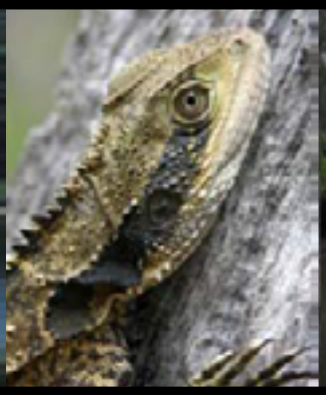

The Vertebrate Fauna of Georges River National Park

NSW GOVERNMENT
Office of Environment & Heritage
NSW National Parks & Wildlife Service

THE VERTEBRATE FAUNA OF GEORGES RIVER NATIONAL PARK

FINAL REPORT

October 2013

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Cover Photos

Front cover
Feature Photo, Estuarine Mangrove Forest. Photo © OEH
View up Georges River from the south bank. Photo © M. Schulz/OEH
Eastern water dragon. Photo © N. Williams
View along Mill Creek. Photo © M. Schulz/OEH
Koala. Photo © P. Madden

Back cover
Chestnut teal. Photo © M. Schulz
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Rocky escarpment along the southern bank of the Georges River. Photo © M. Schulz/OEH
Yeramba Lagoon. Photo © E. Magarey/OEH
Littoral Rainforest at Williams Reserve. Photo © J. Madden/OEH

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OVERVIEW

A picnic on the river bank beneath shady gums; a silent moment after casting a line into the still waters; or gazing from the rear deck of a home overlooking a sea of trees with the glint of water in the distance. This is how most people view Georges River National Park – a place to have fun in, to live close to or to rush past in the car. Much less well known are the fauna values of this reserve which is nestled amongst suburbs such as Alfords Point, Lugarno, Padstow Heights and Sandy Point. The reserve flanks both the northern and southern banks of the Georges River and is a complex of 15 separate portions of land. Some of these portions are narrow foreshore zones located between backyards and the high tide line, while others form a contiguous stretch of vegetation across a sequence of estuarine mudflats, foreshore escarpments and plateau ridges and gullies.

In 2012-13 a fauna study was undertaken as part of the Biodiversity Survey Priorities program. This study included new survey work and compilation of previously existing information. Two hundred and forty-eight native vertebrate fauna species (excluding fish) are now recorded for Georges River National Park, comprising 16 frog, 32 reptile, 180 bird and 20 mammal species. In addition 19 introduced species have been documented. The Park provides habitat for at least 20 fauna species listed as threatened under the NSW *Threatened Species Conservation Act 1995*, more than half of which occur on a regular basis or as breeding residents. The 2012-13 surveys confirmed the presence of the iconic threatened species the koala; habitat is found on flats south of the River and form one of the closest known haunts to the Sydney CBD. A number of threatened fauna species were recorded in the Park for the first time during the surveys, including Rosenberg's goanna, little eagle, little lorikeet and the sooty owl.

The species richness results from the range of habitats present in the Park including littoral rainforest, dry sclerophyll forests, heath, freshwater lagoons, swamp forests, floodplain wetlands, mangroves and saltmarshes. Also important is the fact that the southern portion of the Park is connected to a vast tract of bushland which extends southwards to Budderoo and Morton national parks and beyond. Furthermore, the Georges River is a significant feature itself, as it connects Botany Bay with the protected Sydney Water catchment lands and drains parts of the Cumberland Plain. The intertidal mudflats, sandy beaches and open tidal waters along the River and its tributaries provide habitat for a number of marine species and waterbirds ranging upstream from Botany Bay such as the eastern osprey, a variety of cormorants, large wading birds and some species listed under international migratory bird agreements. The contrasting dry forests and heaths on the slopes and ridges above the River support species typical of the Sydney sandstone landscape, including some endemic to the Sydney basin (such as the rockwarbler and red-crowned toadlet) and some that have declined on the fringes of the Sydney urban area (such as Rosenberg's goanna and the chestnut-rumped heathwren). The western parts of the reserve support fauna more typical of drier woodland communities, such as the weebill, fuscous honeyeater and black-chinned honeyeater. The freshwater lagoons, particularly Yeramba Lagoon, attracts a variety of frog and waterbird species, including the Tyler's tree frog which is generally uncommon in southern Sydney and some vagrant bird species which predominantly occur during inland droughts such as the blue-billed duck and freckled duck. Six of the eleven fauna habitats identified in Georges River National Park are considered priority habitats in the Sydney metropolitan context.

The 2012-13 fauna study found that almost half of the total number of threatened species recorded in the Park occur in the Mill Creek catchment. This portion of the Park is subject to less recreational use than many parts of the reserve and is less affected by urban land uses. However this area is not free from threats to native fauna. Rusa deer were found to be well established in this portion, an indication that the reserve's connection to the Woronora Plateau allows movement of both native and introduced species. The Mill Creek catchment is also extensively used illegally by trail bike riders.

The challenge for the management of Georges River National Park is the maintenance of its biodiversity values despite the 15 separate portions and the surrounding highly urbanised environment. Threats to native fauna include high frequency fire, weed invasion, loss of key feed trees, feral species and road mortality of animals crossing sealed roads within and bordering the Park. The maintenance of habitat connectivity between the southern portion of the Park and the Holsworthy Military Area is important for many bushland species.

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1 INTRODUCTION

1.1 PROJECT RATIONALE

Information that describes the type, distribution and status of biodiversity in New South Wales is required by many arms of the Office of Environment and Heritage (OEH) for regulatory, conservation assessment and land management purposes. In the Sydney Basin Bioregion over 60 per cent of extant native vegetation occurs in OEH reserves making it the largest individual custodian of native flora and fauna in the region. Since 2003, the Metropolitan Branches of the Parks and Wildlife Group and the group now called Regional Operations have 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. Between 2003 and 2012 28 reserve areas 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 Threatened Ecological Communities (TECs).

In 2009 a number of reserves in the southern Sydney metropolitan area were prioritised for systematic fauna survey and reporting. Work has been completed in the Royal National Park (NP), Heathcote NP and Garawarra State Conservation Area (SCA) reserve complex (DECCW 2011a) and in Kamay Botany Bay National Park (DECCW 2011b). This report presents the results for Georges River NP, and a report for Towra Point Nature Reserve (NR) is being prepared concurrently.

1.2 PROJECT AIMS

The existing Plan of Management for Georges River NP (NPWS 1994) sets the following policies: “native animal populations will be surveyed”; and “the Park will be surveyed for introduced plants and animals and their status monitored”. The current project was designed to address the aims of both the BSP program and the existing Plan of Management for Georges River NP by surveying native and introduced animals and providing an adequate level of information on native vertebrate fauna to inform the revised Plan of Management.

The primary objectives of the surveys were to:

- Undertake a review of previous systematic fauna survey effort across Georges River NP and identify gaps for particular fauna groups, habitats or areas.
- Undertake systematic fauna survey to fill in the gaps identified above.

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 reserve, 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 Georges River NP makes towards the protection of vertebrate fauna in the region, with a focus on threatened and migratory fauna species.
- Identify broad-scale patterns in fauna habitat use across the reserve and identify habitats of particular conservation significance in a regional context.
- Identify major threatening processes to native fauna in Georges River NP.
- Identify priorities for conservation and management of terrestrial vertebrate fauna in the reserve and propose management strategies to maintain or enhance the current fauna values.

1.3 STUDY AREA

1.3.1 Location and study area boundaries

Georges River NP is located on a stretch of sandstone escarpment and riverflat along the Georges River, about 25 kilometres south-west of central Sydney. It comprises 15 disconnected portions of land that lie both north and south of the River between Sandy Point and Lugarno (Map 1). Together these portions comprise over 500 hectares of mostly vegetated land. North of the River the Park lies amongst an urban-residential setting. Several parcels of the reserve are very narrow and lie on precipitous slopes between the riverbank and residential development on the ridgelines above. The largest portion of the reserve occurs on the southern banks between Sandy Point and Mill Creek and is bordered by residential development on its east and west flanks, while its southern boundary links to the northern extremity of the extensively vegetated Woronora Plateau.

For the purposes of this report the tidal sections of waterways below high tide mark, including the Georges River and Mill Creek, are included within the study area, even though they are situated outside the national park boundary.

1.3.2 Geomorphology, soils, elevation and climate

The reserve falls within the Sydney Basin Bioregion (Thackway and Creswell 1995), a region defined by extensive sandstone landscapes. The broad geological features of Georges River NP and surrounding area are shown in Map 2. The Georges River is a drowned coastal valley, a landscape that is mirrored across the major rivers in the Sydney area. The surrounding valley and plateau is characterised by thick Hawkesbury sandstone bedrock that has been dissected by a series of minor streams. The sandstone plateau has eroded to form steep escarpment slopes that rise steeply above the major rivers. These slopes flatten above a series of rocky benches before opening to wider gently sloping ridgelines. On top of the ridges soil depth varies from shallow to skeletal, sometimes with localised rock outcrops. Further downslope soils are deeper where colluvium from eroding clifflines gathers on benches and lower slopes.

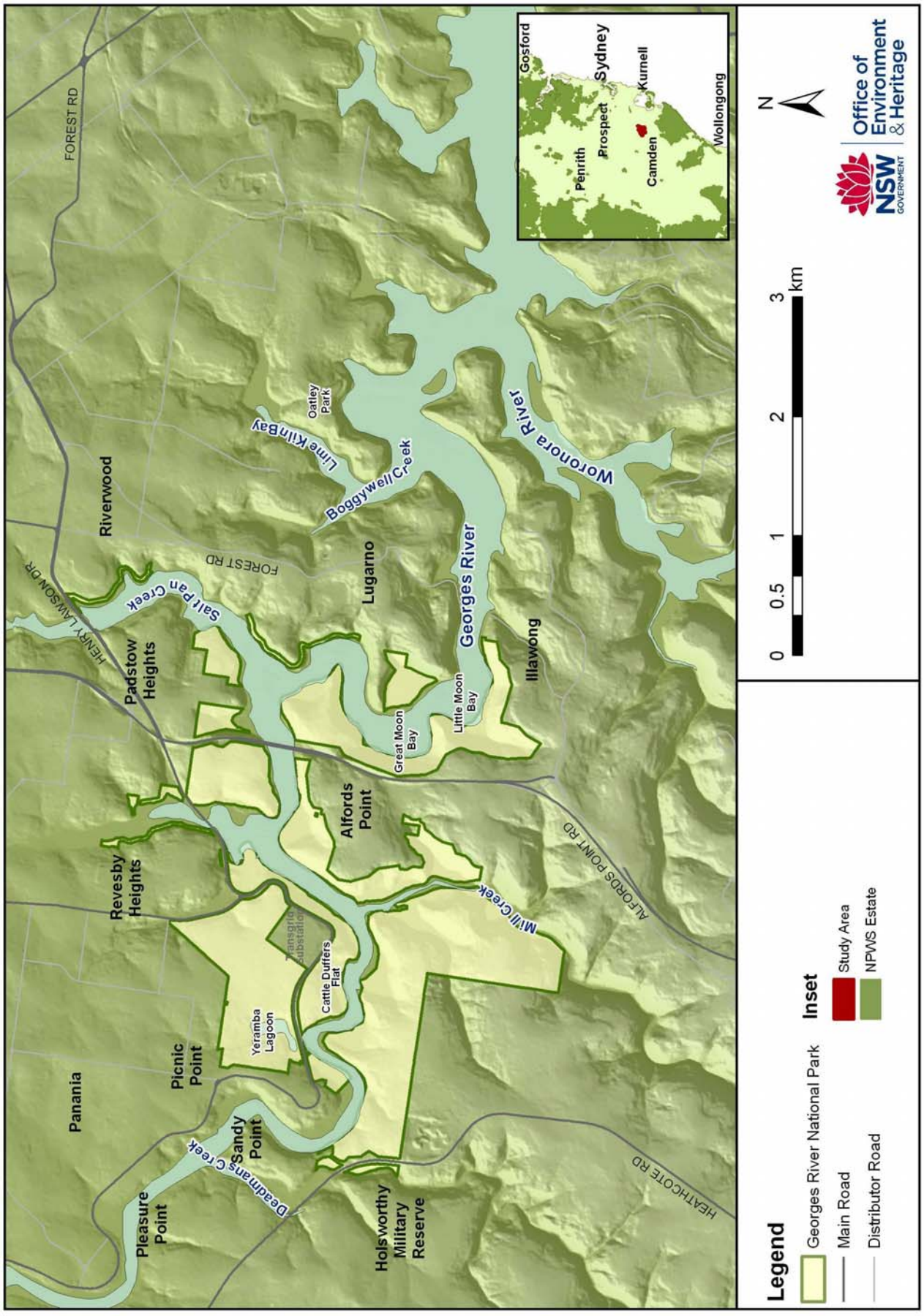
The composition of the Hawkesbury sandstone is not uniform across the reserve. In some locations such as the Mill Creek catchment, shale bands appear in the sandstone stratum and are exposed on some of the steep slopes. These bands are often only narrow but erode to produce a soil of greater fertility. In other locations fragments of ironstone otherwise known as lateritic gravel form a shallow coffee-coloured mantle along some of the ridges and this can produce a distinctive orange stain to the otherwise white sandy soil.

Around Sandy Point ridgelines support an eroded capping of Mittagong sandstone, a younger more fertile sedimentary deposit that has a greater proportion of fine-grained clay sediments than Hawkesbury material. The landscape here is less steeply dissected and crests are typically broader. More fertile again are soils derived from Wianamatta shale, a clay-rich shale material which lies above the sandstone strata and typifies the landscape of the Cumberland Plain found to the north-west of the reserve. Only a small shallow tongue of this shale deposit is found on the northern fringe of the reserve in Revesby Heights.

