	Breeding period	Source
Grass Owl	Throughout year	Higgins 1999
Southern Emu-wren	August-February	Higgins *et al.* 2001
Tawny-crowned Honeyeater	July-February	Higgins *et al*. 2001

7.1.5 Weed Invasion, particularly by Bitou Bush

Rationale: Sections of the two Precincts are currently heavily infested with Bitou Bush. Scattered individual Bitou Bush plants were found well away from tracks in virtually otherwise weed-free heathland in the southern parts of the Kurnell Precinct during the current survey. If unchecked these plants have the potential to invade heathland/wetland habitats that support a number of priority species. Such an invasion is likely to provide additional pressure on heathland species with low dispersal abilities, such as the Southern Emu-wren and Tawny-crowned Honeyeater and wetland species. Another threat posed is invasion of water bodies by aquatic weeds leading to a change in the ratio of reedlands to open water thus altering habitat features for frog species, particularly Green and Golden Bell Frog and Wallum Froglet.

Priority species threatened: At least five High Management Priority Species (Table 12), with unknown impacts on additional species.

7.1.6 Spread and establishment of Rusa Deer

Rationale: The spread and establishment of a Rusa Deer population in the Kurnell Precinct could lead to Herbivory and Environmental Degradation Caused by feral Deer which listed as a Key Threatening Process. To understand the impact that establishment of Deer could have, one need only look at the current situation in the Royal, Heathcote and Garawarra reserves (for example see DECCW 2011). In these reserves Deer impact on native fauna both directly and indirectly as follows: through the degradation of vegetation by grazing; by trampling of fragile habitats, including the creation of well-defined pads in wetlands that Foxes can then use for access; by trampling of mud/sand edges of wetlands that impact on foraging areas for shorebirds and some large wading birds such as egrets and bitterns; by the trampling of the nests of ground-breeding fauna; the potential interference of bat roosts in cave overhangs; and the loss of viability of plant populations through the curtailment of seed production and seedling recruitment (Keith and Pellow 2005).

Priority species threatened: At least five High Conservation Management Priority Species (Table 12) as well as impacts on Priority Fauna Habitats.

7.1.7 Public disturbance

Rationale: The study area has very high cultural, historic and scenic value and correspondingly has a high rate of visitation. Some public disturbance is therefore expected. However, some fauna species are particularly susceptible to certain types of human disturbance, either during a particular stage within the daily or annual cycle or if they only utilise restricted, accessible habitat. These disturbances include: a) the disturbance of Sooty Oystercatcher, Pied Oystercatcher, Little Tern and other shorebirds, waders and waterbirds resting or feeding along the intertidal flats west of Inscription Point, between Potter Point and Boat Harbour, between Cape Banks and Henry Head and on Bare Island; b) disturbance of roosting Eastern Bentwing-bats in old tunnels associated with the gun emplacements, particularly through noise, the lighting of fires and fumes from cigarettes and spray paint; c) uncontrolled playback or searching for the Grass Owl by bird twitchers; d) disturbance of foraging Grey-headed Flying-foxes feeding in flowering Swamp Mahoganies adjacent to picnic areas and other high use visitor areas; and e) disturbance and interference of seals hauled out on the shoreline.

Priority species threatened: At least four High Conservation Management Priority Species and two Moderate Conservation Management Priority Species (see Table 12) as well as seals that haul out in the study area.

7.1.8 Invasion of the Cane Toad

Rationale: Invasion and establishment of the Cane Toad (*Rhinella marina*) is listed as a Key Threatening Process under the *TSC Act* while the biological effects, including lethal toxic ingestion, caused by Cane Toads is listed under the *EPBC Act*. In 2010 over 200 Cane Toads were collected in the Sutherland Shire with a concentration around Taren Point (A. White pers. comm.). It is estimated that 500 toads currently occur, with a range of size classes observed ((A. White pers. comm.). No sightings of eggs or tadpoles have yet been made, but in early 2010 many juvenile toads were found and in September 2010 calling toads were heard, both being indirect signs of breeding (A. Goeth pers. comm.). If this outbreak of Cane Toads becomes established it has the potential to spread to reserves on the Kurnell Peninsula, including KBBNP. A few individuals have already been sighted on the Kurnell Peninsula, meaning they have expanded from Taren Point (A. Goeth pers. comm.). Cane Toad populations can reach very high densities (e.g. 2000 individuals per hectare), and there is currently no efficient method for significantly reducing established populations (NSW Scientific Committee 2008c). Trapping has some potential to eradicate small populations or create a barrier to expansion, but is labour-intensive. Adult Cane Toads have a catholic diet with almost any vertebrate or invertebrate that can be swallowed vulnerable to predation, and tadpoles sometimes feed on their own and other species (NSW Scientific Committee 2008c). Predation by adult and tadpole Cane Toads is expected to reduce the population viability of threatened frog species where they co-exist and potentially contribute to their extinction (NSW Scientific Committee 2008c). High Conservation Management Priority species in the park that would be threatened by invasion and establishment of the Cane Toad are Wallum Froglet and to a much lesser extent Green and Golden Bell Frog. In addition, the establishment of the Cane Toads is likely to cause declines in faunal biodiversity by competing for food with other carnivores, by preying upon small vertebrates (such as skinks) and by causing intoxication among larger predators such as Goannas and raptors (NSW Scientific Committee 2008c). Associated with Cane Toad invasion is the potential introduction of the exotic nematode *Rhabdias* which has been found to effect native tree frogs (A. White pers. comm.).

Priority species threatened: Two High Conservation Management Priority Species, with potential impacts on fauna biodiversity.

7.1.9 Disturbance and predation by domestic Dogs

Rationale: Domestic Dogs are frequently encountered in the study area either roaming off-leash unaccompanied or on- or off-leash accompanied by their owners. Dogs were observed chasing waterbirds on the intertidal flats in the Sutherland Point area and chasing birds, including two Sooty Oystercatchers in the Potter Point area during the current survey. Additionally, people walking with Dogs were encountered on various management trails within the park.

Priority species threatened: One High Conservation Management Priority Species and two Moderate Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.10 Habitat fragmentation and lack of connectivity

Rationale: The La Perouse Precinct is virtually isolated from other native vegetation remnants, though there remains a broken habitat link to the Malabar Headland area. The Kurnell Precinct is proximate to patches of native vegetation on various tenures to the south, and a number of very tenuous habitat links or potential links to other reserves, namely Towra Point NR and Lucas Reserve, have been identified (Brennan 2009). Currently there is little potential for species with low dispersal abilities to recolonise the park following catastrophic events such as extensive severe wildfire or to reduce the incidence of inbreeding depression. Habitat fragmentation has likely been a key factor in the loss of several fauna species from both Precincts to date, possibly for example the Beautiful Firetail. In its current state of isolation KBBNP would be expected to lose additional fauna species in the future.

Priority species threatened: At least two High Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.11 Predation by the Black Rat

Rationale: There is little evidence that the Black Rat threatens native fauna on the Australian mainland, though dietary studies are limited (Dickman and Watts 2008). However, this species has had a significant impact on island fauna, for example on Lord Howe Island six bird species became extinct after the Black Rat became established following a shipwreck in 1918 (Garnett and Crowley

2000, DECC 2007c). Such an impact has been recognised through this species being listed on Lord Howe Island as a Key Threatening Process under the *TSC Act*. Therefore, given the impact on island fauna and the lack of dietary studies in natural bushland on the mainland it is expected that there is some impact on fauna within the study area, particularly given the arboreal nature of this species compared to native rat species (Stokes *et al*. 2009). The Black Rat possibly contributed to the decline of native ground mammals in KBBNP and to the known or suspected loss of Eastern Bristlebird, Ground Parrot and Beautiful Firetail, and currently poses a threat to Southern Emu-wren, Tawny-crowned Honeyeater and other ground-nesting birds. The predominance of Black Rat remains in the Grass Owl pellets analysed as part of this study suggests that, ironically, the abundance of introduced rodents is the primary foraging resource for this threatened owl species in the area. It would be near impossible to eradicate Black Rat from the park and use of rodenticide itself would constitute a threat to native predators. Hence it is not recommended that removal of the Black Rat be attempted at this stage.

Priority species threatened: At least two High Conservation Management Priority Species (see Table 12), with an unknown impact of other species.

7.1.12 Amphibian Chytrid fungus

Rationale: Research has implicated amphibian Chytrid fungus in the decline of several frog species both in Australia and elsewhere (Berger *et al.* 1998). It is likely to be a factor in the disappearance of Green and Golden Bell Frog from the study area.

Priority species threatened: Two High Conservation Management Priority Species (see Table 12) as well as other frog species.

7.1.13 Predation by the Plague Minnow

Rationale: The Plague Minnow (or Mosquito Fish) preys on the eggs, tadpoles and adults of a variety of frog species, including threatened species such as the Green and Golden Bell Frog (NPWS 2003c). The species is known to occur in Swamp Sedgelands in the Kurnell Precinct (Pyke and White in press) and can be presumed to occur in water bodies of the La Perouse Precinct.

Priority species threatened: Two High Conservation Management Priority Species (see Table 12), with unknown impacts on additional frog species.

7.1.14 Loss of key feed tree species

Rationale: The Swamp Mahogany is a key flowering feed tree for threatened species such as the Swift Parrot, Grey-headed Flying-fox and Regent Honeyeater. This tree has a limited distribution within KBBNP, with many trees in high public usage areas and modified parkland landscapes. It is important that all adult trees be retained and that regeneration of new individuals be supported. Other flowering feed trees for threatened species include Bangalay, Red Bloodwood and Smooth-barked Apple.

Priority species threatened: Two High Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.15 Herbicide spraying

Rationale: The spraying of herbicides in and adjacent to Swamp Sedgelands and other water bodies may impact High Conservation Management Priority frog species, in addition to a variety of waterbirds and other species. The current programme of aerial spraying of Bitou Bush is undertaken in winter when Wallum Froglet breeds.

Priority species threatened: Two High Conservation Management Priority Species (see Table 12).

7.1.16 Pollution of inshore waters

Rationale: A number of shorebird species may be impacted by the pollution of inshore waters from chemical or oil spills, including by impacting on intertidal fauna that serve as prey species.

Priority Species Impacted: One High Conservation Management Priority Species and two Moderate Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.17 Collection of intertidal invertebrates

Rationale: A number of shorebird species may be impacted directly or indirectly through the taking of bait and food in the intertidal areas of the park. Bait and food collection happens despite the existence of the Intertidal Protected Area around Inscription Point and the Aquatic Reserves between Boat Harbour and Potter Point and between Cape Banks and Henry Head, which explicitly prohibit collection of intertidal invertebrates.

Priority species threatened: One High Conservation Management Priority Species and two Moderate Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.18 Road mortality

Rationale: The diversity and number of species killed on the sealed roads within and bordering the Park has not been documented. During the 2007 and 2010 surveys several road killed animals were encountered including: one Grey-headed Flying-fox on Polo Street in Kurnell; several reptiles (including Jacky Lizard and an unidentified snake probably Black-bellied Swamp Snake) on the road to Potter Point; a Common Brushtail Possum near the Discovery Centre; a Blue-tongue Lizard near Cottage Three in the Kurnell Precinct; a Weasel Skink on the main road to the Golf Course in the La Perouse Precinct.

Priority species threatened: At least two High Conservation Management Priority Species (see Table 12) with unknown impacts on other species.

7.1.19 Use of boundary fencing with barbed wire top strands

Rationale: Use of boundary fences with barbed wire top strands may result in mortality of a number of species, particularly bats and nocturnal birds including the threatened Grey-headed Flying-fox, Yellow-bellied Sheathtail-bat and Grass Owl (Booth 2006).

Priority species threatened: At least two High Conservation Management Priority Species (see Table 12).

7.1.20 Secondary poisoning from rodenticides

Rationale: Some owl species that prey on small- to medium-sized mammals are susceptible to secondary poisoning in areas where rodenticide baits have been laid, including the Grass Owl (Higgins 1999).

Priority species threatened: One High Conservation Management Priority Species (see Table 12), with unknown impacts on additional species.

7.1.21 Electrocution on powerlines

Rationale: The Grey-headed Flying-fox is susceptible to electrocution on powerlines within and adjacent to the study area.

Priority species threatened: One High Conservation Management Priority Species (see Table 12).

7.1.22 Sealing up and incorrect gating of gunnery tunnels

Rationale: The sealing up or gating of old tunnels is commonly seen as a solution to meet public safety requirements. However, a number of species of cave-dwelling bats will abandon roosts if the entrance is sealed in or incorrect gating is installed. The most sensitive bat species present within the study area is the Eastern Bentwing-bat which will typically abandon tunnels/caves/old mines that have been gated (L. Lumsden pers. comm.). On the other hand, reduction of the level of public visitation to the gun emplacements may be advantageous to the species.

Priority species threatened: One High Conservation Management Priority Species Priority Species (see Table 12).

7.1.23 Beak and Feather Disease

Rationale: Psittacine Circoviral (Beak and Feather) Disease affects parrots by killing the cells of the feather and beak, in addition to the cells of the immune system, exposing infected birds to bacterial

and other infections. This disease has been recorded in a number of priority parrot species that occur in the area including the Swift Parrot and Little Lorikeet.

Priority species threatened: One High Conservation Management Priority Species (see Table 12), with unknown impacts on additional parrot species.

7.2 OTHER CURRENT THREATS

There are a number of additional threats that have the potential to impact on fauna species not currently identified as high or moderate conservation priority, as follows.

- Loss of hollow-bearing trees (listed as a Key Threatening Process).
- Loss of dead standing and fallen timber (listed as a Key Threatening Process).
- Competition from introduced bird species, particularly the Eurasian Blackbird, Common Starling and Common Myna.
- Competition from feral Honeybees (*Apis mellifera*) (listed as a Key Threatening Process).
- Public disturbance of hauled out seals on the shoreline (follow procedural guidelines, DECCW 2010b).
- The potential of oiled marine life washing from spills or shipping incidences (follow procedural guidelines, NPWS 2003b).
- The potential of live single or mass cetacean strandings on the shoreline of KBBNP, (follow procedural guidelines, DECCW 2010c, NPWS 1997b).
- Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments (listed as a Key Threatening Process).
- Impacts of grazing by the Rabbit (listed as a Key Threatening Process).
- Infection of native plants by root-rot fungus (*Phytophthora cinnamomi*) (listed as a Key Threatening Process).
- Infection of native plants in the Myrtaceae family by Myrtle Rust (*Uredo rangelii*) potentially resulting in plant death.
- Invasion, establishment and spread of Lantana (*Lantana camara*) (listed as a Key Threatening Process).
- Invasion and establishment of exotic vines and scramblers (listed as a Key Threatening Process).
- Invasion of native plant communities by exotic perennial grasses (listed as a Key Threatening Process).
- Riding of horses, push bikes and illegal motorbikes leading to erosion, habitat destruction and possible road mortality.
- Pollution from adjacent heavy industry and urban areas, including industrial fall out which may result in wildfire ignition.
- Rubbish dumping, including the dumping and burning of motor vehicles.