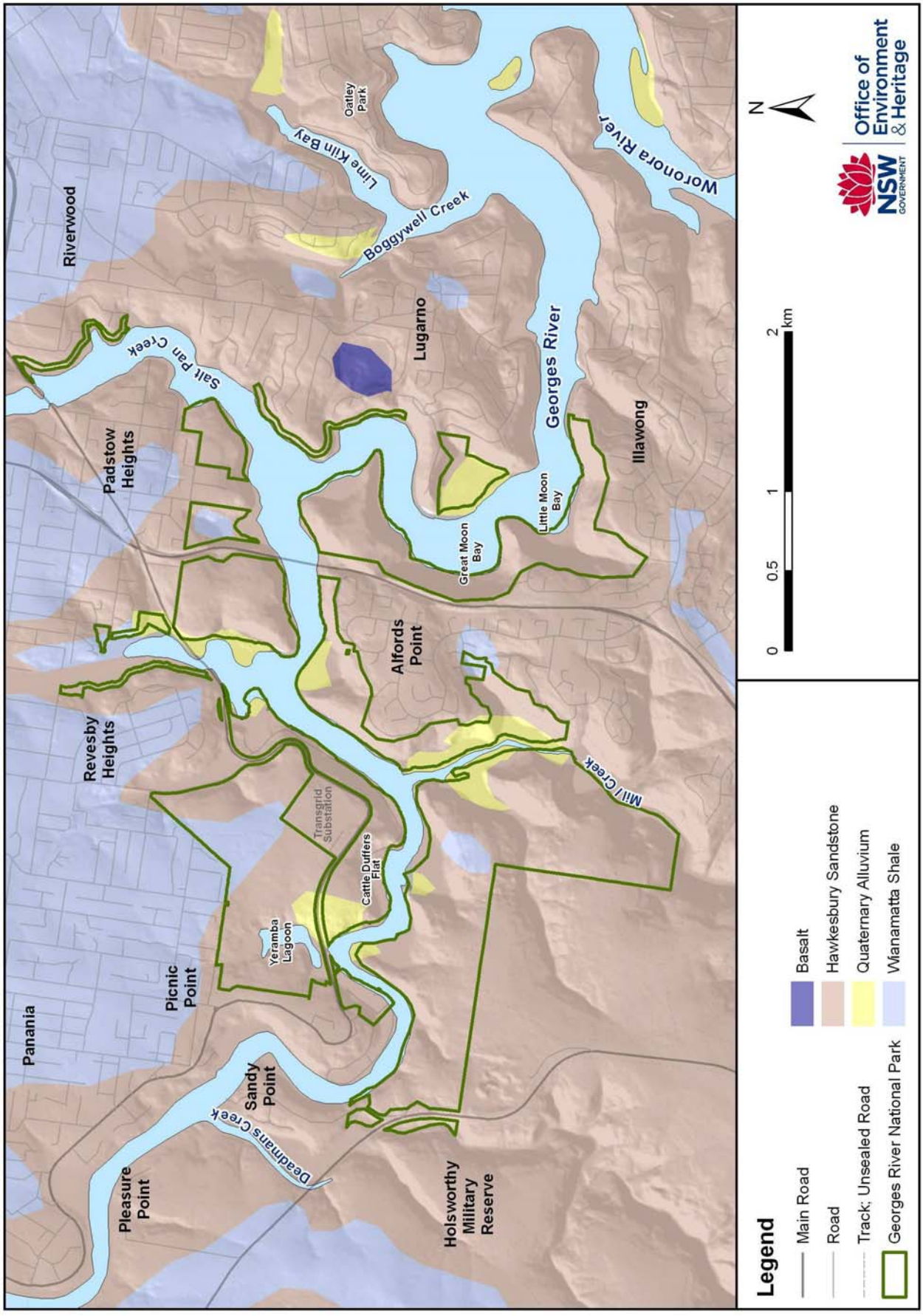
Alluvial material has been deposited at the base of the sandstone escarpment where it forms narrow banks between the River and the sandstone bedrock. These deposits widen just upstream of the confluence of the minor creeks with the Georges River. This produces flat, crescent and semi-circular shaped landforms which lie just above sea level. In larger tributaries these embayments become linear and may extend some way upstream. The seaward side of these deposits is intertidal while the back terraces are fed freshwater from the upper catchment. The composition of the alluvium appears to be variable with tributaries from sandstone catchments on the southern side of the Georges River containing more sandy material than those on the River itself, which drains finer-grained sediments from shale-dominated catchments.

The reserve extends from sea level to high points of 100 metres above sea level on several crests above the western banks of Mill Creek. Much of the landscape is under 60 metres above sea level (Map 3). The climate of Georges River NP is typical of the hinterland environments of Sydney. It receives between 850 and 900 millimetres of mean annual rainfall (based on extrapolations of data from Bureau of Meteorology weather stations at Bankstown Airport and Lucas Heights). Temperature is typified by warm summers that average around 26 degrees Celsius and mild winters with an average low of eight degrees Celsius.

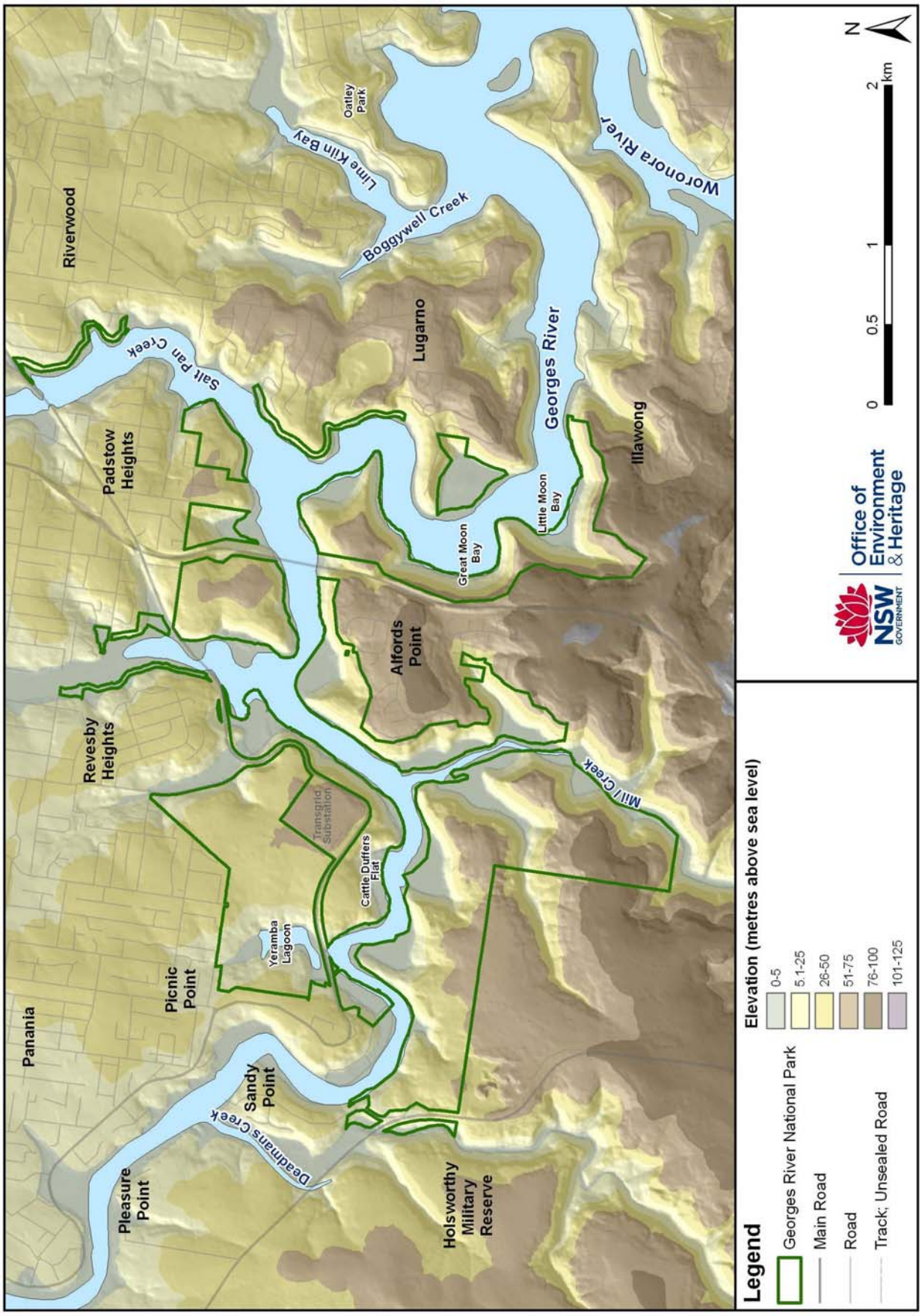
Map 1: Location of Georges River National Park



Map 2: Broad geology of Georges River National Park



Map 3: Elevation of Georges River National Park



1.3.3 Vegetation

The vegetation communities occurring in Georges River NP have recently been described and mapped in the report *The Native Vegetation of Georges River National Park* (DECCW 2011c), in the context of a Sydney Metropolitan Catchment Management Authority (SMCMA) area wide study (DECCW 2009). The vegetation mapping used for this report follows that delineated by DECCW (2011c). This vegetation mapping allocates communities to the formations and classes described by Keith (2004) to provide statewide context. By broadly following the Keith (2004) statewide class allocation of DECCW (2011c) the vegetation communities mapped in the reserve 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, are described in section 3.2 and presented in Map 4.

1.3.4 Fire history

Fire has long been an important factor influencing the environment of Georges River NP. The known history, pattern, behaviour and management of fire in the reserve are detailed in the Plan of Management and the Fire Management Strategy (NPWS 1994, DECC 2009a). The reserve is subject to periodic wildfires, however these are generally contained in sections and are usually small and patchy (DECC 2009a). There is a complex mosaic of time-since-fire classes, ranging from patches that are frequently burnt to patches that have not been burnt for decades.

1.3.5 Past and present land use

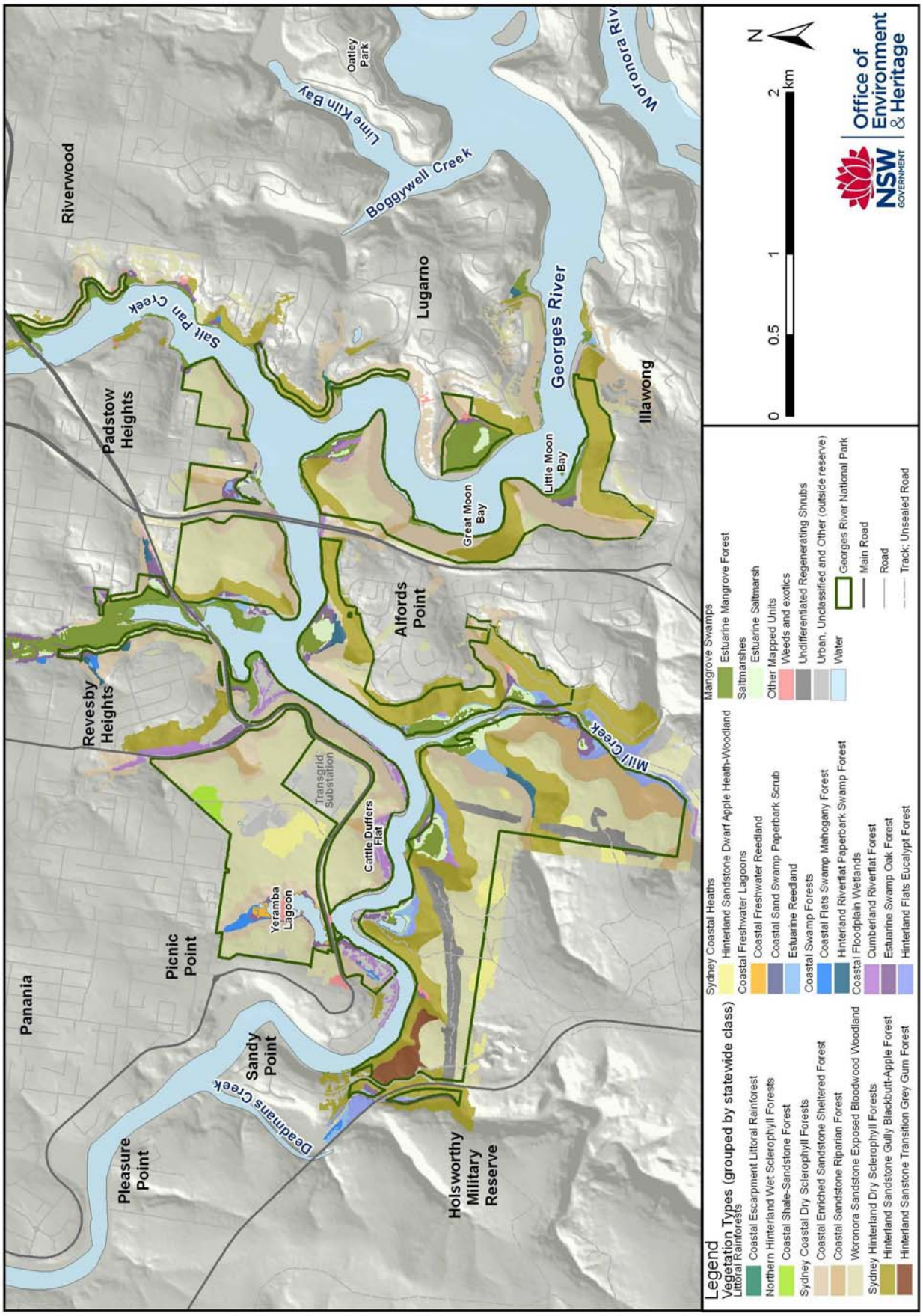
The use of the reserve by Indigenous people at the time of European settlement is not well documented. Evidence of use exists in the form of shelters, rock engravings and axe grinding sites (NPWS 1994). Wider studies across the Georges River offer greater insight into the Indigenous heritage of the locality (Goodall and Cadzow 2009). Equally, the European heritage of each of the separate portions is not precise. Evidence of agriculture associated with early settlement is suggested (NPWS 1994), but its impacts are localised owing to the ruggedness of the landscape and its limited suitability for farming.

Aerial photographs taken in 1943 (Land and Property Information 2013) show the extent of activity around the locality at that time (Map 5). Early subdivision of the Bankstown-Revesby suburban precinct is evident and the market gardens on the alluvial flats of the River are clearly actively cultivated. The small shale cap around the now substation on the portion of the reserve at Picnic Point is completely denuded of vegetation. The village at Sandy Point had not yet been established. The changes that were arriving in the locality at the time of this photo are suggested as part of the motive for the retention of bushland along the Georges River (Goodall et al. 2010). Widespread clearing and expansion of urban development particularly during the post-war period was changing the landscape of the River and impacting water quality. The River remained as a domestic sewer channel and an outlet for heavy industrial waste well into the early 1970s. The prevailing view at that time was that intertidal areas were wastelands, at best considered unsightly and at worst a threat to public health. Proposals to transform these flats into sporting fields were common and in upper Salt Pan Creek it was considered desirable to clear mangroves to establish a household waste dump to infill the swamp before later transforming the landscape into sports grounds (Goodall et al. 2010).