The threats listed above that require active management at this time can be grouped into three broad categories: limited availability of tree hollows; establishment, maintenance and use of tracks and trails; and threats that already have existing procedural guidelines (including seal haul out, cetacean stranding and oiled marine life). The first two of these categories are addressed below and in the management recommendations section.

7.2.1 Limited availability of tree hollows

Rationale: Though none of the high or moderate conservation priority species are dependent on the existence of tree hollows within the study area (though Swift Parrot may utilise hollows when they visit) several other fauna species are hollow dependent. The number of hollow-bearing trees within the study area is limited due to past land management practices and the small patch size of forest habitat types. The removal of hollow-bearing trees during park maintenance activities and competition for hollows from pest species including Common Myna, Common Starling and feral Honeybee would

further limit the availability of hollows to native wildlife and potentially contribute to past or future local extinction of some mammal and bird species.

7.2.2 Establishment, maintenance and use of tracks and trails

Rationale: A number of non-priority fauna species may be impacted by road/management trail/walking track construction and maintenance, primarily through localised impacts on drainage and water quality of adjacent streams or seepages, particularly where bridgeworks are undertaken. In addition to this, unauthorised use and proliferation of a network of informal tracks and trails can lead to erosion, removal of habitat, and potentially road mortality of several species, including two priority species Southern Emu-wren and Tawny-crowned Honeyeater.

7.3 FUTURE THREATS

- Human-induced climate change (listed as a Key Threatening Process under the *TSC Act*), including sea level rise and other hydrological changes to the shoreline (e.g. impacting on the rock platforms in the Potter Point area and the intertidal flats supporting foraging waterbirds in the Sutherland Point area).
- Introduction of the Red-eared Slider Turtle (*Trachemys scripta elegans*) into wetlands within the survey area. This pest species aggressively competes with native species for food resources and may carry pathogens and diseases that can kill native turtles and other aquatic wildlife. Although it is illegal to keep, sell or release this species it is commonly dumped in the wild as adults are capable of inflicting painful bites (Dept of Primary Industries and Fisheries 2007).

7.4 RELATIVE PRIORITY OF THREATS

Section 3.3.2 of this report defined several classes and ranks of threats posed to native fauna within KBBNP. In Table 12 the threats identified as Key Current Threats are ranked according to these definitions, relating to the number of High and Moderate Priority fauna species they potentially affect. The Very High and High threats are ordered from highest to lowest left to right in terms of the number of priority species known or potentially impacted.

The Other Current Threats identified above have a lower priority for management than the Key Current Threats, while the Future Threats should be assessed for management priority as they emerge.

Table 12: Prioritisation of key current threats to high and moderate priority fauna species within the study area

Threat Priority Ranking	Very High						High													Moderate			
Key Current Threat	**Predation by Fox**	**Hydrological changes to Swamp Sedgelands, Sand and Sandstone Heaths, Swamp Forest and seepage lines along the shoreline**	**Predation by feral and domestic Cat**	**Inappropriate fire regime including high frequency fire**	**Weed invasion including by Bitou Bush**	**Spread and establishment of feral Deer**	**Public disturbance**	**Invasion of the Cane Toad**	**Habitat fragmentation and low connectivity**	**Predation by Black Rat**	**Amphibian Chytrid fungus**	**Predation by Plague Minnow**	**Loss of key feed tree species**	**Herbicide spraying**	**Disturbance and predation by domestic Dog**	**Pollution of inshore waters**	**Collection of intertidal invertebrates**	**Road mortality**	**Use of boundary fencing with barbed wire top strands**	**Secondary poisoning from rodenticides**	**Electrocution on powerlines**	**Incorrect gating of gunnery tunnels**	**Beak and Feather Disease**
Threat listed as a Key Threatening Process	X		X	X	X	X		X			X	X											X
Threatens integrity of Priority Fauna Habitat		X		X	X	X							X				X					X	
High Priority Species																							
Wallum Froglet	X	X	X		X	X		X			X	X		X									
Green and Golden Bell Frog	X	X	X		X	X		X			X	X		X									
Sooty Oystercatcher							X								X	X	X						
Swift Parrot		X		X									X										X
Grass Owl	X	X	X	X	X	X	X											X	X	X			
Southern Emu-wren	X	X	X	X	X	X			X	X													
Tawny-crowned Honeyeater	X	X	X	X	X	X			X	X													
Grey-headed Flying-fox	X	X		X			X						X					X	X		X		
Eastern Bentwing-bat	X		X				X															X	
Moderate Priority Species																							
Pied Oystercatcher	X						X								X	X	X						
Little Tern	X		X				X								X	X	X						

8 RECOMMENDATIONS FOR FAUNA MANAGEMENT

8.1 MANAGEMENT OF VERY HIGH THREATS

Table 13: Recommendations for management of very high threats

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Predation by the Fox	Continue to implement the current Fox control programme on the Kurnell Peninsula with focus on key sites and habitats. For La Perouse also focus Fox management on key habitats and locations. For both Precincts follow protocols in the Fox Threat Abatement Plan (NPWS 2001b).	Kurnell	Swamp Sedgeland (Priority Fauna Habitat) between Cape Baily and Tabbigai Gap.	Reduce predation pressure on Priority Species including Wallum Froglet and Grass Owl as well as ground-dwelling and nesting birds such as the Lewin's Rail and Brown Quail.
		Kurnell	Shoreline (Priority Fauna Habitat), specifically from Cape Baily to Boat Harbour and from Cape Solander to west of Sutherland Point.	Reduce predation pressure on Priority Species Pied Oystercatcher and Little Tern as well as other intertidal bird species.
		Kurnell and La Perouse	Sand Heath and Sandstone Heath (Priority Fauna Habitats).	Reduce predation pressure on Priority Species including Southern Emu-wren, Tawny-crowned Honeyeater and Grey-headed Flying-fox.
		La Perouse	Shoreline (Priority Fauna Habitat) between Cape Banks and Henry Head.	Reduce predation pressure on Priority Species Pied Oystercatcher as well as other intertidal bird species.
		La Perouse	In the vicinity of the Henry Head and Cape Banks gun emplacements.	Reduce predation pressure on roosting Eastern Bentwing-bats.
		Kurnell	In the vicinity of nesting sites for Grass Owl *should they be discovered.*	Reduce predation pressure on Priority Species Grass Owl.
	Any baiting should follow protocols that minimise the take of non-target species.	Kurnell and La Perouse	All	Poisoning of Lace Monitor.
	Implement feral Cat control in parallel with Fox control measures to reduce risk of competitive release and an increase in Cat numbers (Glen and Dickman 2005).	Kurnell and La Perouse	All	Reduce predation pressure on a variety of terrestrial species.
	Continue to support a cross tenure approach to Fox management through cooperation and integration of programmes with neighbouring landholders, such as via the Kurnell Peninsula Integrated Pest Management Strategy.	Kurnell and La Perouse	All	Reduce predation pressure on a variety of terrestrial species.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Hydrological changes to Swamp Sedgelands, Sand and Sandstone Heaths, Swamp Forests and seepage lines along the Shoreline	Avoid permanent and temporary hydrological changes (including deposition of silt or erosion) during road, management trail, walking track, car park and other construction and maintenance and keep soil disturbance to a minimum.	Kurnell and La Perouse	All	Maintain integrity of habitat for Priority Species that utilise Swamp Sedgeland, Heaths and seepages including Wallum Froglet, Green and Golden Bell Frog, Grass Owl, Southern Emu-wren, Tawny-crowned Honeyeater, Grey-headed Flying-fox. Maintain integrity of habitat for species that utilise Swamp Forest for foraging including Swift Parrot and Little Lorikeet.
	Ensure that runoff from current roads and trails is not adversely impacting water bodies or soaks. Implement appropriate remediation techniques as necessary.	Kurnell and La Perouse	Swamp Sedgeland, Heaths and seepages adjacent to formal or informal tracks and trails.	Maintain integrity of habitat for fauna species.
	Work cooperatively with neighbours and other stakeholders to ensure that best practice is adopted for water management around the park periphery. Maintain vigilance for any off-park activities adversely affecting water bodies on park, including siltation, pollution and ground water extraction.	Kurnell and La Perouse	Swamp Sedgeland on southern and western fringes of the Kurnell Precinct. All water bodies in the La Perouse Precinct.	Maintain integrity of habitat for fauna species including Wallum Froglet.
Predation by the feral Cat and domestic Cat	Continue to implement intermittent trapping program for feral and roaming domestic Cats.	Kurnell and La Perouse	Prioritise efforts towards Sandstone Heath, Sand Heath and Swamp Sedgeland (Priority Fauna Habitats).	Reduce predation pressure on High Priority frog and bird species.
	After Fox baiting undertake a trapping program targeting feral Cats that may have moved in or bred up. The removal of Foxes frequently results in the competitive release of Cats and an increase in numbers (Glen and Dickman 2005).	Kurnell and La Perouse	Prioritise efforts towards Sandstone Heath, Sand Heath and Swamp Sedgeland (Priority Fauna Habitats).	Reduce predation pressure on High Priority frog and bird species.
	Work with local government to raise public awareness of the impact that free roaming domestic Cats have on native fauna and encourage neighbours to always keep their Cats inside at night.	Kurnell and La Perouse	Urban lands neighbouring the park.	Reduce predation pressure on a variety of terrestrial species.
	Encourage members of the public to report Cat sightings made on the reserve.	Kurnell and La Perouse	All	Reduce predation pressure on a variety of terrestrial species.
	Continue to support a cross tenure approach to Cat management through cooperation and integration of programmes with neighbouring landholders, such as via the Kurnell Peninsula Integrated Pest Management Strategy.	Kurnell and La Perouse	All	Reduce predation pressure on a variety of terrestrial species.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Inappropriate fire regime including ecological consequences of high frequency fires	Revise current fire management plans to incorporate new vegetation mapping for the reserve, once finalised.	Kurnell and La Perouse	All	
	Continue to manage fires in the Heritage/Land Management Zones identified in NPWS 2001a and 2002b to *meet the conservation objective for species, populations, habitats, wilderness areas or cultural heritage values which may be at risk of long-term damage as a result of inappropriate bushfire regime*. The primary current approach is to maintain fire frequencies within the biodiversity threshold for each vegetation community and to avoid burning all of a vegetation community at any one time (NPWS 2001a).	Kurnell and La Perouse	All	
	Follow the recommendation of the DECCW Woronora post-fire fauna study interim report (DEC 2004) to protect unburnt patches of a particular vegetation community or habitat group from fire for *at least 10 years* after surrounding lands have been burnt.	Kurnell and La Perouse	All	Protect source populations to facilitate recolonisation of burnt areas for species with smaller dispersal ability including reptiles, frogs and small mammals.
	Maintain a mosaic of time since fire classes, including long unburnt areas, within each habitat group, with the exception of Littoral Rainforest and Swamp Forest and Swamp Sedgeland.	Kurnell and La Perouse	All	
	Protect Littoral Rainforest, Swamp Forest and Swamp Sedgelands from fire.	Kurnell	Littoral Rainforest, Swamp Forest and Swamp Sedgeland.	Maintain integrity of habitat for fauna species, particularly protect Wallum Froglet habitat from fire.
	Protect gunnery emplacements from fire.	La Perouse	Particularly those that are known to support roosting Eastern Bentwing-bat, namely Henry Head and Cape Banks.	Protect roosting Eastern Bentwing-bats.
	Where prescribed burns are necessary conduct them in autumn to minimise overlap with breeding times for Priority species.	Kurnell and La Perouse	All	Minimise impacts on Priority species as the majority predominantly breed between late winter and midsummer.
	Prescribed burns should be planned to avoid burning heath and forest habitat types when key trees and shrubs are in flower, particularly Swamp Mahogany, Bangalay, Heath-leaved Banksia and Coast Banksia.	Kurnell and La Perouse	Sandstone Heath, Sand Heath, Swamp Sedgeland, Swamp Forest, (Priority Fauna Habitats) as well as Sand Scrub, Dune Forest, Sandstone Forest, Littoral Rainforest and Swamp Mahogany trees in Parkland or isolated patches.	Protect the feeding resources of nectarivorous threatened species such as Swift Parrot, Little Lorikeet, Regent Honeyeater and Grey-headed Flying-fox.
	Avoid felling or damage to hollow-bearing or standing dead trees during fire operations.	Kurnell and La Perouse	All	Protection of arboreal fauna dependent on hollows.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	Prescribed burns should be planned to avoid known raptor nest sites.	Kurnell and La Perouse	All	Raptor nests are commonly re-used over consecutive years. Species affected include White-bellied Sea-Eagle.
	Encourage the awareness and implementation of hygiene protocols to avoid spread of amphibian Chytrid fungus or weeds during operations.	Kurnell and La Perouse	All	Wallum Froglet, Green and Golden Bell Frog.
	Consult the relevant habitat group profiles in this report when developing fire plans, reviewing environmental factors and assessing potential impacts on threatened species in particular vegetation types.	Kurnell and La Perouse	All	
	Incorporate findings of this report, including habitat group profiles, when writing, updating and implementing park management plans, fire plans and other management documents.	Kurnell and La Perouse	All	
Weed invasion particularly by Bitou Bush	Implement a weed control and revegetation plan for the park with priority given to areas currently or formerly occupied by heath and sedgeland.	Kurnell and La Perouse	Sand Heath, Sandstone Heath and Swamp Sedgeland (Priority Fauna Habitats).	Maintain integrity of habitat for Priority Species.
	Continue programme of aerial Bitou Bush control with ongoing review if any detrimental impacts on native flora or fauna are discerned.	Kurnell	Current and former areas of Sand Heath and Sandstone Heath (Priority Fauna Habitats).	Maintain integrity of habitat for Priority Species that utilise heaths including Southern Emu-wren, Tawny-crowned Honey-eater, Grass Owl, and Grey-headed Flying-fox.
	Avoid the aerial application of Round up within 50 metres of Swamp Sedgelands and other wetlands. Instead it is recommended that regular patrols be undertaken to these habitats on foot and non-chemical or direct-application removal techniques used.	Kurnell	Swamp Sedgelands (Priority Fauna Habitat) between Tabbigai Gap and Cape Baily to minimise any impacts of frog species at the same time as preventing Bitou invasion (particularly when swamps dry out and are susceptible to invasion).	Potential impacts on frog species, particularly Wallum Froglet which breeds in winter when aerial spraying is undertaken. Maintain integrity of habitat for Priority Species that utilise Swamp Sedgeland, including Wallum Froglet and Grass Owl.
	Monitor Swamp Sedgelands and other water bodies for choking by aquatic weeds including increased cover of Cumbungi. If the latter does occur this should be managed in close consultation with frog specialists.	Kurnell	Swamp Sedgelands (Priority Fauna Habitat) and other water bodies.	Maintain value of habitat for Wallum Froglet and possibly Green and Golden Bell Frog.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	Continue weed removal and bush regeneration works.	La Perouse	Current and former areas of Sand Heath and Sandstone Heath (Priority Fauna Habitats), particularly between Henry Head and Cape Banks. Also consider major rehabilitation work in the area mapped as 'Weeds and Exotics' in DECCW (2009) (far east of the Precinct) with the aim of restoring connections between patches of heath.	Increase coverage and connectivity of habitat for Priority Species including Tawny-crowned Honeyeater and Grey-headed Flying-fox.
Spread and establishment of feral Deer	Remove individuals as soon as possible after they are sighted. Control techniques should follow the protocols set out in the *Deer Management Plan for Royal National Park and Reserves in the Sydney South Region* (DEC 2005b).	Kurnell	All	Reduce possibility of Deer impacting on the integrity of habitat for Priority Species that utilise heaths and sedgelands.