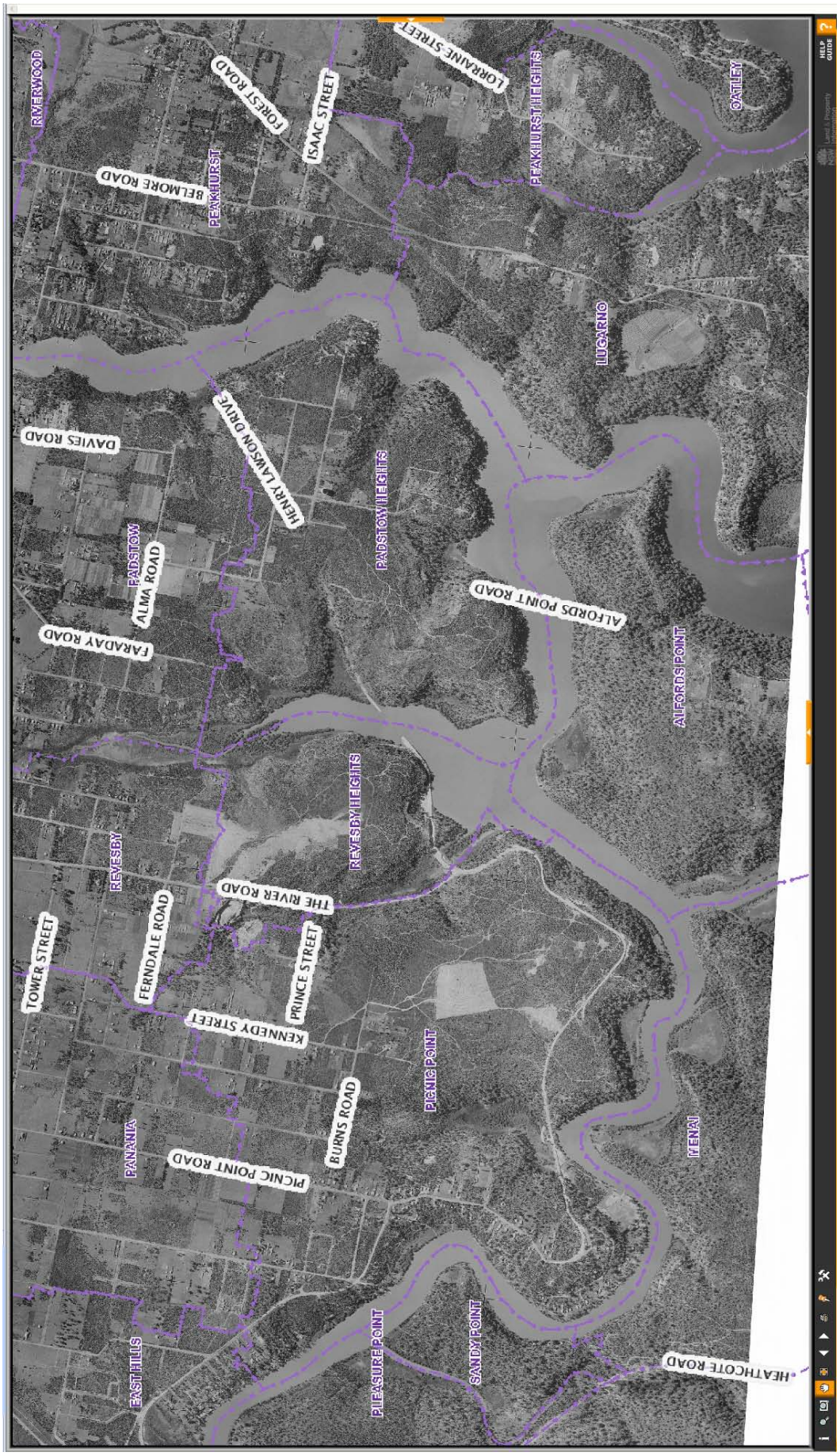
Other major changes are associated with the construction of roads and power grids. Yeramba Lagoon is an artificially created wetland that has transformed an intertidal flat into a stagnant freshwater pond following the construction of a causeway for Henry Lawson Drive. Powerline easements dissect several of the portions of the reserve.

An initial area of 173 hectares of the area now known as Georges River NP was set aside as a conservation and recreation reserve in 1962 and was managed as a Parkland Trust prior to the establishment of the National Parks and Wildlife Service (NPWS). At that time part of the funding arrangements were sourced by the letting of sand mining leases along the River flats (NPWS 1994) which have since become the riverside picnic areas present today. The 'park' was re-declared a nature reserve in 1967 under the new NSW *National Parks and Wildlife Act 1967* (NPW Act). It was then converted to a national park in 1992 and since the original declaration the protected area has more than tripled in size. An aerial photo from 2010 has been presented for comparison with the photo from 1943 (Map 6).

Map 4: The native vegetation of Georges River National Park (from DECCW 2011c)



Map 5: Georges River National Park and surrounds in 1943, with present day major roads and suburbs highlighted (Land and Property Information 2013)



Map 6: **Georges River National Park and surrounds in 2010 (Land and Property Information 2013)**

1.4 PROJECT TEAM

This project was completed by the Biodiversity Survey and Data Group within the Metropolitan Branch, Regional Operations of the Office of Environment and Heritage, NSW Department of Premier and Cabinet. The project was funded under the Biodiversity Survey Priorities program. Joshua Madden undertook initial project management, background research, site selection, field survey planning and logistics. Field surveys were undertaken by Martin Schulz, Joshua Madden and Elizabeth Magarey, with assistance from Debbie Andrew and Ben Hope and support from Barry Hodgson, Jason Bishop and Michael Hand. Barry Hodgson provided valuable management information and other related information. Martin Schulz wrote the draft report, with input, revisions and edits by Elizabeth Magarey. Report maps were produced by Elizabeth Magarey using templates produced by Kylie Madden. Kerry Oakes designed the report cover and formatted the report.

Urban development extends along the foreshores of the Georges River. Photo © M. Schulz/OEH.

2 METHODS USED TO BUILD THE SPECIES INVENTORY

2.1 COMPILATION OF EXISTING FAUNA DATA

Despite the reserve's location within the Sydney metropolitan area there has been surprisingly little documented fauna survey work or research conducted, with the exception of incidental sightings predominantly around Yeramba Lagoon. Some of these sightings are recorded in the Atlas of NSW Wildlife, some in Birdline NSW, some in published and unpublished reports, and many are anecdotal. This project brings together information from as many of these sources 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 1998-99, 10 sites were sampled in the reserve during the Georges River biodiversity study (NPWS 2000, Table 1) using the same techniques described in section 2.4.1 (hereafter referred to as OEH standard systematic fauna survey techniques).

Table 1: OEH standard systematic fauna survey effort prior to July 2012

Project	Diurnal bird survey	Diurnal herpetofauna search	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Timing of survey
Georges River biodiversity study (NPWS 2000)	3	1	3	2	1	December 1998-March 1999

In 2012 OEH initiated a statewide fauna monitoring program which aims to detect trends over time in widespread non-threatened fauna species. The program, known as WildCount, deploys digital cameras across reserves in the east of the State. One WildCount site is located in Georges River NP (Table 2). The program aims to re-survey the same site using the same method every autumn.

Table 2: Other systematic fauna survey effort prior to July 2012

Project	Infra-red camera trapping	Timing of survey
WildCount	1 site (four cameras)	14 February-19 March 2012

2.1.2 Other Atlas of NSW Wildlife records

The Atlas of NSW Wildlife (OEH 2013c, accessible on the BioNet website) was the primary resource used to access data on the fauna of the reserve. In 2006 the SMCMA commissioned OEH (then called the Department of Environment and Climate Change) to undertake a rapid fauna habitat assessment across the larger vegetation remnants in the SMCMA area (DECC 2008a). As part of that project a number of incidental sightings were recorded within Georges River NP, particularly on the south side of the Georges River in the Mill Creek area. Additionally, the Park has been visited by various fauna enthusiasts and researchers, resulting in many sighting records. Records within the Atlas of NSW

Wildlife derive from observations made by: OEH staff; naturalists and bird watchers; 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 published 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. 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

For each species, a compiled list of records from within and around the reserve was reviewed. Each species was then allocated to one of the following classes:

- **Accepted**: Species for which there are *reliable* and *accurate* records; or species for which there is some evidence and can reasonably be presumed to exist due to suitable habitat within the reserve and reliable records in the surrounding area. This category includes species that are resident, visitors or vagrants. It also includes species that have become locally extinct but have been reliably recorded in the past.
- **Excluded (poor locational accuracy)**: Species for which all records had low spatial reliability (generally the accepted cut-off for records was those with a stated accuracy of 1000 metres), or the description indicated that the species was actually seen elsewhere *and* for which there was no suitable habitat in the reserve or other supporting evidence of its occurrence. Excluded species are detailed in section 4.1.
- **Excluded (potential misidentification or data entry error)**: Species that had either been misidentified or recorded via a data entry error. These were identified by highlighting all species that had no suitable habitat in the reserve, and/or were outside their known range *and* for which no supporting evidence existed to indicate they were actually reliably-recorded vagrants or recent extinctions. Excluded species are detailed in section 4.1.
- **Excluded (introduced or non-local species that do not have wild populations)**: Species that are introduced or not native to the area and do not have known established wild populations in the reserve or neighbouring lands. This includes aviary escapees and feral species that have been dumped in the reserve.

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 reserve.

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 (2011c). 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 OEH standard systematic fauna survey for each fauna group within each vegetation community and habitat group and identified gaps in survey effort. Due to the limited systematic surveys previously undertaken, gaps were identified for all fauna groups in all vegetation communities.

2.4 BSP SURVEY PROGRAM

2.4.1 Systematic fauna survey techniques

The systematic fauna survey methods used in the BSP survey were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997) and are in this document referred to as OEH standard systematic fauna 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 Atlas of NSW Wildlife via the fauna survey module on the BioNet website. 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 (2011c) vegetation map, topographic maps, access trails, and knowledge held by OEH staff. Sites were placed as far away from each other as possible. However, due to the size and shape of the reserve and the location of different vegetation types, site spacing in some sections was closer than would be ideal from a statistical perspective. The placement of harp traps to capture microbats was limited by the risk of vandalism and 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. Systematic survey sites were 100 metres by 200 metres (two hectares) in area.

Systematic sites and the systematic techniques undertaken are shown in Maps 7 and 8.

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.

A boat was an essential tool for undertaking the fauna survey. Photo © J. Madden/OEH.

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 detected 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.

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 technique 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 BSP survey some sites were only trapped for one night. This variation to the standard survey effort is recorded in the fauna module of the Atlas of NSW Wildlife, but both one and two night trapping sites are included in the summary in Table 4.

Harp trapping was used to sample microbat species. Photo © J. Madden/OEH

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 (2008). Animals were released either in the early morning or on the following night at the point of capture.

Bat Ultrasonic Call Recording

Ultrasonic recorders (Corben 1989) are particularly useful for the 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 are useful in identifying bats using areas that are unsuitable for the siting of harp traps, such as along the Georges River and smaller tidal waterways, close proximity to high use public areas and where there are no tracks or other situations suitable for the siting of harp traps. 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* or *Anabat SD2* detector, each housed within a plastic box for weather protection. The box was set up at sites where bats were expected to fly, such as over water bodies and other open areas, and along cliff lines and tracks. 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.

Anabat recordings were transferred onto computer and analysed by Martin Schulz. Troublesome calls were verified by Narawan Williams and/or Brad Law. Calls identified with 'definite' and 'probable' degree of confidence were entered into the fauna module of the Atlas of NSW Wildlife.

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; 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, masked owl (*Tyto novaehollandiae*), sooty owl and the barking owl (*Ninox 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

Two vegetation communities covered too small an extent to be systematically sampled for fauna or warrant inclusion as separate habitat types. These vegetation communities are: Coastal Sand Swamp Paperbark Scrub (0.47hectares) and Coastal Freshwater Reedland (0.87 hectares).

One extra habitat type was identified in the reserve that is not a native vegetation community. This habitat type is called Shoreline and was not subject to systematic sampling. Hence the fauna descriptions for this habitat in this report rely on opportunistic records, surveys done in adjacent lands, and expert knowledge.

2.4.2 Targeted fauna survey techniques

Elliott Trapping

Target Species: Native small terrestrial mammals such as the brown antechinus and swamp rat.

This technique involved setting Elliott A traps at approximately five metre intervals through a site. Twenty-five traps were set per site. Traps were baited with a mixture of peanut butter, rolled oats and honey. Traps were left in place for four consecutive nights, and were checked every morning soon after dawn. Any animals captured in the traps were identified, sexed if possible, and released.

Infra-red Camera Trapping

Target Species: Cryptic native and introduced ground-dwelling mammals (such as the long-nosed bandicoot and feral cat), and cryptic birds such as crakes and rails.

This technique involved setting up cameras triggered by infra-red motion sensors (Moultrie GameSpyi60 Digital Game Camera with Infrared Flash). Either one or two cameras were set at each site and left in place for between 42 and 50 days. The cameras were attached to a trunk, sapling or stake between ground level and one metre above the ground. The cameras faced either towards a bait station (with bait consisting of a mix of rolled oats, peanut butter, honey and walnuts) or towards a point of expected fauna activity (such as the edge of a water body). On detecting a moving heat source cameras were set to take a five second video followed by a still photograph, with a delay of ten minutes between subsequent images. The internal white flash of the camera was set to be triggered in low light (including night time). At the end of the period the cameras were collected, the memory cards downloaded and all species were identified by Martin Schulz.

Survey of Autumn-flowering Trees

Target Species: Swift parrot (*Lathamus discolor*) and little lorikeet.

In May 2013 flowering swamp mahogany (*Eucalyptus robusta*) and red gum species (Eucalyptus *tereticornis/amplifolia*) were checked on two days for the presence of nectarivorous threatened species such as the swift parrot and little lorikeet. Surveys involved listening for calls and scanning flowering trees with binoculars.

2.4.3 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. Hence it is an efficient sampling technique for prey animals, some of which may not be detected using other survey techniques. 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 a species. 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 road culverts) were searched with a head torch for animals such as cave-roosting bats, geckos and nesting birds.

Scanning of the Shoreline

Shoreline areas and exposed intertidal mudflats were scanned for birds, particularly for potentially occurring threatened 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 global positioning system (GPS)) and microhabitat of the animal was recorded on a data sheet.

2.4.4 Survey timing

The bulk of the systematic and targeted field surveys techniques described above were undertaken in October and November 2012. The study area was visited for one additional night in February 2013 and two additional days and nights in May 2013. Table 3 summarises the timing of systematic and targeted fauna survey techniques undertaken for this project.

Table 3: Timing of OEH standard systematic fauna survey techniques and targeted fauna survey techniques undertaken within Georges River National Park for this project

Timing	Systematic techniques employed	Targeted techniques employed
8 to 12 October 2012	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording.	Elliott trapping and setting of infra-red camera traps.
28 to 29 November 2012	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording and nocturnal streamside search.	Collection of infra-red camera traps.
25 February 2013	Nocturnal site spotlighting and nocturnal call playback.	
10 to 11 May 2013	Diurnal herpetofauna search and nocturnal call playback.	Survey of autumn-flowering trees.