8.2 MANAGEMENT OF HIGH THREATS

Table 14: Recommendations for management of high threats

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Public disturbance	Together with local government erect signs to raise public awareness of wildlife that rests or feeds on intertidal flats and the impacts that disturbance can have, with the aim of minimising public disturbance in key areas within and adjoining the reserve.	Kurnell	West of Inscription Point and between Potter Point and Boat Harbour.	Reduce disturbance of Sooty Oystercatcher, Pied Oystercatcher, Little Tern and other shorebirds, waders and waterbirds.
		La Perouse	Between Cape Banks and Henry Head and on Bare Island.	Reduce disturbance Sooty Oystercatcher, Pied Oystercatcher, Little Tern and other shorebirds, waders and waterbirds.
		La Perouse	Old tunnels associated with the gun emplacements.	Reduce disturbance of roosting Eastern Bentwing-bat.
	Discourage the use of owl playback in the vicinity of Grass Owl habitat and promote the importance of ecologically sensitive survey that does not lead to proliferation of walking pads or spread of pathogens.	Kurnell	Heaths and Swamp Sedgelands between Tabbigai Gap and Cape Baily	Grass Owl
	For hauled out seals situated in sections of shoreline used by the public follow the DECCW *Standard Operating Procedures for Pinniped Haul Outs* (DECCW 2010b).	Kurnell and La Perouse	Shoreline and adjacent Parkland	Reduce disturbance and harassment of Australian and New Zealand Fur-seals.
	Restrict public access to old tunnels by constructing physical obstacles that deter people but do not restrict bat movements.	La Perouse	Old tunnels associated with the gun emplacements.	Reduce disturbance of roosting Eastern Bentwing-bat.
	Continue to keep the park closed to public vehicles at night to minimise disturbance to foraging bats.	Kurnell and La Perouse	All	Minimise disturbance to foraging Grey-headed Flying-fox.
Invasion of the Cane Toad	Continue to actively participate with the Cane Toad Working Group (including Sutherland Shire Council, other arms of DECCW, the University of Sydney and local frog experts) in efforts to monitor and eradicate the outbreak of Cane Toads centred around Taren Point.	Kurnell	Currently an off park issue.	Stop the potential for severe impacts on Wallum Froglet and numerous other fauna species.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	Encourage neighbouring industries (particularly those that receive shipments from northern Australia), other landholders and local naturalists to immediately report any Cane Toad specimens, alive or dead.	Kurnell	Currently an off park issue.	Stop the potential for severe impacts on Wallum Froglet and numerous other fauna species.
	Maintain close contact with the Cane Toad Working Group should the outbreak removal fail and aid in the formulation and implementation of a coordinated action plan as a matter of urgency.	Kurnell	Currently an off park issue.	Stop the potential for severe impacts on Wallum Froglet and numerous other fauna species.
Habitat fragmentation and low connectivity	Work together with the Sydney Metropolitan CMA, local government and private landholders and other arms of DECCW to establish vegetated wildlife linkages between Kamay Botany Bay and the recently announced reserve at Malabar Headland.	La Perouse	Potential habitat linkages along the coastline between La Perouse Precinct and Malabar Headland.	Reduce further species losses due to lack of connectivity and enable recolonisation in the event of single catastrophic events such as intense widespread wildfire. Focus is on species with low dispersal ability across urban or industrial lands including frogs, small reptiles and small mammals.
	Work together with the Sydney Metropolitan CMA, local government, private landholders and other arms of DECCW to support habitat linkages between Kurnell Precinct and Towra Point NR, using corridors highlighted in the Kurnell 2020 plan.	Kurnell	Potential habitat linkages identified in Brennan (2009).	Reduce further species losses due to lack of connectivity and enable recolonisation in the event of single catastrophic events such as intense widespread wildfire. Focus is on species with low dispersal ability across urban or industrial lands including frogs, small reptiles and small mammals.
Predation by the Black Rat	No ameliorative strategies recommended at this stage for the reasons outlined in Section 7.1 of this report.	Kurnell and La Perouse		
Amphibian Chytrid fungus	Ensure that staff, contractors and bush regeneration teams follow the *Hygiene protocol for the control of disease in frogs* (NPWS 2001c)	Kurnell and La Perouse	Entire park with particular attention when working in Swamp Sedgelands and adjacent Sand Heath between Tabbigai Gap and Cape Baily.	Minimise spread of disease between habitats of Wallum Froglet and other frog species.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	As part of the annual monitoring program of Wallum Froglet ensure surveyors look out for signs of Chytrid-infected frogs (of any species) and periodically swab frogs to test for the disease. If the disease is found to be prevalent, consider mitigation measures in consultation with a frog expert.	Kurnell	Swamp Sedgelands between Tabbigai Gap and Cape Baily.	Gain an understanding of the level of infection and potential threat posed to Wallum Froglet.
Predation by the Plague Minnow	No ameliorative strategies recommended at this stage but survey is warranted as part of the annual monitoring of Wallum Froglet to help gain a better understanding of distribution in the reserve.	Kurnell	Swamp Sedgelands between Tabbigai Gap and Cape Baily.	Gain an understanding of the distribution and consequently level of threat posed to Wallum Froglet.
Loss of key feed tree species	Retain Swamp Mahogany trees wherever they occur, including in Parkland habitats.	Kurnell and La Perouse	Swamp Forest (Priority Fauna Habitat), Parkland with native tree canopy, isolated Swamp Mahogany trees in La Perouse Precinct.	Retain foraging resources for nectarivorous birds and bats including Priority Species Swift Parrot and Grey-headed Flying-fox as well as Little Lorikeet and possibly Regent Honeyeater.
	Assist natural regeneration of existing Swamp Mahogany stands, where necessary by bush regeneration and removal of competing weed species including the non-local Tallowwood.	Kurnell	Swamp Forest (Priority Fauna Habitat),	Retain foraging resources for nectarivorous birds and bats including Priority Species Swift Parrot and Grey-headed Flying-fox as well as Little Lorikeet and possibly Regent Honeyeater.
	Encourage the replanting of vegetation communities featuring Swamp Mahogany in areas from which it has been cleared.	Kurnell	Commemoration Flat in areas mapped as 'Swamp Forest' by Benson and Eldershaw (2007).	Increase the foraging resources for nectarivorous birds and bats.
	Advocate the protection of Swamp Mahogany trees (and vegetation communities featuring it) on adjoining private and council lands.	Kurnell		
Herbicide spraying	Avoid spraying of herbicide within 50 metres of Swamp Sedgelands and other water bodies.	Kurnell and La Perouse	All water bodies particularly Swamp Sedgelands.	Minimise potential impacts on Wallum Froglet and other fauna species using that use the water.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Disturbance and predation by domestic Dog	Work with local government and other arms of DECCW to undertake regular patrol of shorelines, particularly in the morning and towards dusk and issue warnings or fines to Dog owners as appropriate.	Kurnell and La Perouse	Shoreline at Sutherland Point and Potter Point and other Shoreline habitat frequented by Dogs.	Reduce disturbance to Priority Species Pied Oystercatcher, Sooty Oystercatcher and Little Tern as well as other intertidal bird species.
	Undertake irregular patrols, particularly on weekends, along tracks and trails throughout the Park and issue warnings or fines to Dog owners as appropriate.	Kurnell and La Perouse	All	Reduce disturbance and predation to fauna species.
	Consider public signage highlighting the ecological sensitivity of intertidal areas and the impact that domestic Dogs can have.	Kurnell	Shoreline at Sutherland Point and Potter Point and other Shoreline habitat frequented by Dogs.	Reduce disturbance to Priority Species Pied Oystercatcher, Sooty Oystercatcher and Little Tern as well as other intertidal bird species.
Pollution of inshore waters	No ameliorative strategies recommended other than ongoing advocacy regarding the sensitivity of intertidal areas and intertidal fauna species.	Kurnell and La Perouse	Shoreline (Priority Fauna Habitat)	
Collection of intertidal invertebrates	Work together with the Department of Industry and Investment and other arms of DECCW to patrol and enforce management of intertidal areas, including the ban on collection of invertebrates from the aquatic reserves and intertidal protected areas.	Kurnell and La Perouse	All Shoreline (Priority Fauna Habitat) particularly the Intertidal Protected Area around Inscription Point and the Aquatic Reserves between Boat Harbour and Potter Point and between Cape Banks and Henry Head.	Maintain integrity of habitat for Priority Species Sooty Oystercatcher, Pied Oystercatcher and Little Tern as well as other intertidal bird species.
Road mortality	Continue to keep the park closed to public vehicles at night to minimise chance of road mortality for nocturnal species.	Kurnell and La Perouse	All	Reduce risk to Priority Species Grey-headed Flying-fox and Grass Owl as well as other nocturnal species such as possums.
	Commence a program encouraging all Area staff and Discovery Rangers as well as members of the public, bush regenerators and local naturalists to report fauna road kills with accurate location information and species type. Compile this information on a data base/GIS and look for patterns in mortality, for example a 'reptile kill hot spot'.	Kurnell and La Perouse	All	Identify risk to diurnal species.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	If it becomes clear that diurnal species are regularly being killed along particular stretches of road then consider erecting signs to alert motorists of the wildlife crossing and encouraging them to slow down and check for wildlife.	Kurnell and La Perouse	Hotspots identified by compilation of road kill data.	Reduce risk to diurnal species.
Use of boundary fencing with barbed wire top strands	Promote the use of Wildlife Friendly Fencing for the park and neighbouring areas with reference to options set out in Booth (2006) and the associated Wildlife Friendly Fencing website.	Kurnell and La Perouse	All	Reduce risk of entanglement by Grey-headed Flying-fox and owl species.

8.3 MANAGEMENT OF MODERATE THREATS

Table 15: Recommendations for management of moderate threats

Threat	Management response	Precinct	Target areas or habitats	Key species issues
Secondary poisoning from rodenticides	Avoid use of rodenticides.	Kurnell and La Perouse	All	Remove risk of secondary poisoning of native predators.
Electrocution on powerlines	Check electrocuted individuals found in the local area for the presence of young (which can survive for a time even if the mother has been electrocuted) and seek help from wildlife carers as necessary.	Kurnell and La Perouse	All	Grey-headed Flying-fox.
	Commence a program encouraging all Area staff and Discovery Rangers as well as members of the public, bush regenerators and naturalists to report bat electrocutions in the park and neighbourhood with accurate location information. Compile this information on a data base/GIS and look for patterns to identify problem areas.	Kurnell and La Perouse	All	Grey-headed Flying-fox.
	If problem areas are identified, work together with power supply companies reduce the incidence in these areas for example by increasing the visibility of powerlines or bundling cables (DECC 2008c).	Kurnell and La Perouse	Problem areas to be identified by compilation of electrocution data.	Grey-headed Flying-fox
Sealing up and incorrect gating of gunnery tunnels	Do not seal up any tunnels that have been used for roosting by the Eastern Bentwing-bat.	La Perouse	Gun Emplacements Henry Head and Cape Banks.	Avoid abandonment of Eastern Bentwing-bat roost sites.

Threat	Management response	Precinct	Target areas or habitats	Key species issues
	If gating (or other public access restrictions) is to be considered for gunnery tunnels used by Eastern Bentwing-bat, closely consult with the Australasian Bat Society *before proceeding* to ensure the most appropriate strategy is used.	La Perouse	Gun Emplacements Henry Head and Cape Banks.	Minimise risk of abandonment of Eastern Bentwing-bat roost sites.
	If closure is to be considered for other tunnels, mines or underground structures closely consult with the Australasian Bat Society to minimise any risk to cave-dwelling bats.	Kurnell and La Perouse	All abandoned underground structures.	
	Consult with the Australasian Bat Society regarding tunnels that have been previously gated with the view of improving such structures for cave-dwelling bats.	Kurnell and La Perouse	All abandoned underground structures.	
Beak and feather disease	Remove all aviary escapee parrots.	Kurnell	Predominantly in the vicinity of the Discovery Centre.	Reduce risk of spread of disease to wild parrot populations.

8.4 MANAGEMENT OF OTHER FAUNA THREATS

8.4.1 Management of tree hollows

Strategies to reduce impacts on native fauna:

- Wherever possibly avoid the removal of hollow-bearing trees, including dead trees, during DECCW works.
- Continue the current programme in the Kurnell Precinct of removal of feral Honeybee hives when they are discovered and extend programme to the La Perouse Precinct.
- Common Starling currently is most frequently seen in the Shoreline and Heath habitat groups where they do not pose a threat to hollow-dwelling animals. The species has also been recorded from the Jennifer Street boardwalk and on the track to Congwong Beach, which are more of a concern, and once near the Discovery Centre in 1981. Given the proximity to urbanisation the Common Starling is unlikely to be successfully removed from the La Perouse Precinct, and is not a management priority at this time. If the species is found to continue to occur near the Discovery Centre it has higher potential to be controlled. Park staff and local naturalists should be encouraged to report any Common Starling sightings made in the forest habitat types, with any obvious increase in distribution or abundance to trigger management actions in consultation with experts on the species.
- Common Myna is largely restricted to the dry woodlands and open forests in the vicinity of the Discovery Centre in the Kurnell Precinct, while in the La Perouse precinct it appears to be restricted to disturbed areas and the urban-bushland interface. Again control of Common Myna in La Perouse is unlikely to be successful or have a high conservation benefit. Numbers in the Kurnell Precinct are currently low, with the species not detected during the 2007 or 2010 surveys. Park staff and local naturalists should be encouraged to report any Common Myna sightings made in the forest habitat types of the Kurnell Precinct, with any obvious increase in distribution or abundance to trigger management actions in consultation with experts on the species.

8.4.2 Management of tracks and trails and their use

Strategies to reduce impacts on native fauna:

- Ensure construction and maintenance of formal tracks and trails does not interfere with local hydrology or cause sedimentation, including the flooding and drainage patterns of soaks and seepages in the Heath and Shoreline habitat groups.
- Ensure that all works carried out in the park incorporate best practice soil erosion, sediment control and revegetation measures as state in the park Plan of Management (NPWS 2002a).
- Consult the relevant habitat group profiles in this report when revising park management plans, undertaking reviews of environmental factors and assessing potential impacts of works on fauna in particular vegetation types.
- Undertake mapping of the current network of informal tracks and trails. Subsequent to this, review trails that are not required or that are unstable and close them using barricades, fencing or plantings.
- Undertake patrols of both Precincts for illegal use of bikes and riding of horses, particularly in the Sand Heath habitat type and administer warnings and penalties as appropriate.

8.5 POTENTIAL DISCOVERY OF NEW OR PRESUMED LOST SPECIES

This report documents the most accurate possible current inventory of species for KBBNP. New species may arrive or be discovered over time, or species that are suspected to have been lost may return or be rediscovered. When additional species are reported it is important that reliable supporting evidence is sourced so that an accurate inventory can be maintained. When confirmed, a new species should be reviewed to identify its relative conservation priority so that resources are continually directed toward those species currently most in need.

Annual checks of the species recorded in the Atlas of NSW Wildlife is recommended by comparing the species list outputs with those generated for this report. Recent records of species not discussed in this report, or listed as suspected loss, should be verified and reviewed. A reordering of species conservation priorities may be warranted depending on the conservation status of newly discovered species.

8.6 LAND ACQUISITION PRIORITIES FOR FAUNA

The assessment of fauna species and habitats undertaken for this report indicates that acquisitions and additions to Kamay Botany Bay National Park should be prioritised toward areas that contain vegetation communities that fall within the Swamp Sedgeland, Sandstone Heath, Sand Heath or Swamp Forest habitat groups and/or Shoreline habitats. The addition of the intertidal flats and exposed rocky reefs along the shoreline of the park, together with the reef and intertidal rock platform of Boat Harbour and Merries Reef, would significantly enhance the value of KBBNP to several shorebird species that have declined in numbers in the region.

In addition to the above, additions should also be prioritised towards lands that would provide a habitat linkage between the Kurnell Precinct of KBBNP and other parts of the Kurnell Peninsula, particularly Towra Point NR, as well as linkages between La Perouse and the new reserve at Malabar Headland.

8.7 MAINTAINING WILDLIFE DATA SYSTEMS

A survey such as the current survey is restricted in terms of providing only a 'snapshot in time' with respect to the fauna present and fauna patterns during different annual cycles, such as drought and above-average rainfall years. The following recommendations are therefore provided with the aim of gaining a better understanding of the fauna present within the survey area.

- Strongly encourage all researchers and fauna consultants to contribute their records (e.g. trapping effort and results) to the Atlas of NSW Wildlife. These records should be submitted on a regular basis rather than after the study has been completed. It would be highly advantageous for accompanying photographs or ultrasound recording files of rare species or species that have not previously been confirmed to occur in the area to also be submitted with records.
- Strongly encouraged DECCW staff and contractors to enter sightings into the Atlas of NSW Wildlife, where possible with accompanying photographs if the species is rare or has not been previously recorded.

8.8 SPECIES RE-INTRODUCTIONS

One potential approach to improve biodiversity values of the study area is to undertake re-introductions of selected species. However, in this report it is recommended that re-introductions be considered a last resort, with biodiversity strategies instead being directed toward managing and improving the current fauna values. Additionally, species re-introductions are typically expensive, require a large amount of labour and have no certainty of a positive outcome. Any re-introduction program needs to be coupled with a statistically robust fauna monitoring program which provides baseline population trend data that can be used to assist in the evaluation of re-introduction proposals.

If species re-introductions were to be considered within the study area a number of questions need to be addressed for each species before such an approach is undertaken.

Was the species known to be present within the survey area?

Is the species really not present anymore?

Why did the species become locally extinct?

If the factors that caused the decline of a species in the first place have not been identified and addressed there is no point in re-introducing the species. It is paramount to understand the reasons behind the extinction since it will be an important factor in determining whether a species can be successfully re-introduced.

Does the biology of the animal lend itself to successful re-introduction?

Are sufficient funds available?

Re-introductions are ongoing, time consuming and expensive. For a re-introduction to be successful long-term funding assurance is required.

Re-introduction approval

Rationale: Re-introduction approval is required by the Wildlife Licensing Unit of DECCW. Such approvals may not be provided if there are insufficient grounds for such a re-introduction to be successful.

9 RECOMMENDATIONS FOR FURTHER SURVEY AND MONITORING

9.1 FAUNA MONITORING

9.1.1 Background

Discussion of fauna monitoring is important as it is increasingly included as a key corporate environmental management objective for park managers. It is a complex and difficult issue because questions about what to monitor are often poorly described and projects are rarely funded for sufficient time periods to generate meaningful results. The purpose of this section is to discuss the current overarching monitoring strategies in NSW, the reasons why monitoring programs often fail and to suggest monitoring projects that are relevant to fauna within the reserves that are the focus of this report.

Part of the complexity of fauna monitoring lies in the different sorts of monitoring questions there are to choose from. The NSW Monitoring and Evaluation Strategy (NSW NRE CEO Cluster Group 2006) describes two different types of monitoring program that attempt to answer completely different questions.

1. **Resource Condition Monitoring** follows trends in particular aspects of a natural resource to understand whether the overall health of the resource is changing. We would use Resource Condition monitoring to answer questions like 'What is the condition of fauna in Royal NP?" and "Is the health declining, improving or staying the same?" To answer these questions it is imperative to develop good indicators of the condition or health of fauna diversity so that it can be measured periodically over a long time period. Resource condition monitoring allows us to observe the **net effect of all active threats and management actions**, but it does not explain the cause of the observed trend.

2. **Performance monitoring** on the other hand can inform us about what is causing an observed trend, and can be used to assess whether management actions are resulting in improved health. Performance monitoring can be split into two components (1) identifying the cause of an observed trend, and (2) measuring the effectiveness of a management action to eliminate that causal factor.

   Performance monitoring often relies on more detailed research, and requires a carefully planned experiment if causal factors are to be identified (NSW NRE CEO Cluster Group 2006). Once the causal factors for a change are understood then a performance monitoring program may be implemented to track the success of any management actions. For example, Fox predation has been identified as a major factor in the decline of medium sized ground-dwelling mammals. A monitoring program can be set up to measure the success of management actions carried out to ameliorate this threat (e.g. increase in abundance of ground-dwelling mammals following a Fox-baiting program).

PWG has recently initiated a programme called ParkIQ to improve the strategic approach to coordinating survey, monitoring, evaluation and research work on reserves across the state. The programme has three main components: development of a Monitoring and Evaluation Guide (MEG, DECCW 2010d); compilation of a Monitoring, Survey and Research Inventory (MSR inventory, currently being populated); and the Park IQ Strategy (PIQS). The key biodiversity component of the PIQS is an initiative known as WildCount which seeks to provide a single unifying framework for vertebrate fauna monitoring across the NSW reserve system. Development and roll out of the ParkIQ will inform the design and implementation of monitoring and research programmes undertaken within the survey area in the future.

The completion of the current report and survey program is actually a key step towards the development of a monitoring program for the reserve. It provides the baseline fauna data against which future trends can be gleaned by adopting the same systematic methods employed here. The results of the current work help answer questions not only about the state of fauna in Kamay Botany Bay NP but also about the contribution the area makes toward the persistence of species in the region and within the state. This is particularly the case for threatened species.

9.1.2 Implementing a fauna monitoring program

There are two broad components of a monitoring program. The first is the scientific design and the second is the administration of the project. Monitoring projects commonly fail as a result of the latter. Fauna monitoring is expensive and requires a long term commitment to generate reliable data. New surveys generate data all of which needs to be entered into a database and analysed periodically to assess results. Consider that for many fauna it may be at least 5-10 years to observe a trend. Unless there is clear support for such a program the long term viability will be tenuous and may become a one-off study that is not maintained over time. A well constructed monitoring program should link with other monitoring projects occurring within DECCW to ensure that projects can as far as possible satisfy multiple monitoring objectives. This includes threatened species management, state of the parks reporting and scientific services research. Consultation with the relevant staff greatly increases the chances of implementing an integrated project that garners support for its continuation over time.

The scientific issues to consider before setting up a monitoring program are also complex. Table 16 presents a summary of the issues that confront fauna monitoring programs.

Table 16: Scientific issues to consider In relation to monitoring programs

Issue	Description
Have clear, simple goals and test well defined hypotheses	Monitoring programs that have very broad aims, or vague hypotheses, or are too ambitious in terms of the number of questions they try to answer, often fail. It is important to keep things simple.
Develop reliable and useful indicators	Choosing the right indicators requires careful thought to ensure they will provide information that clearly relates to the issue that you want to monitor. For example monitoring a hard to find fauna species to inform of the health of fauna overall will be more resource intensive than using a common species.
Have a well thought out survey design that uses appropriate stratification	Again, a simple design that is limited to a particular species, or a few or perhaps limiting the subject of the monitoring to one suite of species, will give the monitoring project a better chance of success
Have enough sites and therefore enough statistical power to detect change	A simple calculation can be done *a priori* to determine the minimum sample size needed to have sufficient power. Too few survey sites will guarantee that a monitoring program will either fail to detect change, or give an unreliable or misleading result.
Clearly define the type of data the monitoring program sets out to collect	For example, presence/absence of species at the site scale which can be regionally summarised as species x was present at 10 out of 18 sites in the region; OR breeding success of a species per year, OR number of individuals of a species per unit effort
Employ appropriate survey methods for the desired data type	For example you might choose one method to generate presence/absence data, but another to obtain abundance estimates. This needs to be thought about and planned for at the concept stage of planning.
Be undertaken at an appropriate temporal scale, and most importantly have on-going commitment for the long-term	Most monitoring projects need at least 5 years worth of data to detect change, whereas many will need much longer than that (IUCN red list criteria suggest that 10 years (or 3 x generation length) of data is the minimum amount needed to adequately assess trends over time see http://www.iucnredlist.org/technical-documents/categories-and-criteria for more detail). The number of years needed for monitoring will depend on the frequency of monitoring, the methods used and the biology, in particular the life history of the species or suite of species being monitored. Monitoring anything for less than 5 years is a waste of time and resources, as statistically, you will likely need many more than 5 data points to confidently interpret any observed trend.

Issue	Description
Set limits of acceptable change	This is an important aspect of monitoring that many programs omit. It is easy at the conclusion of a monitoring program to say, "Species x declined by 60% over 30 years", however it is often too late to use this information and the population has changed beyond recovery. Information that a decline is occurring at present is much more useful, so that something can be done to halt or reverse the decline. Hence, there must be a limit of acceptable change set for all monitoring programs. This will define a point of "worry", and help to facilitate a feedback loop for adaptive management. There will always be a small amount of change due to natural fluctuations, e.g. drought, however this amount of expected natural fluctuation needs to be estimated and a sensible limit of acceptable change determined. For example, you might set an acceptable limit of change for the abundance of a certain species to be +/- 8% annually (this translates into the species being at risk of extinction within 20 years), and for the first 3 years, the population has shown a 2% increase, then a 2% decline, then a 4% decline, then in the 4th year, the population drops by 9%. Because we have set 8% as the "worry" point, we know that we need to act to halt or reverse this decline. The relevant land managers should be made aware and act accordingly, maybe stepping up predator control, or investigating other threats.

9.1.3 Suggested monitoring programs

As discussed above, the design of monitoring programs is a complex issue requiring extensive planning and consultation. The simplest way to start is by integrating with established monitoring projects to ensure that they are supported and relevant to the management of the reserve. These already address some priority species and priority threats present in the reserves.

- The first phase of WildCount will concentrate on fauna monitoring using digital cameras across reserves in the east of the State, and is due to commence in 2012. DECCW Area staff are encouraged to continue to actively participate in this initiative and maintain close links with the PIQS (and other components of Park IQ) as it rolls out.
- Staff or volunteers be encouraged to contribute to regular national or statewide surveys for priority species, such as the Swift Parrot and Regent Honeyeater (see relevant Species Profiles).
- Continue to support and participate in the monitoring of shorebirds at Boat Harbour/Merries Reef and other sites in Botany Bay by the NSW Wader Study Group.

In addition to the above regional scale monitoring programs, a suggested local scale program for the Kurnell Precinct is monitoring of Swamp Sedgelands known to currently support Wallum Froglet with the aim of detecting changes in abundance and gaining a better understanding of potential threats. The monitoring program should consider the issues outlined in Section 9.1.2 and be designed in consultation with experts on the species and a biostatistician to ensure that it is statistically robust and suited to detecting population trends. The monitoring should record all other frog species encountered, and thus go some way to addressing the current inventory shortfall on amphibians or detecting any Cane Toad invasion. The programme should also monitor key habitat features including water level, weed invasion and presence of Plague Minnow, and should consider periodically swabbing frogs to test for the presence of Chytrid fungus. Monitoring and testing should be undertaken by an experienced herpetologist, utilising the latest collection and pathology techniques and the hygiene protocols outlined in (NPWS 2001a) must be strictly adhered to at all times.

9.2 FURTHER FAUNA SURVEY

The systematic and targeted fauna survey work undertaken in KBBNP in 2007 and 2010 has resulted in an adequate baseline understanding of terrestrial vertebrate fauna in the study area, with the exception of amphibians. In addition, the work has highlighted issues that require further study to broaden the understanding of fauna in the locality and region, and enable effective management in the long term. The following surveys are recommended to address these issues, listed in order of relative priority.

- Undertake a targeted survey for feral Deer species in the Kurnell Precinct. This survey should be three fold: targeted field survey; collection of accurate past and future sighting information from Area staff including sightings made during helicopter work; and a letterbox survey of the

local community to establish the current extent and distribution of sightings in neighbouring lands. This survey and resulting management should be designed and undertaken in consultation with the Royal National Park Deer Working Group.

- Undertake further survey for Grass Owl in Swamp Sedgelands between Tabbigai Gap and Cape Baily order to increase understanding of occupation rates and habitat usage. Include searches of sedgelands and adjacent heath for characteristic flattened vegetation and connecting tunnels, searches for regurgitated pellets, and active searches for individuals. Analysis of remains within regurgitated pellets will provide information not only on the Grass Owl diet, but also on the composition of the ground mammal assemblage with potential for detection of additional native mammal species.
- Undertake an annual survey program around the three pitfall trap sites established in 2010 and left in situ and the fourth pitfall trap site established by UBM Ecological in Dune Forest near Yena Track. This programme would aim to detect native small ground mammal species that were not found during the 2010 surveys, particularly Brown Antechinus, Bush Rat, Swamp Rat, and possibly Eastern Pygmy-possum, Common Dunnart and New Holland Mouse. It would also provide additional information on herpetofauna.

10 REFERENCES

Anyon-Smith, S. (2006) *Birdwatching in Royal & Heathcote National Parks*. Sydney South Region, DEC, Audley.

Augee (2008) Short-beaked Echidna *Tachyglossus aculeatus*. Pp 37 – 39 in The Mammals of Australia (ed.) S. Van Dyck and R. Strahan. Reed New Holland, Australia.

Barrett, G., Silcocks, A., Barry S., Cunningham, R. and Poulter, R. (2003) *The New Atlas of Australian Birds*. Royal Australian Ornithologists Union. Hawthorn East, Victoria.

Benson and Eldershaw (2007) Backdrop to encounter: the 1770 landscape of Botany Bay, the plants collected by Banks and Solander and the rehabilitation of natural vegetation at Kurnell. *Cunninghamia* **10 (1)**: 113-137.

Berger, L., Speare, R., Daszak, P., Green, D.E., Cunningham, A.A., Coggin, C.L., Slocombe, R., Ragan, M.A., Hyatt, A.D., McDonald, K.R., Hines, H.B., Lips, K.R., Marantelli, G. and Parkes, H. (1998) Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. *Proceedings of the National Academy of Science USA* **95**: 9031-9036.