2.4.5 Survey site locations

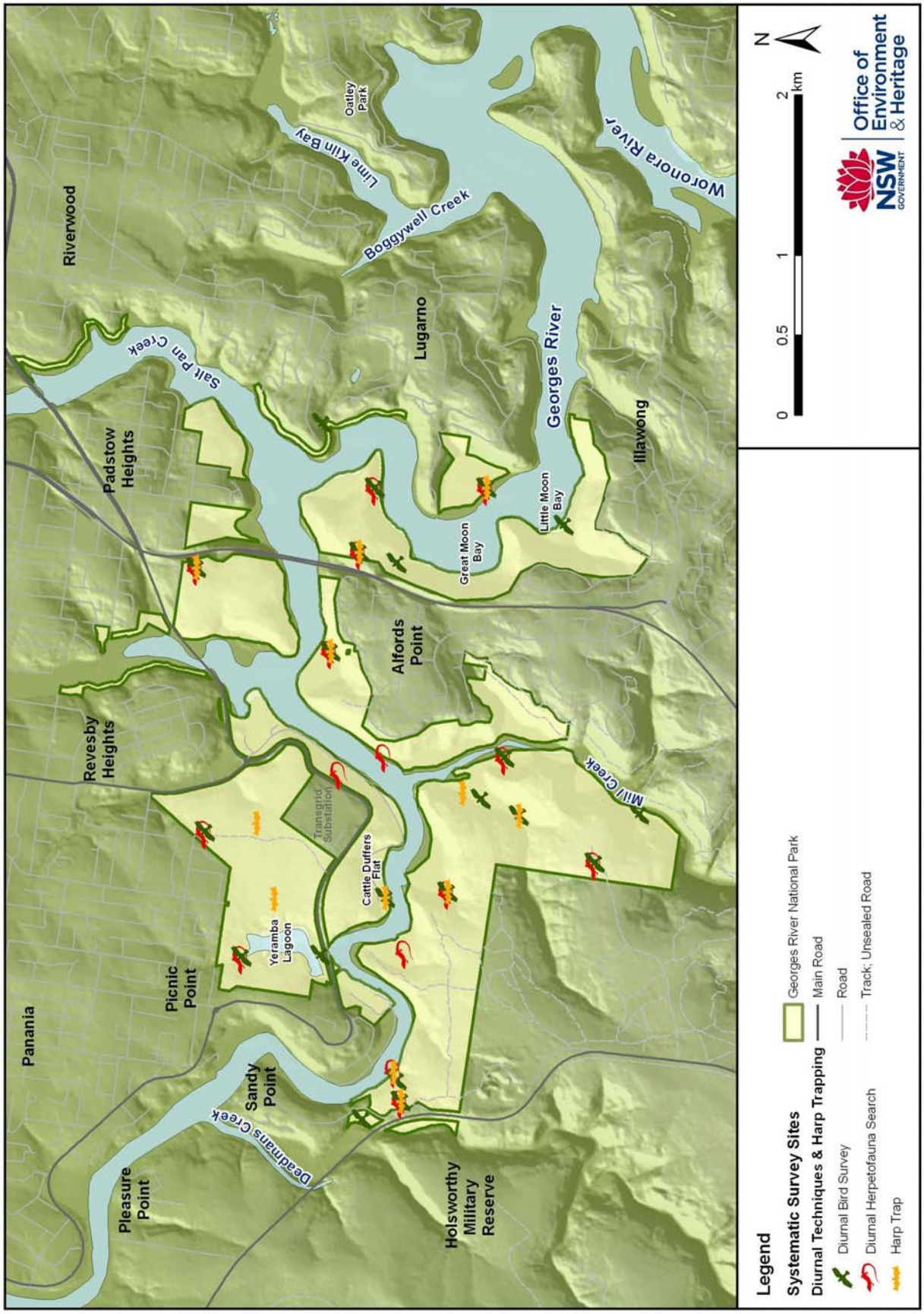
A total of 24 systematic fauna survey sites were established and surveyed in Georges River NP for this project. This is in addition to the 10 systematic sites established and surveyed during the Georges River biodiversity study in 1998-1999 (Table 1). Table 4 shows the number of OEH standard systematic fauna survey techniques undertaken in each vegetation community after completion of the 2012-13 field surveys, including sites from the Georges River biodiversity study. Point-based targeted survey techniques undertaken for this project are also included in the table. Maps 7 and 8 show the location of OEH standard systematic fauna survey techniques in Georges River NP (including the BSP survey and the Georges River biodiversity study). Map 9 shows the location of point-based targeted survey techniques undertaken for the BSP survey.

2.4.6 Survey limitations

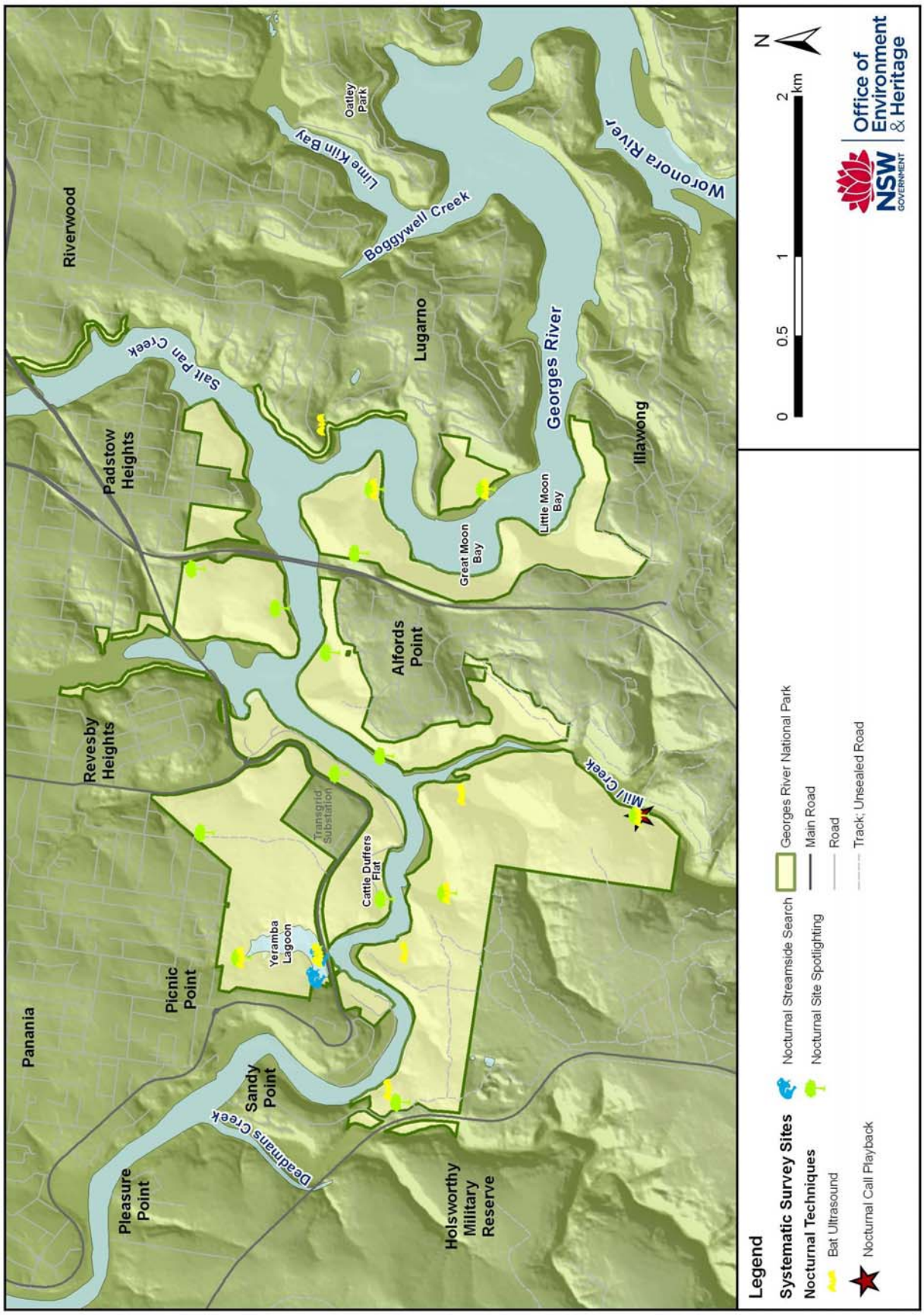
At the completion of the systematic and targeted surveys it is considered that all vertebrate fauna groups, except amphibians and threatened nocturnal birds, have been systematically sampled to an adequate level to provide a baseline biodiversity assessment. Only limited systematic frog searches were conducted during the BSP survey, primarily due to the absence of rain during or prior to the two main survey periods in 2012. Frog species are therefore not considered to be surveyed adequately enough to enable an understanding of species occurrence, status or distribution. The inventory of frogs for the Park was developed for this report in conjunction with records in the Atlas of NSW Wildlife, but the BSP status of many frog species remains uncertain. Similarly, only two nocturnal call playbacks for threatened owl species were conducted in the reserve and therefore owls are not considered adequately surveyed. However, the powerful owl has been well surveyed in parts of the reserve by the Birdlife Australia powerful owl project (Birdlife Australia 2012).

Not all portions of the reserve were visited during the BSP survey; in particular several of the narrow foreshore portions were not sampled. Efforts were made to visit all of the fauna habitats found in the reserve although not all survey techniques were deployed in each habitat (Table 4).

Map 7: **Location of OEH standard systematic fauna survey sites using diurnal techniques and harp trapping in Georges River National Park**



Map 8: **Location of OEH standard systematic fauna survey sites using nocturnal techniques in Georges River National Park**



Map 9: **Location of point-based targeted fauna survey techniques undertaken in Georges River National Park for the BSP project**

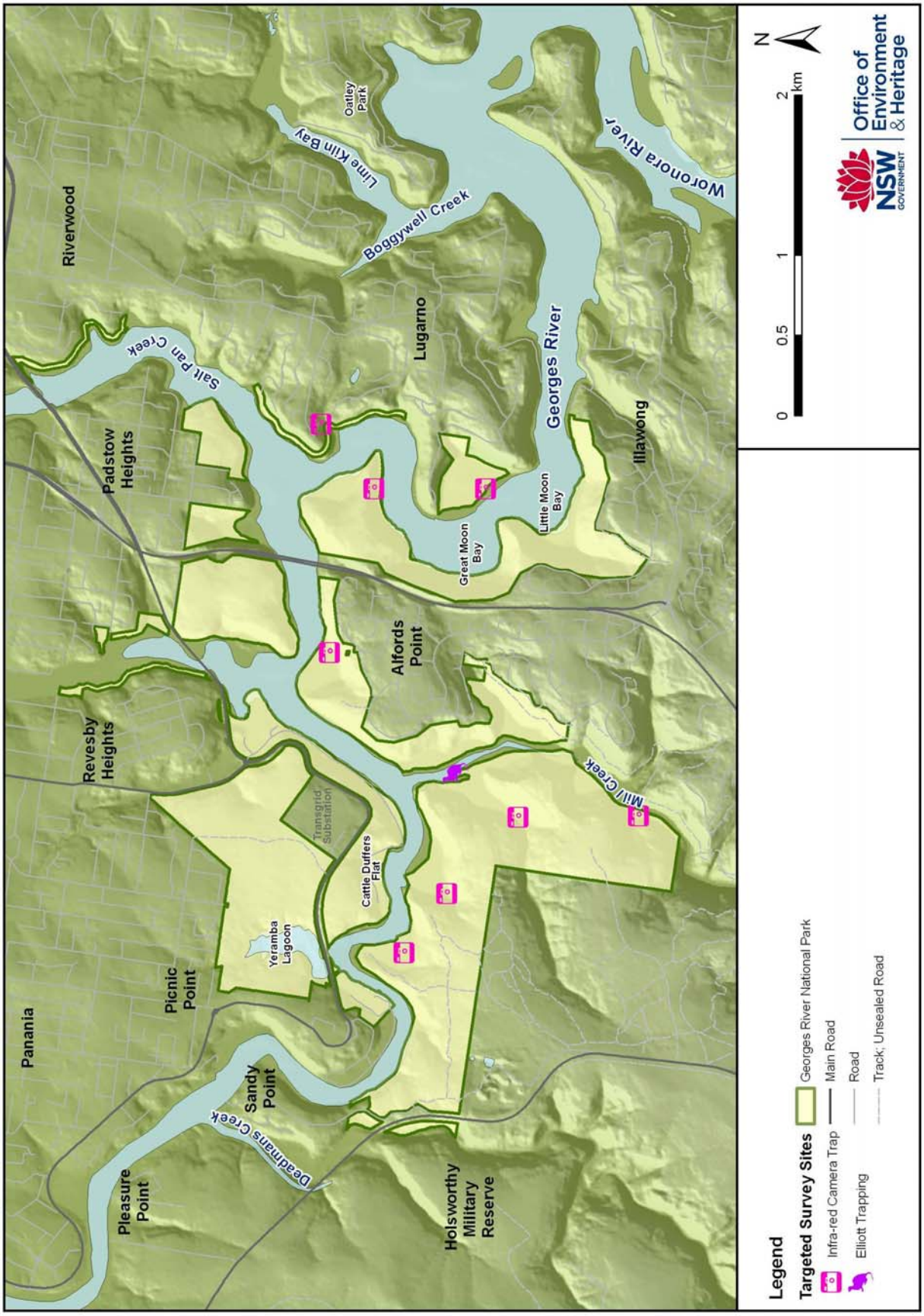


Table 4: Vegetation communities within Georges River National Park and corresponding allocation of point-based fauna survey effort as at June 2013

Statewide class and vegetation community (DECCW 2011c)	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 trapping	Infra-red camera trapping*
Littoral Rainforests										
Coastal Escarpment Littoral Rainforest	0.2	1				1				1
Northern Hinterland Wet Sclerophyll Forests										
Coastal Shale-Sandstone Forest	2.5	1	1	1						
Sydney Coastal Dry Sclerophyll Forests										
Coastal Enriched Sandstone Sheltered Forest	97.4	1	2	2		1				1
Coastal Sandstone Riparian Forest	27.4	1		1						
Woronora Sandstone Exposed Bloodwood Woodland	168.2	3	3	2	4					
Sydney Hinterland Dry Sclerophyll Forests										
Hinterland Sandstone Gully Blackbutt-Apple Forest	96.1	1	1	1		1			1	
Hinterland Sandstone Transition Grey Gum Forest	6.0	1	1	1	1					
Sydney Coastal Heaths										
Hinterland Sandstone Dwarf Apple Heath-Woodland	8.6		1							
Coastal Freshwater Lagoons										
Coastal Freshwater Reedland	0.9	1				1	1			
Coastal Sand Swamp Paperbark Scrub	0.5									
Estuarine Reedland	5.6	2								
Coastal Swamp Forests										
Coastal Flats Swamp Mahogany Forest	1.5	1	1	1		1				
Hinterland Riverflat Paperbark Swamp Forest	2.5	1			1					1
Coastal Floodplain Wetlands										
Hinterland Flats Eucalypt Forest	5.0	1		1		1		2		1
Cumberland Riverflat Forest	8.1	2	1	2	2	1				1
Estuarine Swamp Oak Forest	11.6	2	1	1	2		1			2
Mangrove Swamps										

Statewide class and vegetation community (DECCW 2011c)	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 trapping	Infra-red camera trapping*
Estuarine Mangrove Forest	24.0	2	1	1	3	3				1
Saltmarshes										
Estuarine Saltmarsh	10.9	1	2			1				1
Non-vegetated (water or shoreline)	4.8		1			1				
Total number of sites of each technique		22	16	14	13	12	2	2	1	9

* Note that this table does not include the WildCount infra-red camera site that is located in Georges River NP.

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 reserve, 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 NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).** This includes all species reported within the study area that currently occur, are known to have occurred in the past, or for which there are unconfirmed or spatially inaccurate records. Note that the study area includes the waterways (including Georges River, Mill Creek and Saltpan Creek) even though they are technically outside of the national park boundary.

- **Listed under international migratory bird agreements (incorporated in to the EPBC Act).** This includes all species recorded within the study area that are listed under one or more of the international migratory bird agreements to which the Australian Government is a signatory (Department of Sustainability, Environment, Water, Population and Communities 2009). The migratory bird agreements are: China-Australia Migratory Bird Agreement (CAMBA) (Commonwealth of Australia 1995a), Japan-Australia Migratory Bird Agreement (JAMBA) (Commonwealth of Australia 1995b), and Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) (Commonwealth of Australia 2006).
- **Recognised as Key Threatening Process.** This includes all terrestrial vertebrate fauna species recorded from the study area 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 a long 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. The ranking system is derived from expert knowledge rather than quantitative assessment.

The rankings are defined as follows. The term region means the Sydney Basin Bioregion.

Highest: Species that are likely to become extinct from the region in the short to medium term without action at a site by site level and for which the reserve plays a key role in the regional conservation of the species.

High: Species that are at risk of becoming extinct or severely declining in the region without management of key habitats and abatement of threats and for which the reserve holds a significant amount of foraging, roosting, wintering or breeding habitat relative to the amount reserved across the region.

Moderate: Species for which there is inadequate information to assess their status in the reserve and are not reserved in high numbers elsewhere in the region. If more information is gained on these species in the survey area and other reserves in the region, a review of their status would likely see them moved to one of the other priority categories.