Birding-Aus (2010) *NSW - Sydney (Eastern Suburbs) - La Perouse-highlights*. Report by Frank Hemmings, 7th May 2007. http://bioacoustics.cse.unsw.edu.au/archives/html/birding-aus/2007-05/msg00080.html Accessed 3/6/2010.

Birdline NSW (2010) Eastern Grass Owl (female) near Cape Solander, Botany Bay NP. Report by David Potter, 17th July 2009. http://www.eremaea.com/BirdlineSpecies.aspx?Taxon=2545&Birdline=2

Birds Australia (2003) *Integrating Biodiversity into Regional Planning – the Wimmera Catchment Management Authority Pilot Project.* Scoping Report prepared for Wimmera Catchment Management Authority. Birds Australia, Melbourne.

Booth, C. (2006) *Barbed wire action plan.* Queensland Conservation Society, Brisbane. Available to download at http://www.wildlifefriendlyfencing.com/WFF/Home.html

Brennan, K. (2009) *Kurnell 2020: Corridor Delineation.* Department of Environment and Climate Change for the Sydney Metropolitan Catchment Management Authority.

Brunner, H. and Coman, B. (1974). *Identification of Mammalian Hair*. Inkata Press, Melbourne.

Chafer, C.J., Brandis, C.C.P. and Wright, D. (1999) *Handbook of birds found in the Illawarra, Shoalhaven and adjacent tablelands. Illawarra* Bird Observer's Club, Wollongong.

Churchill, S. (1998) *Australian Bats* Reed New Holland, Sydney.

Corben, C. (1989) Computer-based call analysis for microbat identification. *Macroderma* **5**:7.

Cuneo, P. and Leishman, M.R. (2006) African Olive (*Olea europaea* subsp. *cuspidata*) as an environmental weed in eastern Australia: a review. *Cunninghamia*, 9: 545-557

Debus, S.J.S., Agnew, L.R. and Schulz, M. (2001) Surveys of the Grass Owl *Tyto capensis* in coastal New South Wales. *Australian Bird Watcher* **19**: 94-102.

DEC (2004) *Post-fire Study of the fauna of the Woronora Plateau. Progress Report, July 2004*. Unpublished report funded under the Special Areas Plan of Management by the Department of Environment and Conservation (NSW), Conservation Assessment and Data Unit, Environment Protection and Regulation Division.

DEC (2005a) *Eastern Bristlebird – profile.* Department of Environment and Conservation (NSW) Threatened Species website. http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10206 Accessed 8/6/2010.

DEC (2005b) *Deer management plan 2005-2008 for Royal National Park and NPWS Parks and Reserves in the Sydney South Region*. NSW Dept of Environment and Conservation, Audley.

DECC (2007a) *Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region: Volume 2 – Fauna of Conservation Concern including priority pest species.* A joint project between the Sydney Catchment Authority and the Department of Environment and Climate Change (NSW) (DECC) under the Special Areas Strategic Plan of Management (SASPoM) by the Information and Assessment Section, Metropolitan Branch, Climate Change and Environment Protection Group, DECC, Hurstville.

DECC (2007b) *Management Plan for the Green and Golden Bell Frog Key Population at Kurnell*. Department of Environment and Climate Change (NSW), Sydney.

DECC (2007c) Lord Howe Island Biodiversity Management Plan.

http://www.environment.nsw.gov.au/resources/parks/LHI_bmp.pdf Accessed 8 June 2010.

DECC (2008a) *Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area*. New South Wales Department of Environment and Climate Change, Hurstville.

DECC (2008b) *Best practice guidelines: managing threatened beach-nesting shorebirds.* DECC, Sydney.

DECC (2008c) *Best practice guidelines for the grey-headed flying-fox*. DECC, Sydney.

DECC (2009a) *Eastern Bentwing-bat – profile.* Department of Environment and Climate Change (NSW) Threatened Species Website. http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10534 Accessed 09/06/2010.

DECC (2009b) *Royal and Heathcote National Parks and Garawarra State Conservation Area fire management strategy 2009.* NSW Dept of Environment and Climate Change, Sutherland.

DECCW (2009) *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area. Volume 1: Technical Report* and *Volume 2: Vegetation Community Profiles*. *Working Drafts.* Department of Environment, Climate Change and Water NSW, Hurstville.

DECCW (2010a) Atlas of NSW Wildlife. Database of Fauna and Flora records. Spatial Information and Analysis Section, Policy and Science Division, NSW Department of Environment and Climate Change, Hurstville. Data extracted on 16th June 2010.

DECCW (2010b) *Standard Operating Procedures for Pinniped Haul Outs.* Final Draft. NSW Department of Environment, Climate Change and Water, Hurstville.

DECCW (2010c) *Standard operating procedures for cetacean strandings.* Final Draft. Marine Fauna Program, NSW Department of Environment Climate Change and Water, Hurstville.

DECCW (2010d) *PWG Monitoring and Evaluation Guide*. Draft, August 2010. A product of the Park Management Program.

DECCW (2011) *The Vertebrate Fauna of Royal and Heathcote National Parks and Garawarra State Conservation Area*. Department of Environment, Climate Change and Water, Hurstville.

Department of Local Government (2007) *Information for cat owners in NSW*. Information brochure. NSW Dept of Local Government, Sydney.

Department of Primary Industries and Fisheries (2007) Warning Declared Class 1 Red-eared Slider Turtle *Trachemys scripta elegans*. http://www.dpi.qld.gov.au/documents/Biosecurity_EnvironmentalPests?IPA-Slider-Turtle-Warning.pdf Accessed 10 June 2010.

Dickman, C.R. (1996) Impact of exotic generalist predators on the native fauna of Australia. *Wildlife Biology* **2**: 185-195.

Dickman, C.R. and Watts, C.H.S. (2008) Black Rat *Rattus rattus*. Pages 707-709 in *The Mammals of Australia*. (eds.) van Dyck, S. and R. Strahan. Third edition. Reed New Holland, Sydney.

Dodkin, M.J. and Gilmore, A.M. (1984) Species and ecosystems at risk – a preliminary review. Pp 35-52 in *Proceedings of a Conference on Chrysanthemoides monolifera, Port Macquarie*. (eds.) A. Love and R. Dyason. NSW NPWS and NSW Department of Agriculture, Sydney.

Eby, P., Richards, G.C., Collins, L. and Parry-Jones, K. (1999) The distribution, abundance and vulnerability to population reduction of a nomadic nectarivore, the Grey-headed Flying Fox Pteropus *poliocephalus* in New South Wales, during a period of resource concentration. *Australian Zoologist* **31**: 240-253.

Garnett, S.T. and Crowley, G.M. (2000) *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.

Glen, A.S. and Dickman, C.R. (2005) Complex interactions among mammalian carnivores in Australia, and their implications for wildlife management. *Biological Reviews* **80**: 387-401.

Higgins, P.J. (ed.) (1999) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4. Parrots to Dollarbird*. Oxford University Press, Melbourne.

Higgins, P.J. and Davies, S.J.J.F. (eds.) (1996) *Handbook of Australian, New Zealand & Antarctic Birds. Volume 3: Snipe to Pigeons.* Oxford University Press, Melbourne.

Higgins, P.J., Peter, J.M. and Steele, W.K. (eds.) (2001) *Handbook of Australian, New Zealand & Antarctic Birds. Volume 5: Tyrant-flycatchers to Chats.* Oxford University Press, Melbourne.

Higgins, P.J., Peter, J.M. and Cowling, S.J. (eds.) (2006) *Handbook of Australian, New Zealand & Antarctic Birds. Volume 7: Boatbill to Starlings.* Oxford University Press, Melbourne.

Hoskin, E.S. (1991) *Birds of Sydney*. Surrey Beatty, Chipping Norton.

IUCN (International Union for the Conservation of Nature) (2005) 100 of the world's worst invasive alien species. http://www.issg.org/database/species/search.asp?st=100ss&fr=1&sts Accessed 21 May 2010.

Keith, D.A. (2004) *Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT*. NSW Dept of Environment and Conservation, Hurstville.

Keith, D. and Pellow, B. (2005) Effects of Javan Rusa Deer (*Cervus timorensis*) on native plant species in the Jibbon-Bundeena area, Royal National Park, New South Wales. *Proceedings of the Linnean Society of NSW* **126**: 99-110.

Le Souef, A.S. and Burrell, H. (1926) *The Wild Animals of Australasia; embracing New Guinea and the nearer Pacific Islands.* George Harrap, Sydney, NSW.

Lesryk Environmental Consultants (1997) *Ecological Assessment of Calsil Dune, Kurnell*.

Loyn, R.H. and French, K. (1991) Birds and environmental weeds in south-eastern Australia. *Plant Protection Quarterly* 6(3): 137-149.

Lunney, D., Matthews, A. and Triggs, B. (2002) Long-term changes in the mammal fauna of logged, coastal forests near Bega, New South Wales, detected by analysis of dog and fox scats. *Australian Mammalogy* 23: 101-114

McDonald, R.C., Isbell, R.F., Speight, J.G., Walker, J. and Hopkins, M.S. (eds.) (1990) *Australian Soil and Land Survey Field Handbook* (second edition). Inkata Press, Melbourne.

McFarland, D.C. (1991) The biology of the Ground Parrot *Pezoporus wallicus*, in Queensland. III. Distribution and abundance. *Wildlife Research* **18**: 199-213.

Menkhorst, P., Schedvin, N. and Geering, D. (1999) *Regent Honeyeater recovery plan 1999-2003*. Report prepared for the Regent Honeyeater Recovery Team, Dept of Natural Resources and Environment, Melbourne.

Morris, A.K. (1989) The birds of Botany Bay National Park, New South Wales. *Australian Birds* 23 (1): 7-21.

NPWS (1997a) *NSW Comprehensive Regional Assessments: Vertebrate fauna surveys, 1997-1998 summer survey season: Field survey methods*. NSW National Parks and Wildlife Service. Unpublished.

NPWS (1997b) *Management manual for marine mammals in NSW*. NSW National Parks and Wildlife Service, Hurstville.

NPWS (2000) Endangered population of Little Penguins (Eudyptula minor) at Manly, recovery plan. NSW National Parks and Wildlife Service, Hurstville.

NPWS (2001a) *Draft Fire Management Plan – Botany Bay National Park Kurnell Precinct*. NSW National Parks and Wildlife Service, Sydney South Region, Sutherland.

NPWS (2001b) *Threat abatement plan for predation by the Red Fox (Vulpes vulpes).* NSW National Parks and Wildlife Service, Hurstville.

NPWS (2001c) *Hygiene protocol for the control of disease in frogs*. Information Circular No. 6. NSW NPWS, Hurstville NSW.

NPWS (2002a) Botany Bay National Park Plan of Management. NSW National Parks and Wildlife Service. South Region, Sutherland

NPWS (2002b) *Draft Fire Management Plan Sydney Harbour and Botany Bay (La Perouse Precinct) National Parks.* NSW National Parks and Wildlife Service, Sydney Region, Parramatta.

NPWS (2003a) *Little Tern (Sterna albifrons) Recovery Plan*. New South Wales National Parks and Wildlife Service, Hurstville.

NPWS (2003b) *Procedural guidelines for the rescue and rehabilitation of oiled wildlife.* NSW National Parks and Wildlife Service, Hurstville.

NPWS (2003c) *Threat abatement plan for predation by Gambusia holbrooki - the Plague Minnow.* NSW National Parks and Wildlife Service, Hurstville.

NSW Natural Resources and Environment (NRE) CEO Cluster Group (2006) NSW Natural Resources Monitoring, Evaluation and Reporting Strategy.

NSW Scientific Committee (2004) *Herbivory and environmental degradation caused by feral deer - key threatening process listing*. http://www.environment.nsw.gov.au/determinations/FeralDeerKtp.htm Accessed 15/6/2010.

NSW Scientific Committee (2008a) *Predation by the European red fox - key threatening process listing*. http://www.environment.nsw.gov.au/determinations/EuropeanRedFoxKTPListing.htm Accessed 13/6/2010.

NSW Scientific Committee (2008b) Final determination to list feral Cat as a key threatening process. *http://www.environment.nsw.gov.au/determinations/FeralCatsKTPListing.htm* Accessed 7/7/10.

NSW Scientific Committee (2008c) Final determination to list Cane Toad as a key threatening process. http://www.environment.nsw.gov.au/determinations/BufoMarinusKtp.htm Accessed 7/7/10.

NSW Scientific Committee (2008d) Final determination to list Australian Fur-seal as a vulnerable species. http://www.environment.nsw.gov.au/determinations/AustralianFursealVulSpListing.htm Accessed 7/7/10.

NSW Scientific Committee (2008e) Final determination to list New Zealand Fur-seal as a vulnerable species. http://www.environment.nsw.gov.au/determinations/NewZealandFursealVulSpListing.htm Accessed 7/7/10.

NSW Scientific Committee (2009a) *Little Lorikeet Glossopsitta pusilla – vulnerable species listing*. http://www.environment.nsw.gov.au/determinations/littlelorikeetFD.htm Accessed 3/6/2010.

NSW Scientific Committee (2009b) Predation and Hybridisation by Feral Dogs (*Canis lupus familiaris*) - key threatening process listing. http://www.environment.nsw.gov.au/determinations/feraldogsFD.htm Accessed 13/6/2010

NSW Scientific Committee (2010) *White-fronted Chat Epthianura albifrons (Jardine & Selby, 1828) population in the Sydney Metropolitan Catchment Management Authority area – endangered population listing*. http://www.environment.nsw.gov.au/determinations/whitefrontedchatpopFD.htm Accessed 3/6/2010.

Parnaby, H. (1992a) *An interim guide to identification of insectivorous bats of south-eastern Australia. Technical Reports of the Australian Museum Number 8.* Australian Museum, Sydney.

Parnaby, H. (1992b) *An ultrasonic survey of microchiropteran bats of north-east NSW forests. North East Forests Biodiversity Study Report No. 3b.* NSW National Parks and Wildlife Service, Hurstville.

Pennay, M., Law, B. and Reinhold, L. (2004) *Bat calls of New South Wales: region based guide to the echolocation of microchiropteran bats.* NSW Department of Environment and Conservation, Hurstville.

Pyke, G. and White, A. (in press) Patterns of use of breeding habitat for two closely related Australian frogs, *Crinia tinnula* and *C. signifera*. Submitted to *Australian Zoologist* May 2009.

Richards, G.C. (1992). *Fauna Survey: Wingham Management Area, Port Macquarie Region. Part 4: Bats.* Forestry Commission of New South Wales, Forest Resources Services Report No. 22.

Richards, G.C. (1995) Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris*. Pp 467 – 468 in *Mammals of Australia* (ed.) R. Strahan. Reed Books, Chatswood.

Rogers, A.E.F. (1974) NSW bird report for 1973. *Birds* 8: 99 – 118.

Roy, P.S. and Crawford, E.A. (1981) Holocene Geological Evolution of the Southern Botany Bay – Kurnell Region, Central New South Wales Coast. Reprinted from: Department of Mineral Resources. *Records of the Geological Society of New South Wales* 20(2): 159-250.

Salt, D.F. (2000) *Kurnell - Birthplace of Modern Australia. A Pictorial History.* Southwood Press, Marrickville.

Schulz, M. (in prep. a) Land-based observations of inshore cetaceans and seals from the sea cliffs of Royal National Park, New South Wales. In preparation. To be submitted to Australian Zoologist.

Schulz, M. (in prep. b) Land-based observations of seabirds from the sea cliffs of Royal National Park, New South Wales. In preparation. To be submitted to the Australasian Seabird Group Newsletter.

Shelley, D. (2004) *Macquarie Marshes – Threatened species profiles*. Department of Infrastructure, Planning and Natural Resources, Dubbo.

Smith, P. (1991) The biology and management of Waders (Suborder Charadrii) in NSW. *Species Management Report Number 9*. NSW National Parks and Wildlife Service, Hurstville.

Stokes, V.L., Banks, P.B., Pech, R.P. and Williams, R.L. (2009) Invasion by *Rattus rattus* into native coastal forests of south-eastern Australia: are native small mammals at risk? *Austral Ecology* **34**: 395-408.

Straw, P. (1996) Wader population study of Botany Bay and Adjacent Wetlands. Royal Australian Ornithologists Union. Prepared for the Federal Airports Corporation.

Swift Parrot Recovery Team (2001) *Swift Parrot (Lathamus discolor) Recovery Plan 2001-2005.* Tasmanian Department of Primary Industries, Water and Environment and the Australian Department of Environment and Heritage, Canberra.

Thomson, B. (2002) *Australian handbook for conservation of bats in mines and artificial cave-bat habitats.* Australian Centre for Mining Environment Research, Melbourne.

Tidemann, C.R. and Woodside, D.P. (1978) A collapsible bat trap compared with mist-nets. *Australian Wildlife Research* 5: 363-384.

UBM Ecological Consultants (2009) *Fauna Surveys in Support of the Proposed Development of Wildlife Corridors on the Kurnell Peninsula.* Prepared for the Department of Environment and Climate Change. UBM Ecological Consultants, Sydney.

Walker, J. and Hopkins, M.S. (1990). Vegetation. Pages 58-86 in *Australian Soil and Land Survey Field Handbook*. Second edition. (eds.) R.C. McDonald, R.F. Isbell, J.G. Speight, J. Walker, and M.S. Hopkins. Inkata Press, Melbourne.

White (in press) Herpetofauna of the Kurnell Peninsula. Submitted to *Herpetofauna* April 2010.

White, A.W. (2007) The movements of Large Bentwing-bats Miniopterus schreibersii between sites in the eastern suburbs of Sydney. Abstract. Pp 48. In: *Program, abstracts and list of attendees. Symposium on the Biology and Conservation of Australian Bats*. Royal Zoological Society of New South Wales and Australasian Bat Society.

Young, B. and Young, A. (2006) *Understanding the scenery: the Royal National Park with Heathcote National Park*. Envirobook, Annandale.

APPENDIX A: PELAGIC SPECIES THAT OCCUR OFF THE COAST

RECORDS FROM KAMAY BOTANY BAY NATIONAL PARK

The list in Table 17 is compiled from records on the Atlas of NSW Wildlife that fall within the study area but are of pelagic species, as well as pelagic species reported for the waters off shore of KBBNP from other sources. Pelagic species in this report are defined as species that do not come ashore to rest within the study area, but occur as beachwashed individuals or may be seen flying or swimming off the coast.

Source: 1 = Atlas of NSW Wildlife; 2 = Birding Aus Website; 3 = Morris (1989); 4 = Steve Anyon-Smith (pers. comm.).

Table 17: Pelagic species recorded from the waters off shore of KBBNP

Scientific name	Common name	Source	Notes
Reptiles			
Chelonia mydas	Green Turtle	1	One spotted Congwong Beach in May 2003 and another off the west point of Cruwee Cove in 2004.
Birds			
Garrodia nereis	Grey-backed Storm-Petrel	1,3	Rare visitor (Morris 1989).
Pelagodroma marina	White-faced Storm-Petrel	1	Rare summer visitor, most likely found as beachwashed specimens.
Pelecanoides urinatrix	Common Diving Petrel	3	Rare winter visitor (Morris 1989).
Phoebetria fusca	Sooty Albatross	2	Seen from Cape Solander by Chris Ross Birding Aus 2002.
Diomedea exulans	Wandering Albatross	1,3	Common winter migrant from April to September (Morris 1989), although numbers have significantly declined in recent years.
Thalassarche melanophrys	Black-browed Albatross	1,3	Common winter migrant from April to September. Most common Albatross in the vicinity of park (Morris 1989).
Diomedea chlororhynchos	Yellow-nosed Albatross	3	Uncommon winter migrant mostly July to September (Morris 1989).
Diomedea cauta	Shy Albatross	3	Relatively common winter migrant from July to September (Morris 1989).
Ardenna grisea	Sooty Shearwater	1,3	Rare summer visitor (Morris 1989).
Ardenna pacificus	Wedge-tailed Shearwater	1,3	Common summer migrant from August to April. Most common shearwater off Botany Heads (Morris 1989).
Ardenna tenuirostris	Short-tailed Shearwater	1,3	Abundant summer migrant from September to April. Present in large numbers during the southward migration (Morris 1989).
Puffinus pacificus	Flesh-footed Shearwater	3	Uncommon summer visitor between October and March (Morris 1989).
Puffinus gavla	Fluttering Shearwater	1,3	Uncommon visitor mostly in summer (Morris 1989).
Puffinus huttoni	Hutton's Shearwater	1	Uncommon visitor.
Daption capense	Cape Petrel	1,3	Uncommon winter visitor (Morris 1989).

Scientific name	Common name	Source	Notes
Macronectes giganteus	Southern Giant Petrel	1, 3	Common winter migrant, mostly during August (Morris 1989), although numbers have declined in recent years.
Macronectes halli	Northern Giant Petrel	3	Rare winter visitor (Morris 1989).
Pachyptila turtur	Fairy Prion	1,3	Uncommon winter visitor ((Morris 1989).
Pseudobulweria rostrata	Tahiti Petrel	1	Very rare summer visitor.
Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	1	Very rare summer visitor.
Morus serrator	Australasian Gannet	1,3	Common visitor mostly winter April to August (Morris 1989), although seen in all months of the year.
Sula leucogaster	Brown Booby	1,3	Rare visitor (Morris 1989).
Catharacta skua	Great Skua	1,3	Rare winter visitor from June to August (Morris 1989).
Stercorarius parasiticus	Arctic Jaeger	1,3	Uncommon summer migrant from October to March (Morris 1989).
Stercorarius pomarinus	Pomarine Jaeger	3	Uncommon summer migrant from October to March (Morris 1989).
Chlidonias leucopterus	White-winged Black Tern	1	Vagrant.
Gelochelidon nilotica	Gull-billed Tern	1,3	Rare visitor to coastal beaches and reefs (Morris 1989).
Gygis alba	White Tern	1,3	Rare vagrant (Morris 1989).
Mammals			
Megaptera novaeangliae	Humpback Whale	1	Common. Regularly observed off the sea cliffs and from Cape Solander whale watching platform between May and November.
Pseudorca crassidens	False Killer Whale	1	Uncommon.
Eubalaena australis	Southern Right Whale		Uncommon. Would occasionally be observed off the sea cliffs and from Cape Solander whale watching platform, primarily in August.
Stenella coeruleoalba	Striped Dolphin	1	Seen off Inscription Point in 1992.
Stenella attenuata	Spotted Dolphin	4	Rare with one sighting reported from close inshore to Cape Solander (S. Anyon-Smith pers comm.).
Hydrurga leptonyx	Leopard Seal	1	Boat Harbour (1976, west of the Kurnell Precinct) and Yarra Bay (1963, west of the La Perouse Precinct)
Dugong dugon	Dugong	1	Single record near Captain Cooks Landing Place in 1992. Very rare.

OBSERVATIONS MADE IN INSHORE WATERS OFF ROYAL NATIONAL PARK

Table 18 presents a list of observations made during regular seawatches from the sea cliffs of Royal NP (Schulz in prep. a, b). The list is presented here as Royal NP lies just five kilometres to the south of the study area and species seen off the coast there would also be expected off the coast of KBBNP.

This list outlines the monthly occurrence of marine bird and mammal species seen from various locations off the Royal NP sea cliffs. This summary is derived from 564 one-hour seawatches between May 2007 and May 2010 (Schulz in prep. a, b). The scores denote frequency of observation of each species for each month: 6 = seen on all seawatches; 5 = 80-99% of seawatches; 4 = 50-80%; 3 = 25-50%; 2 = 5-25% and 1 = <5%. Species with an asterisk have included all subspecies.

Table 18: Observations made during regular seawatches from the sea cliffs of Royal NP (from Schulz in prep. a, b)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Count Number	**45**	**38**	**35**	**43**	**50**	**40**	**61**	**54**	**46**	**49**	**55**	**43**
Birds												
Wilson's Storm-Petrel	-	-	-	1	-	-	-	-	-	-	-	-
Wandering Albatross*	-	-	-	-	-	1	2	2	2	3	1	1
Black-browed Albatross*	1	1	1	2	4	5	6	5	4	3	2	2
Shy Albatross*	-	1	-	1	2	3	3	3	3	2	1	1
Grey-headed Albatross*	-	-	-	-	-	-	-	1	1	-	1	-
Yellow-nosed Albatross	-	-	-	1	3	3	4	4	2	2	-	-
Buller's Albatross	-	-	-	-	2	1	1	1	1	2	-	-
Southern Giant-Petrel	-	-	-	-	1	2	2	1	1	1	-	-
Northern Giant-Petrel	-	-	-	-	1	-	1	-	-	-	-	-
Giant-Petrel spp.	-	-	-	-	2	3	2	2	2	2	1	-
Cape Petrel	-	-	-	-	1	-	-	-	-	-	-	-
Fairy Prion	-	-	-	-	-	1	1	2	-	-	-	-
Non-Fairy Prion spp.	-	-	-	-	-	-	1	2	-	-	-	-
Wedge-tailed Shearwater	6	6	6	6	2	-	-	-	5	5	6	6
Buller's Shearwater	1	-	1	-	1	-	-	-	-	1	-	-
Flesh-footed Shearwater	1	2	1	2	-	-	-	-	-	-	1	-
Sooty Shearwater	1	1	-	1	2	1	1	-	1	1	1	1
Short-tailed Shearwater	4	4	2	-	-	-	-	-	2	4	3	4
Streaked Shearwater	1	1	2	-	-	-	-	-	-	-	-	-
Fluttering Shearwater	2	2	1	1	2	3	4	4	5	4	3	2
Hutton's Shearwater	1	1	-	-	-	-	1	1	1	2	-	-
Great-winged Petrel	-	-	-	-	1	1	1	1	1	1	1	-
Providence Petrel	-	-	-	1	-	-	-	-	-	-	-	-
White-necked Petrel	-	1	-	-	-	-	-	-	-	-	-	-
Little Penguin	3	2	2	3	3	4	4	3	3	2	2	3
Australasian Gannet	4	4	5	6	6	6	6	6	6	5	5	5

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Great Cormorant	4	4	2	2	2	3	2	2	2	4	3	4
Pied Cormorant	2	3	4	3	3	2	2	2	3	2	2	2
Brown Skua	-	-	1	1	2	1	2	3	2	1	-	-
Pomarine Jaeger	3	4	5	3	1	-	-	-	-	1	2	3
Arctic Jaeger	2	2	2	2	1	-	-	-	1	2	3	2
Long-tailed Jaeger	2	2	2	2	-	-	-	-	-	-	1	-
Sooty Tern	-	2	1	-	-	-	-	-	-	-	-	-
Little Tern	1	-	-	-	-	-	-	-	-	-	-	-
Caspian Tern	1	1	1	1	-	-	-	1	1	2	1	1
White-fronted Tern	-	-	-	1	2	2	3	2	-	-	-	-
Common Tern	-	-	-	-	-	-	-	-	-	1	1	-
Crested Tern	5	5	6	6	6	6	6	6	6	6	5	4
Kelp Gull	1	1	1	-	1	-	1	1	2	1	1	1
Silver Gull	5	6	6	6	6	6	6	6	6	5	6	5
Mammals												
Southern Right Whale	-	-	-	-	-	-	-	2	-	-	-	-
Large Unidentified Balaenoptera whale	-	-	-	-	-	-	-	1	-	-	-	-
Dwarf Minke Whale	-	-	-	-	1	1	-	1	-	-	1	1
Humpback Whale	-	-	-	1	2	5	4	3	3	4	3	1
Beaked Whale spp.	-	-	-	-	-	-	-	-	-	-	1	-
Indo-Pacific Bottlenose Dolphin	2	2	2	2	2	-	2	2	1	2	2	2
Short-beaked Common Dolphin	2	2	2	2	2	2	1	2	2	2	2	2
Risso's Dolphin	-	-	-	1	-	-	-	-	-	-	-	-
Pygmy Killer Whale	-	-	-	-	1	-	-	-	-	-	-	-
False Killer Whale	2	-	-	-	-	-	-	-	-	-	1	1
Killer Whale	-	-	-	-	1	-	1	-	-	-	-	-
Fur Seal spp.	2	1	2	2	1	2	2	2	2	1	1	-

APPENDIX B: VERTEBRATE FAUNA OF KAMAY BOTANY BAY NATIONAL PARK

INTRODUCTION

This appendix provides a list of vertebrate fauna (excluding fish and pelagic species) that currently occur or have previously been accurately recorded within the boundaries of Kamay Botany Bay National Park. The list is based on records from the Atlas of NSW Wildlife extracted on 16 June 2010, with additional species added to the list that are not recorded on the Atlas but were derived from other sources, as noted. Species that are only represented by records with high spatial inaccuracy, by unconfirmed sightings, probable misidentifications or database errors, as well as introduced and non-local species that do not have established wild populations within the study area have been removed from this list (see Table 7 for a list of these species). Users should be aware that such inaccurate species records are still present in several wildlife databases, most notably the Atlas of NSW Wildlife and the Birds Australia databases.

The lists provided below present all fauna confidently and accurately recorded within the reserve, whether historically or in the present. Some of these species no longer occur in the reserve or a particular Precinct and hence have not been included in the current species tallies in this report. Other species have suffered declines within or outside of the study area (or both) while others occur only in low numbers, visit on rare occasions or are vagrants. Yet others are characterised by little information and as a consequence there is uncertainty whether the species is a resident, a seasonal visitor, a vagrant or has been lost in recent years. The lists have therefore been annotated to summarise the current status of all fauna species within each Precinct.

The scientific names, common names and taxonomic order used in these tables and throughout this report follow those used in the Atlas of NSW Wildlife, which uses the Census of Australian Vertebrate Species (CAVS) codes. For each taxa the systematics derive from the following: for birds Christidis and Boles (2008); for mammals except bats Van Dyck and Strahan (2008); for bats Churchill (2008); for reptiles Wilson and Swan (2008); for amphibians Cogger (2000). The exception to this is threatened species, where nomenclature follows that used in the NSW Scientific Committee determinations to list each species.