Low: Species which either: a) have breeding, roosting, foraging and wintering habitat well represented in the regional reserve system and are subject to few threats on reserves; b) have uncertain status in the reserve and are known to be well represented elsewhere in the regional reserve system (note that the status of these species would require revision were evidence of a sizeable resident breeding population detected); or c) are vagrants or rare irregular visitors.

Nil: Species for which there are only anecdotal record(s) with minimal information and/or which would be considered to now be extinct from the study area.

3.2 FAUNA HABITATS

3.2.1 Definition of fauna habitat groups

The study area incorporates a range of environments including intertidal mud flats and beaches, mangrove forests, dry and wet sclerophyll forest and small areas of littoral rainforest (Map 4). This range of environments provides a variety of fauna habitat types. Much of the fauna habitat is in the form of native vegetation communities. The recent native vegetation mapping of the reserve (DECCW 2011c) allocated communities to the statewide formations and classes described by Keith (2004). By broadly following the Keith statewide class allocation, the vegetation communities mapped in Georges River NP have been grouped into ten fauna habitat groups for this report. In addition to the native vegetation there is one unmapped habitat type that has been allocated a fauna habitat group (Shorelines). Picnic areas where native trees are present have been allocated to the relevant statewide class and fauna habitat group.

Fauna 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 Georges River NP and, being a mappable unit, are able to be easily applied for targeted management of the reserve. It must be remembered, however, that the fauna habitat groups were not derived from statistical analysis of fauna records and consequently 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 reserve.

The fauna habitat groups are described below and summarised in Table 5. The native vegetation descriptions are a summary of information presented in the report *The Native Vegetation of Georges River National Park* (DECCW 2011c).

Littoral Rainforests

Vegetation Communities Included: Coastal Escarpment Littoral Rainforest
Corresponding Statewide Class: Littoral Rainforests

Two very small patches (totalling 0.17 hectares) occur in deep protected gullies. The largest patch borders and occurs within the Evatt Park Reserve in Lugarno. Native tree species present include lilly pilly (*Acmena smithii*), sweet pittosporum (*Pittosporum undulatum*), scentless rosewood (*Synoum glandulosum*), cabbage tree palm (*Livistona australis*) and cheese tree (*Glochidion ferdinandi*).

Northern Hinterland Wet Sclerophyll Forests

Vegetation Communities Included: Coastal Shale-Sandstone Forest
Corresponding Statewide Class: Northern Hinterland Wet Sclerophyll Forest
Georges River NP supports a small area (2.5 hectares) of this forest type on the northern margins of the Picnic Point portion. It is characterised as a tall open eucalypt forest with a sparse layer of dry sclerophyllous shrubs and a grassy ground cover. Dominant tree species include tall red bloodwood (*Corymbia gummifera*) and smooth-barked apple (*Angophora costata*) though it is the local abundance of blackbutt (*Eucalyptus pilularis*), turpentine (*Syncarpia glomulifera*) and mahogany species (*Eucalyptus resinifera* and *E. umbra*) that make the forest distinctive from the surrounding sandstone woodlands. A thin layer of clay soil is sufficient to retain the grassy ground covers that help to distinguish the community.

Sydney Coastal Dry Sclerophyll Forests

Vegetation Communities Included: Coastal Enriched Sandstone Sheltered Forest, Coastal Sandstone Riparian Forest and Woronora Sandstone Exposed Bloodwood Woodland.
Corresponding Statewide Class: Sydney Coastal Dry Sclerophyll Forests.

Sydney Coastal Dry Sclerophyll Forests are the dominant and most widespread vegetation type of the reserve, occupying 293 hectares. The most widespread community within this class is Woronora Sandstone Exposed Bloodwood Woodland which occupies broad flat ridgetops above the River. Common dominant tree species are red bloodwood, stringybark (*Eucalyptus oblonga*) and scribbly gums (*Eucalyptus racemosa/E. haemastoma* complex and *Eucalyptus sclerophylla*). On the margins of the Georges River, grey gum (*Eucalyptus punctata*) is prominent while on dry exposed slopes Sydney peppermint (*Eucalyptus piperita*) also occurs. The shrub layer comprises an array of common sandstone heath species such as banksias, wattles, tea-trees, hakeas and conesticks. Coastal Enriched Sandstone Forest occurs on sheltered slopes and is a tall open eucalypt forest with an understorey of dry sclerophyll shrubs, ferns and forbs. Dominant eucalypts are the smooth-barked apple, red bloodwood and Sydney peppermint, with localised patches of blackbutt. Coastal Sandstone Riparian Forest is the most restricted of the three vegetation communities in this fauna habitat group. It occurs in narrow sandstone gorges, along minor creek lines and on steep protected lower escarpment slopes. This vegetation community includes a suite of riparian and rainforest species, including coachwood (*Ceratopetalum apetalum)*, water gum (*Tristaniopsis laurina*), tea tree (*Leptospermum* spp.) and river lomatia (*Lomatia myricoides*). Dominant overstorey eucalypt species include smooth-barked apple and Sydney peppermint.

Sydney Hinterland Dry Sclerophyll Forests

Vegetation Communities Included: Hinterland Sandstone Gully Blackbutt-Apple Forest and Hinterland Sandstone Transition Grey Gum Forest.
Corresponding Statewide Class: Sydney Hinterland Dry Sclerophyll Forests.

Sydney Hinterland Dry Sclerophyll Forests are the second most widespread fauna habitat group, occupying 102 hectares of the reserve. Hinterland Sandstone Gully Blackbutt-Apple Forest is the reserves second most abundant vegetation community, occurring on dry upper valley slopes above the Georges River and its tributaries. Dominant tree species are the smooth-barked apple and blackbutt, with scattered red bloodwood and grey gum. There is a sparse sclerophyllous shrub layer which includes species typical of sandstone environments such as tea-trees, banksias, wattles, geebungs, grevilleas and peas. Hinterland Sandstone Transition Grey Gum Forest is more restricted, only occupying six hectares of the reserve near Sandy Point. It occurs on broad ridges associated with Mittagong formation sandstone and is a tall open eucalypt forest dominated by grey gum and red bloodwood with one of a number of stringybarks (commonly *Eucalyptus oblonga*) as a regular associate and local stands of blackbutt. The understorey is typically shrubby with a diverse mix of plants common on sandstone soils including wattles, tea-trees, banksias and geebungs. Unlike sandstone woodlands however, the ground layer supports a relatively high number of grass species of which kangaroo grass (*Themeda australis*) and spear grass (*Austrostipa pubescens)* are indicative of the presence of shale in the soil.

Sydney Coastal Heaths

Vegetation Communities Included: Hinterland Sandstone Dwarf Apple Heath-Woodland
Corresponding Statewide Class: Sydney Coastal Heaths

Sydney Coastal Heaths are restricted to small areas of skeletal soil along ridgetops on both sides of the Georges River. These heaths are dominated by dwarf apple (*Angophora hispida*), which forms dense clusters amongst other common sandstone heath species such as banksias, tea-trees, conesticks and hakeas. In some areas scattered low broad-leaved scribbly gum (*Eucalyptus haemastoma*) and red bloodwood occur.

Coastal Freshwater Lagoons

Vegetation Communities Included*:* Coastal Freshwater Reedland, Coastal Sand Swamp Paperbark Scrub and Estuarine Reedland
Corresponding Statewide Class: Coastal Freshwater Lagoons

Coastal Freshwater Lagoons are limited in occurrence with the most widespread community being Estuarine Reedland. It occurs in alluvial embayments and is characterised by tall dense swards of the common reed (*Phragmites australis*). These areas are frequently inundated by saline or brackish water, including on the landward side of saltmarsh flats, low-lying alluvium on riverbanks, riverflat

depressions, and banks on coastal lagoons that are open to tidal influence. Salt-tolerant species which are frequently present are sea rush (*Juncus kraussii*), bare twig-rush (*Baumea juncea*) and the small herb creeping brookweed (*Samolus repens*). Coastal Freshwater Reedland is restricted to poorly-drained alluvial flats bordering parts of Yeramba Lagoon. This community is dominated by common reed, cumbungi (*Typha orientalis)* and the reed *Elaeocharis sphacelata*. The reedlands may include a sparse cover of swamp oak (*Casuarina glauca*) or swamp paperbark (*Melaleuca ericifolia*) on the drier margins of the swamp. The most restricted form of the Coastal Freshwater Lagoons is Coastal Sand Swamp Paperbark Scrub which occurs on low-lying areas that are permanently saturated. This community is characterised by dense stands of swamp paperbark with scattered emergent swamp oak. The ground layer has a very diverse and abundant cover of sedges, rushes and taller reeds, including twig-rushes (*Baumea* spp.) and common reed.

The fauna habitat group also includes freshwater and brackish open water bodies such as Yeramba Lagoon.

Coastal Swamp Forests

Vegetation Communities Included: Coastal Flats Swamp Mahogany Forest and Hinterland Riverflat Paperbark Swamp Forest
Corresponding Statewide Class: Coastal Swamp Forests

The Coastal Swamp Forests are limited in occurrence occupying four hectares of the reserve. Hinterland Riverflat Paperbark Swamp Forest primarily occurs near the junction of Mill Creek and Georges River. This forest is dominated by tall paperbarks (*Melaleuca linariifolia* and *M. styphelioides*) and a range of mesic small trees such as black wattle (*Callicoma serratifolia*), cheese tree and grey myrtle *(Backhousia myrtifolia*). Coastal Flats Swamp Mahogany Forest is primarily restricted to an area of impeded drainage behind Yeramba Lagoon. This community is dominated by swamp mahogany (*Eucalyptus robusta*) with a smaller tree layer of swamp oak and paperbarks (*Melaleuca linariifolia* and *M. styphelioides*). A distinct mesic element is present in the shrub layer with cheese tree and cabbage tree palm most prominent. The ground cover is periodically wet with standing water occurring.

Coastal Floodplain Wetlands

Vegetation Communities Included: Cumberland Riverflat Forest, Estuarine Swamp Oak Forest and Hinterland Flats Eucalypt Forest
Corresponding Statewide Class: Coastal Floodplain Wetlands

Coastal Floodplain Wetlands are restricted to low-lying areas, occupying a total of 25 hectares of the reserve. The most widespread community is Estuarine Swamp Oak Forest which forms a narrow fringing forest on tidal flats between mangroves and terrestrial forests and woodlands adjacent to larger waterways in the reserve. It is characterised by dense stands of swamp oak above a thick ground cover of salt tolerant herbs, rushes and sedges. Cumberland Riverflat Forest is situated on the broad alluvial flats of the Georges River. All stands are highly disturbed with the largest areas of floodplain forest cleared at Cattle Dufffers Flat, Fitzgibbon Reserve and Burrawang Beach. Small remnants remain at Deadmans Creek near Sandy Point and Alford Point Bridge. This community is characterised by rough-barked apple (*Angophora floribunda*), forest red gum (*Eucalyptus tereticornis*), cabbage gum (*Eucalyptus amplifolia*) and blue box (*Eucalyptus baueriana*). The understorey within the riverflat forest is characterised by an occasional sparse to open small tree stratum of paperbark (*Melaleuca* spp.) and wattles (*Acacia* spp.) and a sparse lower shrub layer dominated by blackthorn (*Bursaria spinosa*). Hinterland Flats Eucalypt Forest occurs along the sandy riverbanks of the Georges River and its tributaries, including on flats west of Alford Point Bridge and along Mill Creek. It is dominated by a range of eucalypts including forest red gum, bangalay (*Eucalyptus botryoides*), smooth-barked apple, rough-barked apple and the river peppermint (*Eucalyptus elata*). An open layer of small trees, including various wattles, grey myrtle and sweet pittosporum, occurs above an abundant cover of grasses.

Mangrove Swamps

Vegetation Communities Included: Estuarine Mangrove Forest
Corresponding Statewide Class*:* Mangrove Swamps

Mangrove Swamps occupy 24 hectares of the reserve, primarily occurring along the margins of tidal-influenced major watercourses. The most extensive stands occur at the Mill Creek mouth and in the Great and Little Moon bay areas. The dominant species is grey mangrove (*Avicennia marina*), which often forms monotypic stands above open mudflat sometimes with scattered saltmarsh herbs on the

fringes. The river mangrove (*Aegiceras corniculatum*) most commonly occurs along upper reaches of tidal creeks where there are freshwater influences from runoff or lower salinity levels in water inundating the mudflats.

Saltmarshes

Vegetation Communities Included: Estuarine Saltmarsh
Corresponding Statewide Class: Saltmarshes

Saltmarshes occupy 11 hectares of the reserve, frequently intergrading with Mangrove Swamps. In some localities it appears that the mangroves are in the process of colonising saltmarsh as has been recorded elsewhere in the region (Williams et al. 2004). In Georges River NP Saltmarshes occur as small disjunct patches of low succulent herbs and rushes on tidally inundated land adjoining open water and mangroves. Salinity varies greatly through the marsh according to tidal influence, evaporation and freshwater accumulation. Some of the areas are flooded regularly, while at slightly higher elevations flooding is rare. After rain freshwater accumulates and adds extra water to the marsh, leaving pools of standing water when the tide recedes. Chenopod species dominate areas more frequently inundated by the tides, while sea rush occupies the more elevated terrestrial margin. Local scalds occur in small depressions where intensely saline deposits accumulate from the evaporation of tidal waters preventing the growth of any plants at all (Keith 2004).

Shorelines

Environments Included: Shoreline habitats that do not support vegetation communities including rocky shorelines, sandy beaches, intertidal mudflats and open tidal waters
Corresponding Statewide Class: Nil

This habitat group incorporates a variety of environments along the major watercourses of the study area which are not covered by vegetation, including the waterways of Georges River and Mill Creek.

Unassigned Map Units

Areas mapped by DECCW (2011c) as Weeds and Exotics or Undifferentiated Regenerating Shrubs have not been incorporated in to fauna habitat groups for this report. This includes cleared areas under powerline easements and firebreaks bordering the reserve.

Table 5: Summary of the fauna habitat groups and their relation to vegetation communities, statewide formations and statewide classes

Statewide formation (Keith 2004 as allocated in DECCW 2011c)	Fauna habitat group as defined by statewide class (Keith 2004 as allocated in DECCW 2011c)	Vegetation community (DECCW 2011c)
Rainforests	Littoral Rainforests	Coastal Escarpment Littoral Rainforest
Wet Sclerophyll Forests	Northern Hinterland Wet Sclerophyll Forests	Coastal Shale-Sandstone Forest
Dry Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests	Coastal Enriched Sandstone Sheltered Forest
Dry Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests	Coastal Sandstone Riparian Forest
Dry Sclerophyll Forests	Sydney Coastal Dry Sclerophyll Forests	Woronora Sandstone Exposed Bloodwood Woodland
Dry Sclerophyll Forests	Sydney Hinterland Dry Sclerophyll Forests	Hinterland Sandstone Gully Blackbutt-Apple Forest
Dry Sclerophyll Forests	Sydney Hinterland Dry Sclerophyll Forests	Hinterland Sandstone Transition Grey Gum Forest
Heathlands	Sydney Coastal Heaths	Hinterland Sandstone Dwarf Apple Heath-Woodland
Freshwater Wetlands	Coastal Freshwater Lagoons	Coastal Freshwater Reedland
Freshwater Wetlands	Coastal Freshwater Lagoons	Coastal Sand Swamp Paperbark Scrub
Freshwater Wetlands	Coastal Freshwater Lagoons	Estuarine Reedland
Forested Wetlands	Coastal Swamp Forests	Coastal Flats Swamp Mahogany Forest
Forested Wetlands	Coastal Swamp Forests	Hinterland Riverflat Paperbark Swamp Forest
Forested Wetlands	Coastal Floodplain Wetlands	Cumberland Riverflat Forest
Forested Wetlands	Coastal Floodplain Wetlands	Estuarine Swamp Oak Forest
Forested Wetlands	Coastal Floodplain Wetlands	Hinterland Flats Eucalypt Forest
Saline Wetlands	Mangrove Swamps	Estuarine Mangrove Forest
Saline Wetlands	Saltmarshes	Estuarine Saltmarsh
Unallocated	Shorelines (does not correspond to a Keith (2004) statewide class)	Beaches, rocky shoreline and exposed intertidal flats of the Georges River and other tidal streams

3.2.2 Assessing the conservation significance of fauna habitats

The rapid fauna habitat assessment of the SMCMA area (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 importance of habitats in Georges River NP 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 as appropriate. The allocation of priority fauna habitats also considered the number of high and moderate priority species recorded in each habitat group and the extent to which the habitat is represented in reserves within the Sydney basin.