TABLE DEFINITIONS

Species Lists for Each Precinct

Column heading	Definition of terms used
NSW legal status	Current listing under the *TSC Act* 1995 (as of June 2010). Codes used are E=Endangered, EP=Endangered Population, V=Vulnerable, P=Protected, U=Unprotected (Introduced species)
Federal legal status	Current listing under the Commonwealth *EPBC Act* (as of June 2010). E=Endangered, V=Vulnerable
Current status in precinct	Summary of the way that the species currently uses, or doesn't use, the precinct. Vagr= Vagrant= Species which are outside their currently accepted normal distribution. UC= Uncommon= Species for which there are very few records but which are within their currently accepted normal distribution. This includes resident species that appear to only occur in low numbers and species that only visit on an irregular basis. SSL= Suspected Species Loss= Species that are known to have sustained local populations either centred on or incorporating the precinct, but that have been impacted on locally to such an extent that breeding and/or primary habitat use no longer occurs. These species have been excluded from the current species tallies in this report and are presented in grey text. See Table 8 and species profiles for notes on these species. DV= Declining Visitor= Wide ranging and/or nomadic/migratory species which are likely to have once made use of the habitats present in the precinct to varying extents, but have suffered severe impacts across their known range and hence are no longer recorded or are recorded far less frequently. Suitable habitat remains for these species. SU= Status Uncertain= Species for which the current status cannot be

Column heading	Definition of terms used
	clearly defined, including species that are likely to have been under recorded due to their cryptic behaviour, preference for rarely surveyed specialised habitats, or the timing of the 2007 and 2010 surveys. No annotation= Species which have been reliably recorded on several occasions, often by more than one observer.
DECCW Survey	Species recorded during the 2007 and/or 2010 DECCW systematic and targeted surveys are denoted by '✓'
Other Atlas of NSW Wildlife Record	Species recorded by other studies or observers on the Atlas of NSW Wildlife as at 16 June 2010 are denoted by '✓'
Other Sources	The sources of these records are as follows: 1 = Arthur White, Biosphere Environmental Consultants, pers. comm. and White (in press); 2 = NPWS (2001); 3 = Birding Aus Website; 4 = Morris (1989); 5 = Geoff Ross, DECCW; 6 = C. Ramsay, DECCW; 7 = John Cann, former La Perouse Snake Man; 8 = Kaiya Donavan, DECCW. If Atlas records are only from 1950 or earlier, another source has been provided.

Combined Species List

Column heading	Definition of terms used
Kurnell Precinct	A '✓' indicates the species has been accurately recorded in the Kurnell Precinct and is included in the species tallies in this report, ranging from common residents to extremely rare visitors. A blank box indicates the species has not been accurately recorded from within the boundaries of the Precinct on the Atlas of NSW Wildlife or the other data sources listed above. SSL= Suspected Species Loss from the Precinct, as defined above.
La Perouse Precinct	A '✓' indicates the species has been accurately recorded in the La Perouse Precinct and is included in the species tallies in this report, ranging from common residents to extremely rare visitors. A blank box indicates the species has not been accurately recorded from within the boundaries of the Precinct on the Atlas of NSW Wildlife or the other data sources listed above. SSL= Suspected Species Loss from the Precinct, as defined above.

KURNELL PRECINCT

Table 19: Fauna species accurately recorded in the Kurnell Precinct of KBBNP

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Frogs								
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P			✓	✓	
Myobatrachidae	*Crinia tinnula*	Wallum Froglet	V			✓	✓	
Myobatrachidae	*Limnodynastes dumerilii grayi*	Eastern Banjo Frog	P			✓	✓	
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P			✓	✓	
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P			✓	✓	
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	UC		✓	
Hylidae	*Litoria dentata*	Bleating Tree Frog	P		UC		✓	
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P			✓		
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P		UC			1
Hylidae	*Litoria peronii*	Peron's Tree Frog	P			✓		
Reptiles								
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P		UC		✓	
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		UC			1
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		UC	✓		
Pygopodidae	*Pygopus lepidopodus*	Common Scaly-foot	P			✓	✓	
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P		UC	✓		
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		UC	✓		
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P		UC	✓	✓	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Skink	P			✓	✓	
Scincidae	*Cyclodomorphus michaeli*	Mainland She-oak Skink	P		UC	✓		
Scincidae	*Egernia whitii*	White's Skink	P		UC			1
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P			✓	✓	
Scincidae	*Eulamprus tenuis*	Barred-sided Skink	P		UC	✓		
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P			✓	✓	
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		UC	✓	✓	
Scincidae	*Saiphos equalis*	Three-toed Skink	P			✓	✓	
Scincidae	*Saproscincus mustelinus*	Weasel Skink	P		UC	✓		
Scincidae	*Tiliqua scincoides*	Eastern Blue-tongue	P			✓	✓	
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Varanidae	*Varanus varius*	Lace Monitor	P		UC	✓		
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		SU		✓	
Colubridae	*Dendrelaphis punctulatus*	Common Tree Snake	P			✓		
Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	P		UC	✓		
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	P			✓	✓	
Elapidae	*Hemiaspis signata*	Black-bellied Swamp Snake	P			✓	✓	
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P			✓	✓	
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P		SU			2
Birds								
Phasianidae	*Coturnix pectoralis*	Stubble Quail	P		UC	✓		
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P			✓	✓	
Anatidae	*Anas castanea*	Chestnut Teal	P		UC		✓	
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		UC		✓	
Anatidae	*Cygnus atratus*	Black Swan	P		UC		✓	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		UC		✓	
Columbidae	*Columba livia*	Rock Dove	U			✓	✓	
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		UC	✓		
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P			✓	✓	
Columbidae	*Phaps elegans*	Brush Bronzewing	P			✓	✓	
Columbidae	*Streptopelia chinensis*	Spotted Turtle-Dove	U			✓	✓	
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P			✓	✓	
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P			✓	✓	
Turnicidae	*Turnix varius*	Painted Button-quail	P		SSL		✓	
Apodidae	*Apus pacificus*	Fork-tailed Swift	P			✓		
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P			✓	✓	
Spheniscidae	*Eudyptula minor*	Little Penguin	P			✓	✓	
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	P			✓	✓	
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P			✓	✓	
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	P			✓	✓	
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P			✓	✓	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	P			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Ardeidae	*Ardea pacifica*	White-necked Heron	P		UC			3
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P			✓	✓	
Ardeidae	*Egretta sacra*	Eastern Reef Egret	P			✓	✓	
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	P			✓		
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		UC		✓	
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P			✓	✓	
Accipitridae	*Circus approximans*	Swamp Harrier	P		UC		✓	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P			✓	✓	
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P			✓	✓	
Accipitridae	*Haliastur sphenurus*	Whistling Kite	P		UC		✓	
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		UC		✓	
Accipitridae	*Pandion haliaetus*	Osprey	V		UC		✓	4
Falconidae	*Falco berigora*	Brown Falcon	P		UC		✓	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P			✓	✓	
Falconidae	Falco longipennis	Australian Hobby	P		UC	✓		
Falconidae	*Falco peregrinus*	Peregrine Falcon	P			✓	✓	
Rallidae	*Lewinia pectoralis*	Lewin's Rail	P			✓		
Rallidae	*Porzana tabuensis*	Spotless Crake	P		UC		✓	
Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher	V			✓	✓	
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E		UC	✓	✓	
Charadriidae	*Charadrius bicinctus*	Double-banded Plover	P		UC, DV		✓	
Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V		UC, DV		✓	
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	P		UC, DV			4
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	P			✓	✓	
Charadriidae	*Vanellus miles*	Masked Lapwing	P			✓	✓	
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	P		UC		✓	
Scolopacidae	*Calidris ruficollis*	Red-necked Stint	P		UC, DV		✓	
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	P		UC	✓		
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	P		UC			5
Scolopacidae	*Numenius phaeopus*	Whimbrel	P		UC		✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Scolopacidae	*Tringa brevipes*	Grey-tailed Tattler	P		UC		✓	
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	P			✓	✓	
Laridae	*Hydroprogne caspia*	Caspian Tern	P			✓		
Laridae	*Larus dominicanus*	Kelp Gull	P				✓	
Laridae	*Larus pacificus*	Pacific Gull	P		UC, DV		✓	
Laridae	*Sternula albifrons*	Little Tern	E		UC, DV		✓	
Laridae	*Sterna hirundo*	Common Tern	P					4
Laridae	*Sterna striata*	White-fronted Tern	P		UC		✓	
Laridae	*Thalasseus bergii*	Crested Tern	P			✓	✓	
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P			✓	✓	
Cacatuidae	*Cacatua sanguinea*	Little Corella	P		UC	✓		
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P			✓	✓	
Cacatuidae	*Eolophus roseicapillus*	Galah	P			✓	✓	
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P			✓	✓	
Psittacidae	*Lathamus discolor*	Swift Parrot	E	E	UC, DV		✓	
Psittacidae	*Platycercus elegans*	Crimson Rosella	P			✓	✓	
Psittacidae	*Platycercus eximius*	Eastern Rosella	P			✓	✓	
Psittacidae	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	P		SU		✓	
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P			✓	✓	
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P			✓		
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P			✓	✓	
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		UC		✓	5
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P			✓	✓	
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		SU		✓	
Cuculidae	*Eudynamys orientalis*	Eastern Koel	P			✓	✓	
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P				✓	
Strigidae	*Ninox novaeseelandiae*	Southern Boobook	P			✓	✓	
Strigidae	*Ninox strenua*	Powerful Owl	V				✓	
Tytonidae	*Tyto capensis*	Grass Owl	V		SU	✓		
Tytonidae	*Tyto javanica*	Eastern Barn Owl	P					5

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	P			✓	✓	
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	P			✓	✓	
Coraciidae	*Eurystomus orientalis*	Dollarbird	P			✓	✓	
Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	P			✓		
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P			✓	✓	
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P			✓	✓	
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P			✓	✓	
Dasyornithidae	*Dasyornis brachypterus*	Eastern Bristlebird	E	E	SSL			4
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P		SU		✓	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P			✓	✓	
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		SSL		✓	4
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		UC		✓	3, 4
Acanthizidae	Hylacola pyrrhopygia	Chestnut-rumped Heathwren	P		SSL			4
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P			✓	✓	
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P			✓	✓	
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		UC	✓	✓	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		SU			4
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P			✓	✓	
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P			✓	✓	
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V, EP		SSL			4
Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater	P			✓	✓	
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P			✓	✓	
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P			✓	✓	
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		UC		✓	4
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		UC		✓	4
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		UC		✓	
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P			✓	✓	
Meliphagidae	Xanthomyza phrygia	Regent Honeyeater	CE	E	UC, DV		✓	
Psophodidae	*Psophodes olivaceus*	Eastern Whipbird	P		UC			4
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P			✓	✓	
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P			✓	✓	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P			✓	✓	
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		UC		✓	
Oriolidae	*Sphecotheres vieilloti*	Australasian Figbird	P		UC	✓	✓	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P			✓	✓	
Artamidae	*Cracticus tibicen*	Australian Magpie	P			✓	✓	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P			✓	✓	
Artamidae	*Strepera graculina*	Pied Currawong	P			✓	✓	
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	P		UC	✓	✓	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	P			✓	✓	
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	P			✓	✓	
Rhipiduridae	*Rhipidura rufifrons*	Rufous Fantail	P		UC		✓	
Corvidae	*Corvus coronoides*	Australian Raven	P			✓	✓	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P			✓	✓	
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch	P		UC		✓	
Monarchidae	*Myiagra rubecula*	Leaden Flycatcher	P		UC	✓	✓	
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P			✓	✓	
Petroicidae	*Petroica rosea*	Rose Robin	P		UC		✓	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	P			✓	✓	
Megaluridae	*Megalurus timoriensis*	Tawny Grassbird	P		SU	✓		
Timaliidae	*Zosterops lateralis*	Silvereye	P			✓	✓	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P			✓	✓	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P			✓		
Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	U			✓	✓	
Sturnidae	*Sturnus tristis*	Common Myna	U				✓	
Sturnidae	*Sturnus vulgaris*	Common Starling	U			✓	✓	
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	P			✓	✓	
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P			✓	✓	
Passeridae	*Passer domesticus*	House Sparrow	U				✓	
Motacillidae	*Anthus novaeseelandiae*	Australian Pipit	P			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Mammals								
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		SU		✓	
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P					5
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P			✓	✓	
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V		✓		
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		UC		✓	
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P			✓		
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P			✓	✓	
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P			✓		
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V			✓		
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P			✓	✓	
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P			✓		
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P			✓	✓	
Muridae	*Mus musculus*	House Mouse	U			✓	✓	
Muridae	*Rattus rattus*	Black Rat	U			✓	✓	
Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	V					5
Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur-seal	V					5
Canidae	*Canis lupus familiaris*	Dog	U			✓	✓	
Canidae	*Vulpes vulpes*	Fox	U			✓	✓	
Felidae	*Felis catus*	Cat	U			✓	✓	
Leporidae	*Oryctolagus cuniculus*	Rabbit	U				✓	
Cervidae	*Cervus* sp. (presumably *timorensis)*	Deer (presumably Rusa Deer)	U		SU			6

LA PEROUSE PRECINCT

Table 20: Fauna species accurately recorded in the La Perouse Precinct of KBBNP

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Frogs								
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P			✓	✓	
Myobatrachidae	*Limnodynastes dumerilii greyi*	Eastern Banjo Frog	P		UC		✓	
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P			✓	✓	
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E		SSL		✓	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P				✓	
Reptiles								
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P			✓		
Pygopodidae	*Pygopus lepidopodus*	Common Scaly-foot	P			✓	✓	
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P			✓	✓	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Skink	P			✓	✓	
Scincidae	*Cyclodomorphus michaeli*	Mainland She-oak Skink	P		UC		✓	
Scincidae	*Egernia whitii*	White's Skink	P			✓		
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P			✓	✓	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P			✓	✓	
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		UC		✓	
Scincidae	*Saiphos equalis*	Three-toed Skink	P			✓	✓	
Scincidae	*Saproscincus mustelinus*	Weasel Skink	P		UC	✓		
Scincidae	*Tiliqua scincoides*	Eastern Blue-tongue	P			✓		
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P			✓	✓	
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P				✓	
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	P					7
Elapidae	*Hemiaspis signata*	Black-bellied Swamp Snake	P					8
Elapidae	*Notechis scutatus*	Tiger Snake	P		UC			7
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P			✓	✓	
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P				✓	
Birds								
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P		UC		✓	
Columbidae	*Columba livia*	Rock Dove	U			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		UC		✓	
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P			✓		
Columbidae	*Streptopelia chinensis*	Spotted Turtle-Dove	U			✓		
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P				✓	
Spheniscidae	*Eudyptula minor*	Little Penguin	P			✓	✓	
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	P			✓		
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P			✓	✓	
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	P			✓	✓	
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P			✓	✓	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	P			✓		
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P			✓	✓	
Ardeidae	*Egretta sacra*	Eastern Reef Egret	P		UC	✓		
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		UC		✓	
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P			✓	✓	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P			✓	✓	
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P			✓	✓	
Falconidae	*Falco berigora*	Brown Falcon	P		UC		✓	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P			✓	✓	
Falconidae	*Falco longipennis*	Australian Hobby	P					4
Falconidae	*Falco peregrinus*	Peregrine Falcon	P				✓	
Rallidae	*Gallirallus philippensis*	Buff-banded Rail	P		UC	✓		
Rallidae	*Lewinia pectoralis*	Lewin's Rail	P			✓		
Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher	V			✓	✓	
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	P		UC, DV		✓	4
Charadriidae	*Vanellus miles*	Masked Lapwing	P			✓	✓	
Scolopacidae	*Calidris ruficollis*	Red-necked Stint	P		UC, DV		✓	
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	P		UC		✓	
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	P			✓	✓	
Laridae	*Larus dominicanus*	Kelp Gull	P			✓	✓	
Laridae	*Thalasseus bergii*	Crested Tern	P			✓	✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P			✓	✓	
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P			✓	✓	
Cacatuidae	*Eolophus roseicapillus*	Galah	P			✓	✓	
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P			✓		
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V					3
Psittacidae	*Platycercus elegans*	Crimson Rosella	P			✓	✓	
Psittacidae	*Platycercus eximius*	Eastern Rosella	P			✓	✓	
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P			✓		
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P			✓	✓	
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P		UC		✓	
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P			✓	✓	
Strigidae	*Ninox novaeseelandiae*	Southern Boobook	P		UC		✓	
Tytonidae	*Tyto javanica*	Eastern Barn Owl	P					8
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	P			✓	✓	
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	P		UC		✓	
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		UC		✓	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P			✓	✓	
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		UC		✓	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P			✓	✓	
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P					3,4
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P			✓		
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P			✓	✓	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		SU	✓	✓	
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P			✓	✓	
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P			✓	✓	
Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater	P		SU		✓	
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P			✓	✓	
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater	P					3
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	P		UC		✓	
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P			✓		
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P		UC		✓	

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		UC		✓	
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		UC	✓		
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P			✓	✓	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P			✓	✓	
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P			✓	✓	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P			✓		
Artamidae	*Cracticus tibicen*	Australian Magpie	P			✓	✓	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P			✓	✓	
Artamidae	*Strepera graculina*	Pied Currawong	P			✓	✓	
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	P			✓	✓	
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	P			✓	✓	
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	P			✓	✓	
Corvidae	*Corvus coronoides*	Australian Raven	P			✓	✓	
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P			✓	✓	
Monarchidae	*Myiagra rubecula*	Leaden Flycatcher	P		UC		✓	
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P			✓	✓	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	P			✓	✓	
Timaliidae	*Zosterops lateralis*	Silvereye	P			✓	✓	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P			✓	✓	
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P				✓	
Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	U			✓	✓	
Turdidae	*Turdus merula*	Eurasian Blackbird	U			✓	✓	
Sturnidae	*Sturnus tristis*	Common Myna	U			✓	✓	
Sturnidae	*Sturnus vulgaris*	Common Starling	U			✓	✓	
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	P		UC	✓		
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P			✓	✓	
Passeridae	*Passer domesticus*	House Sparrow	U			✓	✓	
Motacillidae	*Anthus novaeseelandiae*	Australian Pipit	P			✓		
Mammals								
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		SU		✓	
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P			✓		

Family	Scientific name	Common name	NSW legal status	Federal legal status	Current status in precinct	DECCW survey	Other Atlas of NSW Wildlife record	Other sources
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P				1	
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V		✓		
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P			✓		
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P			✓		
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V			✓	✓	
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P			✓		
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P			✓		
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P			✓		
Muridae	*Rattus rattus*	Black Rat	U			✓		
Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	V					8
Canidae	*Canis lupus*	Dog	U			✓		
Canidae	*Vulpes vulpes*	Fox	U			✓		
Felidae	*Felis catus*	Cat	U			✓		
Leporidae	*Oryctolagus cuniculus*	Rabbit	U			✓		

COMBINED SPECIES LIST FOR ENTIRE KAMAY BOTANY BAY NATIONAL PARK

Table 21: Fauna species accurately recorded in Kamay Botany Bay National Park

Family	Scientific name	Common name	NSW legal status	Federal legal status	Kurnell Precinct	La Perouse Precinct
Frogs						
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		✓	✓
Myobatrachidae	*Crinia tinnula*	Wallum Froglet	V		✓	
Myobatrachidae	*Limnodynastes dumerilii grayi*	Eastern Banjo Frog	P		✓	✓
Myobatrachidae	*Limnodynastes peronii*	Brown-striped Frog	P		✓	✓
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P		✓	
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	✓	SSL
Hylidae	*Litoria dentata*	Bleating Tree Frog	P		✓	
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		✓	
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P		✓	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		✓	✓
Reptiles						
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P		✓	
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		✓	✓
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		✓	
Pygopodidae	*Pygopus lepidopodus*	Common Scaly-foot	P		✓	✓
Scincidae	*Acritoscincus platynota*	Red-throated Skink	P		✓	✓
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		✓	
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P		✓	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Skink	P		✓	✓
Scincidae	*Cyclodomorphus michaeli*	Mainland She-oak Skink	P		✓	✓
Scincidae	*Egernia whitii*	White's Skink	P		✓	✓
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P		✓	✓
Scincidae	*Eulamprus tenuis*	Barred-sided Skink	P		✓	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P		✓	✓
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		✓	✓
Scincidae	*Saiphos equalis*	Three-toed Skink	P		✓	✓
Scincidae	*Saproscincus mustelinus*	Weasel Skink	P		✓	✓
Scincidae	*Tiliqua scincoides*	Eastern Blue-tongue	P		✓	✓

Family	Scientific name	Common name	NSW legal status	Federal legal status	Kurnell Precinct	La Perouse Precinct
Agamidae	*Amphibolurus muricatus*	Jacky Lizard	P		✓	✓
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P			✓
Varanidae	*Varanus varius*	Lace Monitor	P		✓	
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		✓	
Colubridae	*Dendrelaphis punctulatus*	Common Tree Snake	P		✓	
Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	P		✓	
Elapidae	*Demansia psammophis*	Yellow-faced Whip Snake	P		✓	✓
Elapidae	*Hemiaspis signata*	Black-bellied Swamp Snake	P		✓	✓
Elapidae	*Notechis scutatus*	Tiger Snake	P			✓
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P		✓	✓
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P		✓	✓
Birds						
Phasianidae	*Coturnix pectoralis*	Stubble Quail	P		✓	
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P		✓	✓
Anatidae	*Anas castanea*	Chestnut Teal	P		✓	
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		✓	
Anatidae	*Cygnus atratus*	Black Swan	P		✓	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		✓	
Columbidae	*Columba livia*	Rock Dove	U		✓	✓
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		✓	✓
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	P		✓	✓
Columbidae	*Phaps elegans*	Brush Bronzewing	P		✓	
Columbidae	*Streptopelia chinensis*	Spotted Turtle-Dove	U		✓	✓
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P		✓	✓
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P		✓	
Turnicidae	*Turnix varius*	Painted Button-quail	P		SSL	
Apodidae	*Apus pacificus*	Fork-tailed Swift	P		✓	
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P		✓	
Spheniscidae	*Eudyptula minor*	Little Penguin	P		✓	✓
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant	P		✓	✓
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P		✓	✓

Family	Scientific name	Common name	NSW legal status	Federal legal status	Kurnell Precinct	La Perouse Precinct
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	P		✓	✓
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant	P		✓	✓
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican	P		✓	✓
Ardeidae	*Ardea pacifica*	White-necked Heron	P		✓	
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P		✓	✓
Ardeidae	*Egretta sacra*	Eastern Reef Egret	P		✓	✓
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	P		✓	
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		✓	✓
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		✓	✓
Accipitridae	*Circus approximans*	Swamp Harrier	P		✓	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P		✓	✓
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P		✓	✓
Accipitridae	*Haliastur sphenurus*	Whistling Kite	P		✓	
Accipitridae	*Lophoictinia isura*	Square-tailed Kite	V		✓	
Accipitridae	*Pandion haliaetus*	Osprey	V		✓	
Falconidae	*Falco berigora*	Brown Falcon	P		✓	✓
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P		✓	✓
Falconidae	Falco longipennis	Australian Hobby	P		✓	✓
Falconidae	*Falco peregrinus*	Peregrine Falcon	P		✓	✓
Rallidae	*Gallirallus philippensis*	Buff-banded Rail	P			✓
Rallidae	*Lewinia pectoralis*	Lewin's Rail	P		✓	✓
Rallidae	*Porzana tabuensis*	Spotless Crake	P		✓	
Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher	V		✓	✓
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E		✓	
Charadriidae	*Charadrius bicinctus*	Double-banded Plover	P		✓	
Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V		✓	
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover	P		✓	
Charadriidae	*Elseyornis melanops*	Black-fronted Dotterel	P		✓	
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover	P			✓
Charadriidae	*Vanellus miles*	Masked Lapwing	P		✓	✓
Scolopacidae	*Arenaria interpres*	Ruddy Turnstone	P		✓	

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Scolopacidae	*Calidris ruficollis*	Red-necked Stint	P		✓	✓
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	P		✓	✓
Scolopacidae	*Limosa lapponica*	Bar-tailed Godwit	P		✓	
Scolopacidae	*Numenius phaeopus*	Whimbrel	P		✓	
Scolopacidae	*Tringa brevipes*	Grey-tailed Tattler	P		✓	
Laridae	*Chroicocephalus novaehollandiae*	Silver Gull	P		✓	✓
Laridae	*Hydroprogne caspia*	Caspian Tern	P		✓	
Laridae	*Larus dominicanus*	Kelp Gull	P		✓	✓
Laridae	*Larus pacificus*	Pacific Gull	P		✓	
Laridae	*Sterna albifrons*	Little Tern	E		✓	
Laridae	*Sterna hirundo*	Common Tern	P		✓	
Laridae	*Sterna striata*	White-fronted Tern	P		✓	
Laridae	*Thalasseus bergii*	Crested Tern	P		✓	✓
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P		✓	✓
Cacatuidae	*Cacatua sanguinea*	Little Corella	P		✓	
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P		✓	✓
Cacatuidae	*Eolophus roseicapillus*	Galah	P		✓	✓
Psittacidae	*Glossopsitta concinna*	Musk Lorikeet	P		✓	✓
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V			✓
Psittacidae	*Lathamus discolor*	Swift Parrot	E	E	✓	
Psittacidae	*Platycercus elegans*	Crimson Rosella	P		✓	✓
Psittacidae	*Platycercus eximius*	Eastern Rosella	P		✓	✓
Psittacidae	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet	P		✓	
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P		✓	✓
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P		✓	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		✓	✓
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo	P		✓	
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo	P		✓	✓
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	P		✓	✓
Cuculidae	*Eudynamys orientalis*	Eastern Koel	P		✓	
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P		✓	

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Strigidae	*Ninox novaeseelandiae*	Southern Boobook	P		✓	✓
Strigidae	*Ninox strenua*	Powerful Owl	V		✓	
Tytonidae	*Tyto capensis*	Grass Owl	V		✓	
Tytonidae	*Tyto javanica*	Eastern Barn Owl	P		✓	✓
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		✓	✓
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher	P		✓	✓
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		✓	✓
Climacteridae	*Cormobates leucophaea*	White-throated Treecreeper	P		✓	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P		✓	✓
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		✓	✓
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P		✓	
Dasyornithidae	*Dasyornis brachypterus*	Eastern Bristlebird	E	E	SSL	
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill	P		✓	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P		✓	✓
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		SSL	
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		✓	✓
Acanthizidae	Hylacola pyrrhopygia	Chestnut-rumped Heathwren	P		SSL	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		✓	✓
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		✓	✓
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		✓	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		✓	✓
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P		✓	✓
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P		✓	✓
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V, EP		SSL	
Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater	P		✓	✓
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		✓	✓
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater	P			✓
Meliphagidae	*Lichenostomus penicillatus*	White-plumed Honeyeater	P			✓
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		✓	✓
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P			✓
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		✓	✓

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Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P		✓	
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		✓	✓
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		✓	✓
Meliphagidae	Xanthomyza phrygia	Regent Honeyeater	CE	E	✓	
Psophodidae	*Psophodes olivaceus*	Eastern Whipbird	P		✓	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		✓	✓
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		✓	
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		✓	✓
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		✓	✓
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P		✓	
Oriolidae	*Sphecotheres vieilloti*	Australasian Figbird	P		✓	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P		✓	
Artamidae	*Cracticus tibicen*	Australian Magpie	P		✓	✓
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		✓	✓
Artamidae	*Strepera graculina*	Pied Currawong	P		✓	✓
Dicruridae	*Dicrurus bracteatus*	Spangled Drongo	P		✓	✓
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	P		✓	✓
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	P		✓	✓
Rhipiduridae	*Rhipidura rufifrons*	Rufous Fantail	P		✓	
Corvidae	*Corvus coronoides*	Australian Raven	P		✓	✓
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P		✓	✓
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch	P		✓	
Monarchidae	*Myiagra rubecula*	Leaden Flycatcher	P		✓	✓
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		✓	✓
Petroicidae	*Petroica rosea*	Rose Robin	P		✓	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	P		✓	✓
Megaluridae	Megalurus timoriensis	Tawny Grassbird	P		✓	
Timaliidae	*Zosterops lateralis*	Silvereye	P		✓	✓
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		✓	✓
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		✓	✓
Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered Bulbul	U		✓	✓

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Turdidae	*Turdus merula*	Eurasian Blackbird	U			✓
Sturnidae	*Sturnus tristis*	Common Myna	U		✓	✓
Sturnidae	*Sturnus vulgaris*	Common Starling	U		✓	✓
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	P		✓	✓
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		✓	✓
Passeridae	*Passer domesticus*	House Sparrow	U		✓	✓
Motacillidae	*Anthus novaeseelandiae*	Australian Pipit	P		✓	✓
Mammals						
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		✓	✓
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		✓	✓
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P		✓	✓
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	✓	✓
Emballonuridae	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V		✓	
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P		✓	✓
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P		✓	✓
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P		✓	
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		✓	✓
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat	P		✓	✓
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P		✓	✓
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P		✓	✓
Muridae	*Mus musculus*	House Mouse	U		✓	
Muridae	*Rattus rattus*	Black Rat	U		✓	✓
Otariidae	*Arctocephalus forsteri*	New Zealand Fur-seal	V		✓	✓
Otariidae	*Arctocephalus pusillus doriferus*	Australian Fur-seal	V		✓	
Canidae	*Canis lupus familiaris*	Dog	U		✓	✓
Canidae	*Vulpes vulpes*	Fox	U		✓	✓
Felidae	*Felis catus*	Cat	U		✓	✓
Leporidae	*Oryctolagus cuniculus*	Rabbit	U		✓	✓
Cervidae	*Cervus* sp. (presumably *timorensis)*	Deer (presumably Rusa Deer)	U		✓	




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