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. This project aimed to identify the threats currently acting in the Park, 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 2012 and 2013 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 Park, 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 has the potential to impact one or more High or Moderate Conservation Management Priority fauna species. Key current threats are prioritised as follows.

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

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

Moderate: Known or potentially impacting less than half of the Moderate Conservation Management 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 reserve but have the potential to become significant in the short to medium term future.

4 THE SPECIES INVENTORY

4.1 UNCONFIRMED SPECIES RECORDS

Following the field surveys and the review of fauna records, several species previously recorded in Georges River NP were excluded from the species inventories provided in this report. These species are only represented by records with high spatial inaccuracy, by unconfirmed sightings, by probable mis-identifications or database errors, or are introduced or non-local species that do not have established wild populations in or adjacent to the study area. Table 6 provides a list of all species excluded from the species inventories and the reason they have been omitted. Fish species were also excluded as they are beyond the scope of this report.

Table 6: Species recorded in Georges River National Park which have been removed from the species inventories provided in this report

Common name	Scientific name	Reason for omission from species inventory
Three-toed earless skink	*Hemiergis decresiensis*	This species is not confirmed to occur in coastal areas of Sydney and is likely to have been confused with the regionally common three-toed skink (*Saiphos equalis*) (Griffiths 2006, OEH 2013c).
Corn snake	*Pantherophis guttatus*	This species was found near a toilet block in the main picnic area of the Park (B. Hodgson pers. comm.). It is an exotic species originating from the United States of America which is illegal to keep it as a pet in Australia. This individual was considered a dumped animal.
Domestic goose	*Anser anser/cygnoides*	This species does occur sporadically in the reserve, particularly Yeramba Lagoon, but no breeding population is present.
Eastern reef egret	*Egretta sacra*	Single record from the Sandy Point area (OEH 2013c). In New South Wales this species predominantly occurs on rocky shorelines and reefs (Marchant and Higgins 1990). Although it does occasionally occur on intertidal areas of estuarine mudflats, mangrove-lined shores and tidal reaches of watercourses it is considered unlikely to occur this far upstream in the Georges River.
Banded lapwing	*Vanellus tricolor*	Recorded in the Sandy Point area (OEH 2013c) This species primarily occurs on treeless grasslands and pastureland areas (Marchant and Higgins 1993). Such habitat is poorly represented in the reserve and therefore this species is considered unconfirmed.
Painted honeyeater	*Grantiella picta*	Recorded in the Yeramba Lagoon section of the reserve, with no further details provided (Eco Logical 2009). It was formerly an uncommon breeding visitor to County of Cumberland, occurring most regularly in shale areas with plentiful mistletoe (Hoskin et al. 1991). Today it is considered extinct within the Sydney area with the last confirmed record at Castlereagh on the Cumberland Plain in 1960 (DECC 2007). Therefore as there have been no recent records and little suitable habitat is present it is considered unconfirmed.
Pied butcherbird	*Cracticus nigrogularis*	Reported in the Sandy Point and Yeramba Lagoon areas (Eco Logical 2009, OEH 2013c). However this species is rare in the Sydney region (Hoskin et al. 1991, Higgins et al. 2006) and therefore is considered unconfirmed.

Common name	Scientific name	Reason for omission from species inventory
Southern forest bat	*Vespadelus regulus*	Reported in the Sandy Point area based on a heard record (OEH 2013c). This species cannot be identified by audible call and the echolocation call is readily confused with the little forest bat (*Vespadelus vulturnus*) and large forest bat (*V. darlingtoni*) (Reinhold et al. 2001, Pennay et al. 2004). It is not considered to occur in coastal areas of the Sydney basin. Therefore, due to the absence of trapped individuals and the difficulty in identifying it based on echolocation calls, it is regarded as unconfirmed.

4.2 FAUNA SPECIES INVENTORY

A total of 248 native vertebrate fauna species are currently known to be residents in or visitors to Georges River NP. This total is comprised of 16 frogs, 32 native reptiles, 180 native birds and 20 native mammals (Appendix A). In addition, two introduced reptiles, nine introduced birds and eight introduced mammals have been confirmed to occur within the reserve. Twenty species have been recorded within the reserve that are listed under the TSC Act, while four species have been recorded which are listed as threatened under the EPBC Act (Table 7, Appendix A). Eight bird species occur that have been listed under international migratory bird agreements.

Table 7: Number of vertebrate fauna species known to occur in Georges River National Park

Total number of native fauna species known to occur	248
Number of species listed as threatened under the TSC Act	20
Number of species listed as threatened under the EPBC Act	4
Number of bird species listed under international migratory agreements (CAMBA, JAMBA, ROKAMBA)	8
Number of introduced reptiles	2
Number of introduced birds	9
Number of introduced mammals	8

A total of 179 native fauna species and 12 introduced species were recorded during the OEH surveys of the reserve (Appendix A). This includes 33 species which had not previously been recorded for Georges River NP in the sources compiled for this study, as follows:

Frogs: Leaf-green tree frog.

Reptiles: Thick-tailed gecko, red-throated skink, cream-striped shinning-skink, Cunningham's skink, eastern water-skink, White's skink, eastern water dragon and Rosenberg's goanna.

Birds*:* Black bittern, little eagle, eastern osprey, buff-banded rail, sharp-tailed sandpiper, common greenshank, caspian tern, sooty owl, Australasian figbird, masked woodswallow, white-browed woodswallow, restless flycatcher and tawny grassbird.

Mammals: Eastern freetail-bat, white-striped freetail-bat, Gould's wattled bat, chocolate wattled bat, eastern bentwing-bat, lesser long-eared bat, Gould's long-eared bat, eastern broad-nosed bat, little forest bat, house mouse and swamp rat.

4.2.1 Amphibians

After rain in the summer the air around Yeramba Lagoon is filled with a cacophony of sound from a variety of frogs, in particular the eastern dwarf tree frog, Tyler's tree frog, Peron's tree frog and the brown-striped frog. Large choruses of frogs can also be heard along drainage lines behind the headwaters of the lagoon, such as those meandering through the Coastal Flats Swamp Mahogany Forest. Elsewhere in the reserve, frogs are less prominent with the most commonly heard species being the common eastern froglet, brown-striped frog and Peron's tree frog. These species were recorded in a variety of wetland situations, including on the ecotone of swamp oak and sea rush behind Estuarine Saltmarsh. Unlike other species, the bleating tree frog was most frequently heard calling intermittently during the day from high in trees, usually some distance from the nearest watercourse or wetland.

The large number of Tyler's tree frogs present around and behind Yeramba Lagoon is of interest as this species is generally uncommon and patchily distributed in the southern Sydney area. Photo © M. Schulz

The leaf-green tree frog was recorded during the current survey but had not previously been recorded in the Atlas of NSW Wildlife for Georges River NP. Photo © M. Schulz

In total 16 frog species have been recorded in Georges River NP. The BSP survey detected only eight species, which reflects the cool and dry conditions and the fact that field work was primarily restricted to the spring months. The threatened green and golden bell frog has only been recorded once in 1994 and may no longer occur (see species profile in section 5). The status of some other species not recorded during the BSP survey is also uncertain, including the smooth toadlet, green tree frog and the brown toadlet. The latter two species have declined in the Sydney region in recent decades. Typically autumn-calling species such as the Verreaux's tree frog were not recorded during the BSP survey. Additionally, other spring and summer-calling frogs were not located, including the eastern banjo frog, spotted grass frog and Freycinet's frog.

One species, the leaf-green tree frog, had not previously been documented within the reserve in the Atlas of NSW Wildlife; it was located in a tributary of Mill Creek lined with saw sedge and other dense vegetation. Another notable find was the location of several red-crowned toadlets in a small fern-lined drainage line upslope of Mill Creek. This locality is only one of two sites known for this threatened frog within the Park and the first time the species had been documented to occur on the south side of the Georges River in the reserve.

One species found within one kilometre of Georges River NP, but not within it, is the introduced cane toad (*Rhinella* (formerly *Bufo*) *marinus*). It was located on private property in Casuarina Road, Alfords Point (OEH 2013c). Though searches within the reserve have not located this species to date, all OEH staff and park visitors need to be vigilant to ensure that a population does not become established.

The introduced cane toad has not been seen in Georges River NP but has been recorded nearby at Alfords Point. Photo © M. Schulz

4.2.2 Reptiles

Thirty-two species of locally native reptile have been recorded in Georges River NP, comprising one freshwater turtles, four geckoes, 13 skinks, three dragons, two goannnas and nine snakes. One species listed under the TSC Act has been recorded: the Rosenberg's goanna. The majority of the reptile species present are widespread in the Sydney region, although the bearded dragon and various snake species, such as the yellow-faced whip snake, have declined in the region in recent decades (K. Griffiths pers. comm.).

The broad-tailed gecko shelters in cracks and crevices in sandstone. Photo © M. Schulz

The 15 systematic diurnal herpetofauna searches and incidental observations detected 22 reptile species during the BSP survey. Of interest was the almost complete absence of snakes, with only one of the nine species known from the reserve located. This species, the red-bellied black snake was only recorded as a single individual. A number of other species were also only recorded as single individuals or in single localities. These species were the jacky lizard, wood gecko, thick-tailed gecko, White's skink, three-toed skink and the eastern blue-tongue. Also the eastern water-skink was surprisingly uncommon, only seen in one locality on the edge of Yeramba Lagoon; typically this species is widespread and common in the Sydney region. Eight species not previously recorded from the reserve were found in the BSP survey. These species were the thick-tailed gecko, red-throated skink, cream-striped shinning-skink, Cunningham's skink, eastern water-skink, White's skink, eastern water dragon and Rosenberg's goanna. All these species are widespread in the southern Sydney region.

The jacky lizard was only seen in one location during the current survey. Photo © M. Schulz

The most frequently encountered reptile in the reserve was the dark-flecked garden sunskink which occurs in all habitats including Saltmarshes, the terrestrial edge of Mangrove Swamps and within swamplands. Species that were only or predominantly recorded on dry ridgetops and slopes were the pale-flecked garden sunskink, red-throated skink, copper-tailed skink, White's skink, wood gecko and Rosenberg's goanna. Species predominantly confined to rock outcrops in drier forest habitats were the Lesueur's velvet gecko, broad-tailed gecko and Cunningham's skink. Two species were only sighted on the edge of Saltmarshes, the cream-striped shinning-skink and the eastern blue-tongue. The former species was seen on swamp oak logs and standing dead swamp oaks and the latter was found in a band of dense chaffy saw-sedge (*Gahnia filum*)-sea rush bordering Sydney Coastal Dry Sclerophyll Forests; both sightings were in the Mill Creek area. The three-toed skink was only sighted in Coastal Shale-Sandstone Forest adjacent to the end of Burns Road on the northern edge of the reserve.

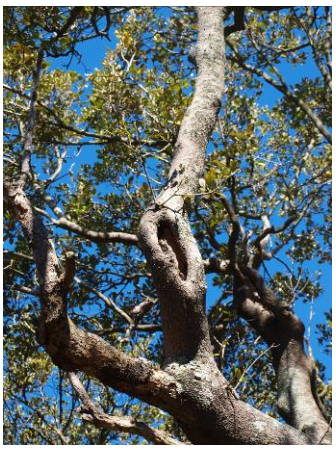
Perhaps the most interesting reptile record was the location of barred-sided skinks sheltering with crabs in the hollows of grey mangroves in a large patch of Estuarine Mangrove Forest opposite Great Moon Bay on the Georges River. These individuals were located close to the river edge well away from dry land, with the substrate beneath the mangrove trees covered by water up to one and a half metres deep in normal high tides.

The red-naped snake is not currently known from the reserve but was recorded in the vicinity of Sandy Point in the 1970s. Photo © M. Schulz

Two additional reptile species recorded in surrounding areas may occur within Georges River NP. These species are the treebase litter-skink (*Lygisaurus*

foliorum) and the red-naped snake (*Furina diadema*). However, the last species has declined significantly in the Sydney area and therefore the location of a population within the reserve would be of regional significance. It was recorded from the Sandy Point area in the 1970s with a spatial accuracy of 10 kilometres (OEH 2013c).

No legless lizards are known from the reserve. However, it is likely that the common scaly-foot (*Pygopus lepidopodus*) occurs, particularly in heathland and heathy woodland vegetation communities such as on the plateau on the south side of the Georges River.



Barred-sided skinks were found sheltering with crabs in hollows in grey mangroves. Photo © M. Schulz

4.2.3 Native birds

Birds are the most obvious wildlife that visitors see in the reserve. A variety of waterbirds frequent the major watercourses and Yeramba Lagoon while within the forested areas honeyeaters and other species fill the air with a multitude of sounds. The Park supports a large variety of bird species due to the mix of habitats present including large tidal watercourses with intertidal mudflats exposed at low tide, a permanent fresh to brackish water lagoon, Estuarine Mangrove Forest, Estuarine Saltmarsh, dry sclerophyll forests, riverflat forest on the flats of the larger watercourses, heathland, dense scrubland and moist forest with patches of rainforest or mesic shrub layers. The southern portion of the Park is also connected to extensive tracts of forest extending south from the reserve through Holsworthy Military Area to the Woronora Plateau and beyond. In all 180 species of native bird have been recorded in Georges River NP, including 14 species listed as threatened under the TSC Act and one species listed under the EPBC Act (Appendix A). In the BSP survey 129 native bird species were recorded, 72 per cent of the documented total for the reserve. Thirteen species, including four threatened species, had not previously been documented as occurring within Georges River NP (see section 4.2).

Australasian darters are commonly seen along the Georges River and tidal tributaries. Photo © M. Schulz

Fifty-nine waterbird species (33 per cent of the total species number) have been recorded, including a number of vagrant species (Appendix A). These vagrant species are predominantly either very rare visitors to the Sydney region (e.g. Hoskin et al. 1991) or primarily occur during periods of drought when many waterbirds move coastward. Such species include the Australasian shoveler, freckled duck, blue-billed duck, great crested grebe and the Australian little bittern. Other species have been recorded within the reserve but are rare elsewhere in the Sydney area. These species include the eastern osprey, Lewin's rail, sharp-tailed sandpiper, common greenshank and the tawny grassbird. A suite of waterbird species primarily occur along the Georges River and tidal tributaries including the four species of cormorants, Australasian darter, Australian pelican, eastern great egret, striated heron, little egret, royal spoonbill, eastern osprey, caspian tern and the silver gull. Small shorebird species were surprisingly uncommon, with the only species recorded in the BSP survey along or in wetlands adjacent to the Georges River being the black-winged stilt, black-fronted dotterel, sharp-tailed sandpiper and the common greenshank. Other waterbird species were only seen at Yeramba Lagoon, including the purple swamphen, dusky moorhen, Eurasian coot, Australasian grebe and the hardhead.

The black-winged stilt was one of only a few small shorebird species seen during the current survey. Photo © M. Schulz

Most waterbird species are non-breeding visitors to the reserve, including species listed under international migratory bird agreements (Appendix A). However, the reserve supports one of the few documented white-bellied sea-eagle nests in the Sydney area. This nest is located upslope of the Georges River, although in the 2012 nesting season it appeared to be disused with an alternate nest site potentially located on the slopes above Mill Creek. A variety of waterbird species nest at

Yeramba Lagoon, such as the purple swamphen, dusky moorhen, pacific black duck and previously the black swan. A number of cryptic waterbird species, such as spotless crake, Lewin's rail and buff-banded rail have been recorded, but it is not known whether these species nest in the reserve. The status of the Australasian bittern, spotless crake, little grassbird and the tawny grassbird is currently unknown.

Non-waterbird species present within the reserve include a combination of drier Cumberland Plain species and species typical of coastal areas of southern Sydney. The former species generally occur sporadically and include the peaceful dove, white-throated gerygone, weebill, fuscous honeyeater and the restless flycatcher. A less common species within this category is the black-chinned honeyeater. This group of species is under ongoing threat from loss of habitat from the Cumberland Plain.

The Lewin's rail is rarely seen due to its cryptic nature. Photo © M. Schulz

Species which occasionally erupt into the Sydney area from inland Australia have been recorded, including the masked woodswallow and the white-browed woodswallow. Nomadic nectarivorous species occur sporadically, depending on the degree of flowering by key eucalypt species within the reserve compared with flowering elsewhere in the region. These species include the musk lorikeet, little lorikeet, scarlet honeyeater and potentially the swift parrot (*Lathamus discolor*) and the regent honeyeater (*Anthochaera phrygia*).

The southern emu-wren was only recorded in sea rushland bordering Saltmarshes between Alfords Point Road bridge and Mill Creek. Photo © M. Schulz

Species more typical of coastal areas include the southern emu-wren which appears confined to sea rushland bordering Estuarine Saltmarsh between Alfords Point Road bridge and Mill Creek. Other species include the tawny-crowned honeyeater and the brown honeyeater. Interestingly, the mangrove gerygone (*Gerygone levigaster*) has not been recorded though it is relatively common in nearby Estuarine Mangrove Forest in Towra Point Nature Reserve (OEH 2013b) and has been recorded at Jew Fish Bay in Oatley (D. Andrew pers. comm.). The mangrove gerygone has expanded its range southwards in New South Wales since the 1940s. It was first recorded in the State at Tweed Heads in 1942, near Harrington at the Manning River mouth in 1955, the Hunter River estuary in 1967 and at Bonna Point in Botany Bay in 1982 (Higgins and Peter 2002). Therefore, it would be expected to occur (particularly in the winter months) in larger tracts of Estuarine Mangrove Forest along the Georges River and lower reaches of Mill Creek.

The dominant avifauna of the reserve is typical of sandstone sclerophyll forests in the Sydney region, including the rock warbler which is endemic to the Sydney Basin Bioregion. Some of the wet forest bird species are resident in the reserve, such as the satin bowerbird, while others pass through on migratory passage, such as the black-faced monarch and rufous fantail. A variety of summer migrants nest in the area, including the eastern koel, sacred kingfisher, dollarbird, rufous whistler and the leaden flycatcher. Similarly, a variety of winter migrants occur, including typically wet forest species that move into drier open forest types (and even Estuarine Mangrove Forest) in the winter months, such as the rose robin, golden whistler and the brown gerygone. Other wet forest species are uncommon sporadic visitors, most frequently occurring in the winter months, such as the white-headed pigeon, topknot pigeon, crescent honeyeater and the spangled

The spotted quail-thrush was photographed by infra-red camera in the reserve during the 2012 WildCount surveys. Photo © OEH

drongo. The most unusual winter migrant record is of a pink robin, one of the only confirmed records from the Sydney region (Hoskin et al. 1991).

The crested pigeon occurs at the picnic areas along the Georges River. Photo © M. Schulz

The status of a number of bushland birds which are uncommon in the Sydney region, except in the largest forest tracts, is uncertain. These species include the brush bronzewing, painted button-quail, glossy black-cockatoo, chestnut-rumped heathwren, spotted quail-thrush, varied sittella, scarlet robin and the Bassian thrush.

The reserve supports a number of nocturnal bird species. At least two powerful owl nesting pairs are present and a further four pairs include the reserve at least partially within their home ranges. Other well represented nocturnal species include the nankeen night-heron (along waterways and in Estuarine Mangrove Forest), the tawny frogmouth and the southern boobook. A notable find during the BSP survey was the location of a sooty owl in Hinterland Flats Eucalypt Forest along Mill Creek.

The picnic areas along the Georges River support a distinct suite of avifauna. Many species occurring here are uncommon or restricted in distribution elsewhere in the reserve including the Australian wood duck, crested pigeon, masked lapwing, sulphur-crested cockatoo, little corella, galah, Australian magpie, willie wagtail and the magpie-lark.

Eight species covered by international migratory bird agreements have been recorded. The majority of these are uncommon and confined to the Georges River (refer to profiles in section 5.3). Two more widespread species within the reserve are the white-bellied sea-eagle (which soars above all vegetation communities) and Latham's snipe (which occurs in dense sedgeland areas such as bordering Yeramba Lagoon and in sea rushland bordering Estuarine Saltmarsh).

The Australian pied oystercatcher has not been recorded but is likely to occasionally use exposed intertidal flats of the Georges River. Photo © M. Schulz

It is likely that additional species may frequent the reserve but go unrecorded, including species which have recently been recorded nearby or downstream in the Georges River estuary such as the grey goshawk (*Accipiter novaehollandiae*) and pacific baza (*Aviceda subcristata*). In summary, species that are listed under the TSC Act or covered by international migratory bird agreements and are likely to occur within the study area but have gone unrecorded include the swift parrot, Australian pied oystercatcher (*Haematopus longirostris*), bar-tailed godwit (*Limosa lapponica*), whimbrel (*Numenius phaeopus*) and the eastern curlew (*N. madagascariensis*) as well as possibly the regent honeyeater. Due to the conservation status of these species, information on their potential occurrence in the Park and surrounding areas is provided in the following paragraphs.

The swift parrot has not been recorded but may visit in winter and spring when swamp mahogany, blackbutt or forest red gum trees are in flower. Photo © H. Cook

The Australian pied oystercatcher (listed as Endangered under the TSC Act) is likely to occasionally range into the study area at low tide from further downstream in the lower Georges River (such as exposed tidal flats in the Illawong Point-Oatley Bay area) and from Botany Bay (such as the Taren and Shell points area) (OEH 2013b, D. Andrew pers. comm.). The species disappeared from beaches around Sydney at the turn of the century, but recolonised Botany Bay in 1973 (Hindwood and McGill 1958, Rogers 1974, Hoskin et al. 1991, Straw 1996). Numbers observed in Botany Bay increased dramatically during monitoring undertaken between 1972 and 1996, with several

sightings of individuals colour-banded in Victoria (Straw 1996). In Botany Bay numbers peak between mid-autumn and mid-winter (NSW Wader Study Group count data) and individuals are likely to range into the study area at this time. The species is primarily expected to occur on exposed intertidal flats at low tide on the bed of the Georges River, outside the actual Park boundary. The Australian pied oystercatcher would be considered of low management priority if recorded.

Neither the bar-tailed godwit (top), whimbrel (middle) or eastern curlew (bottom) have been recorded, but all are likely to be occasional visitors. Photos © M. Schulz (top and middle) and J. Bishop (bottom)

The closest record of swift parrot (listed as Endangered under both the TSC Act and EPBC Act) is from September 1989 in Gannons Park in Peakhurst, less than one kilometre north-east of the Saltpan Creek-Alfords Point section of the Park (OEH 2013c). Movements of this species are highly nomadic due to the variable nature of the flowering of its favoured food trees; sometimes the species does not return to the same locality for a number of years. The most important food tree species within the study area is the swamp mahogany (taken from Higgins 1999). The swift parrot may visit the study area in winter and early spring, particularly when swamp mahogany is in flower (May to July) and to a lesser extent when blackbutt (March to July) or forest red gum (June to October) flower (Higgins 1999). Potential habitat is provided by Coastal Flats Swamp Mahogany Forest, forest communities where forest red gum is prevalent (Cumberland Riverflat Forest, Hinterland Riverflat Paperbark Swamp Forest and Hinterland Flats Eucalypt Forest) and forest communities where blackbutt is present (Coastal Shale-Sandstone Forest, Hinterland Sandstone Gully Blackbutt-Apple Forest and Hinterland Transition Grey Gum Forest). Were this species to be located in the Park it would be allocated to the high priority species rank for management, and managed in accordance with the national recovery plan (Swift Parrot Recovery Team 2001). Meanwhile, habitat for the species should be managed on the presumption that the swift parrot does visit, and hence the species has been considered in sections 7 and 8.

The regent honeyeater (listed as Critically Endangered under the TSC Act and Endangered under the EPBC Act) has not been recorded in the Park. However the BSP survey was not undertaken in the autumn-winter months when the regent honeyeater may use the Sydney area in years when there is poor food supply at core breeding sites (Higgins et al. 2001). There are no records of regent honeyeater within the last decade from within one kilometre of the Park, but older nearby records include adjacent to Saltpan Creek in 1994 and Lugarno in 1977 and 1983 (OEH 2013c). The regent honeyeater is currently estimated to have a total population of 350-400 mature individuals (Garnett et al. 2011). It has severely declined in abundance across its range, including within the Sydney Basin Bioregion. Within the region the species is principally recorded in the lower Hunter, Burragorang and Capertee valleys (DECC 2007, 2008b; Garnett et al. 2011). Its occurrence is dependent on the concentration of flowering of key tree species, and the absence of flowering elsewhere within its range. It is possible that the regent honeyeater is a still an occasional visitor to the Park when the swamp mahogany flowers between May and July and to a lesser extent when the forest red gum flowers between June and October) (Higgins et al. 2001). During these months this honeyeater may occur in Coastal Flats Swamp Mahogany Forest, where the swamp mahogany is a dominant tree species, or Cumberland Riverflat Forest, Hinterland Riverflat Paperbark Swamp Forest and Hinterland Flats Eucalypt Forest where forest red gum occurs. It may also visit other forest types within the Park, such as those supporting flowering smooth-barked apple. Were this species to be located in the Park it would be of high conservation significance and therefore of high management priority; relevant management actions in the national recovery plan should then be followed (Menkhorst et al. 1999). Meanwhile, habitat for the species should be managed on the presumption that the regent honeyeater does visit, and hence the

The regent honeyeater has severely declined in the Sydney Basin Bioregion but there is a chance that it may visit the Park in winter or spring. Photo © OEH

species has been considered in sections 7 and 8.

The bar-tailed godwit (*Limosa lapponica*, listed under CAMBA, JAMBA and ROKAMBA migratory bird agreements) is a predominantly summer migrant which has not been recorded from the Park but has been observed foraging at low tide on intertidal flats upstream along Saltpan Creek and further downstream in the lower Georges River, such as in the Illawong area (OEH 2013c, D. Andrew pers. comm.). It is likely to be a rare visitor at low tide on intertidal flats along the Georges River abutting the Park and on adjacent shorelines of the reserve, particularly at the junction of Little Saltpan Creek. Such visitors would comprise individuals ranging upstream from more regular haunts in Botany Bay and the mouth of the Woronora and Georges rivers (DECC 2008a; OEH 2013b). Similarly the whimbrel (*Numenius phaeopus*) and eastern curlew (*Numenius madagascariensis*) (both also listed under CAMBA, JAMBA and ROKAMBA) are likely to occasionally occur at low tide on intertidal flats along the Georges River and on adjacent shorelines of the Park, particularly at the junction of Little Saltpan Creek and mangrove-lined mudflats opposite Moon Point and in Little Moon Bay.

4.2.4 Native mammals

Twenty species of native mammal have been recorded in Georges River NP. This includes three native mammal species listed under the TSC Act: the koala, grey-headed flying-fox and the eastern bentwing-bat (see species profiles in section 5.2). Half of the native mammal species were recorded for the first time during the BSP survey. Nine of these species were bats, including the threatened eastern bentwing-bat.

A temporary camp of the grey-headed flying-fox has been reported adjacent to Mill Creek. Photo © M. Schulz (not taken locally)

The most frequently encountered native mammal species are the common ringtail possum, common brushtail possum, swamp wallaby and the grey-headed flying-fox. All of these species occur in bushland with little disturbance, including larger stands of Estuarine Mangrove Forest, as well as in and adjacent to picnic areas with scattered native trees. The grey-headed flying-fox is reported to have a temporary camp in swamp oaks adjoining Hinterland Flats Eucalypt Forest adjacent to the lower reaches of Mill Creek. This camp was not in use during the BSP survey periods. Animals that forage within the reserve originate from nearby camps in southern and western Sydney. Other widespread but more cryptic species include the sugar glider.

Species predominantly, or only, recorded on the south side of the Georges River are the koala, short-beaked echidna, brown antechinus, long-nosed bandicoot, swamp rat and the bush rat. A number of koala sightings were made during the BSP survey, all located between Mill Creek and Sandy Point. The swamp rat was only recorded in two localities, south of Blackwall Rock and south of Mickeys Point. Both localities were characterised by dense sea rush-dominated rushland bordering Estuarine Saltmarsh.

The common brushtail possum was photographed by many of the infra-red cameras; this one is in a grey mangrove in Estuarine Mangrove Forest. Photo © OEH

Insectivorous microbat species comprise 45 per cent of the total number of native mammal species in the Park. Insectivorous bats would forage across almost all of the available habitat types including Estuarine Saltmarsh, Shorelines and intertidal areas. Estuarine Mangrove Forest is likely to support important roosting habitat, with mature mangrove trees and dead standing trees providing an abundance of small hollows suited to microbats. The most frequently located species were the little forest bat, chocolate wattled bat, white-striped freetail-bat and the Gould's wattled bat. The lesser long-eared bat was only recorded roosting under exfoliating bark of dead swamp oaks fringing Estuarine Saltmarsh on the edge of Mill Creek. This species has also been recorded roosting in a similar situation on Carters Island in the nearby Towra Point NR (OEH 2013b). Three other bat species were recorded in low numbers, in part probably due to the difficulty in reliably distinguishing them by their ultrasonic call (Reinhold et al. 2001, Pennay et al. 2004). These species were the eastern freetail-bat, Gould's

long-eared bat and the eastern broad-nosed bat. It is likely that all three species are more widespread than current records suggest.

No roosts of cave-dwelling bats were located within the reserve. The absence of such roosts may explain the low number of eastern bentwing-bat records, with only occasional wide-ranging foraging individuals occurring.

The large-footed myotis has not been recorded, but suitable habitat such as this is extensive. Photo © M. Schulz

A number of additional microbat species may occur in the Park. Species which have been recorded in nearby areas include the east-coast freetail-bat (*Mormopterus norfolkensis*, recorded by Anabat adjacent to the western side of Salt Pan Creek in Padstow Heights (OEH 2013c)) and the little bentwing-bat (*Miniopterus australis*, recorded by Anabat in the Mill Creek headwaters (Cumberland Ecology 2011)). Both these species may also occur within the Park; recent studies in the Hunter Valley area have shown that mangroves are an important roosting habitat for the east-coast freetail-bat (A. McConville pers. comm.). The greater broad-nosed bat (*Scoteanax rueppellii*) has been confirmed from nearby areas including Holsworthy Military Area and Towra Point NR (DECC 2008a, OEH 2013b). Suitable habitat is present in Georges River NP and the species is likely to also occur within the Park. The large-footed myotis (*Myotis macropus*) has also not been confirmed to occur. Unconfirmed recordings made by either this species or long-eared bat species (*Nyctophilus* sp.) were made at four sites, including along Mill Creek and at Yeramba Lagoon. The species may have been overlooked during the BSP surveys due to: the fact that the ultrasonic calls are very similar to the more common long-eared bats; the fact that recorded calls were not of sufficient quality to satisfactorily confirm the species' presence; and because it was not possible to set harp traps over the Georges River, larger streams such as Mill Creek and tidal channels within mangrove areas. The large-footed myotis has been captured in nearby areas, including along the Georges River bordering Holsworthy Military Area and further upstream, as well as in nearby river valleys such as the Woronora River at the Pass of Sabugal (DECC 2008a). It is therefore considered highly likely that this species is present in the Park. Confirmation of the presence of these species would require further bat survey involving sampling of all vegetation communities (including Estuarine Mangrove Forest) using ultrasonic call detection, harp trapping and mist nets between mid-spring and late summer. Any ultrasonic call analysis should be undertaken by an experienced analyser in order to avoid the misidentification of calls.

The spotted-tailed quoll (*Dasyurus maculatus*) has also been recorded adjacent to the reserve. There is record of a single individual found dead on Heathcote Road south of Deadmans Creek in September 1993 (OEH 2013c). This species is known to occur in the Holsworthy Military Area, with a number of recent sightings by Australian Defence Force personnel (DECC 2008a). Consequently there is a possibility that individuals may occasionally range into the reserve. It is also likely that eastern grey kangaroos (*Macropus giganteus*) may occasionally range into Georges River NP from the Holsworthy Military Area, where there is a large population, however three are no confirmed sightings (B. Hodgson pers. comm., OEH 2013c).

A spotted-tailed quoll was found dead on Heathcote Road in 1993 and it is possible that quolls occasionally range into Georges River NP. Photo © M. Schulz (not taken locally)

4.2.5 Introduced reptiles

A number of red-eared slider turtles have been captured in Yeramba Lagoon (Eco Logical 2009). However, no females have been located and it is currently not known whether the lagoon supports a breeding population of the species. Similarly it is not known whether short-necked turtles breed at Yeramba Lagoon. This species was reported from Yeramba Lagoon in 1996 and most likely originated from dumped individuals. Due to the possibility that this species may breed in the Park it has been retained in the species inventory. However the corn snake (found near the main picnic area) does not

have the potential to establish a population and hence has been removed from the species inventory in this report (see Table 6).

4.2.6 Introduced birds

The Eurasian blackbird occurs in small numbers including away from disturbed edges. Photo © M. Schulz

Nine introduced bird species have been recorded within Georges River NP, with six of these located during the BSP survey. Additionally, the domestic goose sporadically occurs on Yeramba Lagoon and less frequently on the Georges River; these individuals are likely to have been dumped and do not breed in the reserve.

The common myna, house sparrow and spotted dove are confined to disturbed areas and the fringes of the reserve. The rock dove was chiefly recorded roosting in crevices below the Alfords Point Road bridge and foraging along the adjacent shoreline of the Georges River. The common starling was also recorded along the shoreline of Georges River and at Yeramba Lagoon. The red-whiskered bulbul was found in vegetation bordering the Georges River and adjoining the Yeramba Lagoon. The Eurasian blackbird is present in small numbers including away from the edges of disturbed habitats, with two of the three records deriving from infra-red cameras. This species was recorded in Littoral Rainforest in the Lugarno section of the reserve, dense lantana adjacent to the Georges River upstream of Alfords Point Road bridge and in a drainage line flowing into Yeramba Lagoon.

Two species which were not recorded in the BSP survey have previously been observed around Yeramba Lagoon: the northern mallard and the nutmeg mannikin.

One additional species, the European goldfinch (*Carduelis carduelis*), was recorded adjacent to the reserve in Davies Road Padstow (OEH 2013c). It is likely that this species occasionally ranges into the reserve.

4.2.7 Introduced mammals

Eight species of introduced mammal have been recorded in Georges River NP, five of which are listed as a Key Threatening Process under the TSC Act and/or the EPBC Act. These species are the dog, fox, cat, rabbit and the rusa deer. The fox is common and widespread on both sides of the Georges River. Documenting the extent of rusa deer occurrence was an important result of the BSP survey; the rusa deer is common on the south side of the Georges River between Sandy Point and Alfords Point Road bridge. The rabbit has only been recorded along the Park boundary south of Sandy Point area, while the feral cat occurs on the plateau above the Mill Creek valley. No feral dogs were recorded during the BSP survey and there are no recent documented sightings within the Park (OEH 2013c). However, single individuals or packs have recently been reported adjacent to Georges River NP in the Sandy Point area, crossing Heathcote Road in the vicinity of White Rocks and in the Lucas Heights area (S. Harris pers. comm.). It appears that there may be a small feral dog population in the general area of Lucas Heights-Sandy Point.

The black rat is not listed as a Key Threatening Process on mainland Australia but is recognised as such on offshore islands under the TSC Act and the EPBC Act. This species is abundant throughout the Park in a wide variety of vegetation communities, including Estuarine Mangrove Forest, Estuarine Saltmarsh, Estuarine Reedland and along Shorelines. It was detected at 57 per cent of the infra-red camera survey sites (BSP survey and OEH Wildcount infra-red cameras combined). Individuals were observed entering and exiting hollows in mature grey mangrove trees opposite Moon Point; in many of these hollows the chewed remains of several crab species were found as well as one dead bat (species unknown). The black rat was also the most common mammalian prey item in the fox scats

Black rats were photographed by the infra-red cameras using hollows in mature grey mangrove trees opposite Moon Bay. Photo © OEH

analysed for the BSP survey, comprising 55 per cent of the total mammalian prey. Given the impact of the black rat on island faunas, and the lack of dietary studies in natural bushland, mangroves and other habitats, it is expected that there is at least some impact on fauna within the reserve (after Stokes et al. 2009). The impact of this feral species on threatened fauna, such as tree-hollow roosting bats is currently unknown.

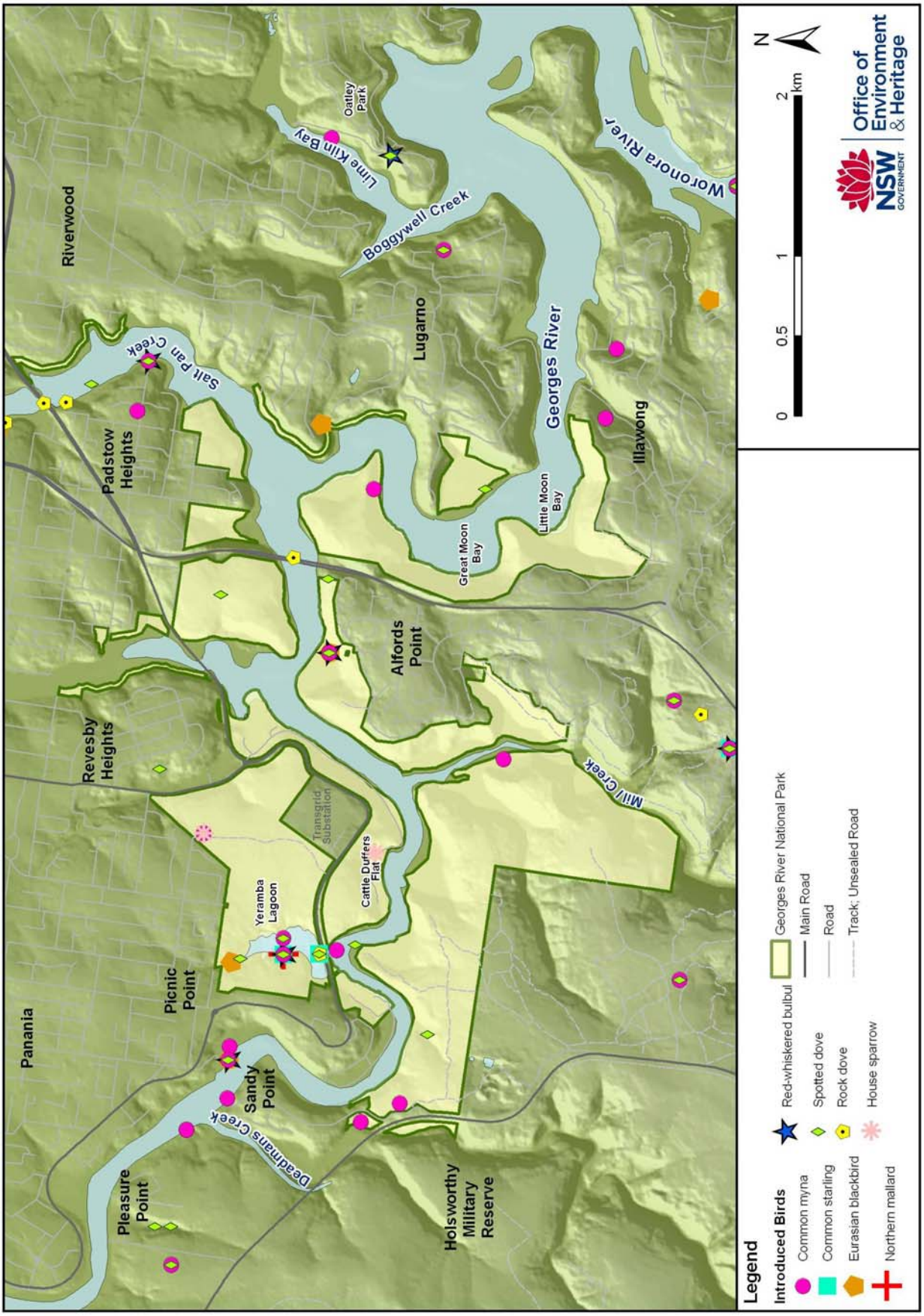
The house mouse was found sheltering under driftwood deposited on the edge of lower Mill Creek in Estuarine Saltmarsh. The brown hare was not recorded during the BSP survey and there are no recent records from the reserve (B. Hodgson pers. comm.). However it has previously been seen in the Yeramba Lagoon and Sandy Point areas (Eco Logical 2009, OEH 2013c).

A number of domestic dogs accompanied by joggers, fishermen and walkers were observed on formal and informal trails, picnic areas and the shoreline edge (both on and off leash). Additionally, a number of domestic cats were seen adjacent to houses on the northern edge of Georges River NP.

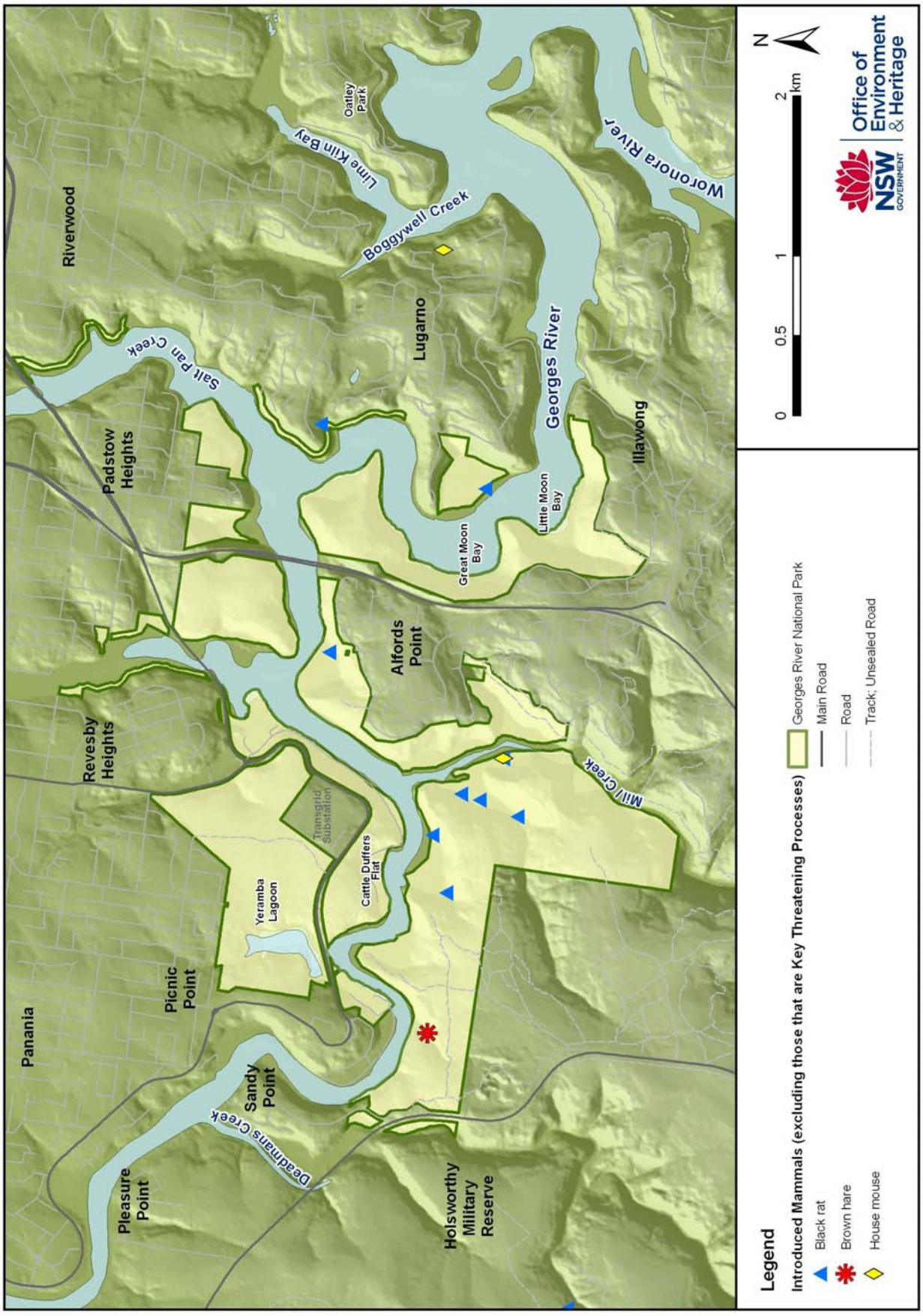
Over the last three years four goats and one sheep have been retrieved by Sutherland Shire Council in the White Rock area immediately adjoining the reserve along Heathcote Road (S. Harris pers. comm.). These are assumed to be dumped individuals. However, it is possible that a small population of feral goats is present in the general area given that between four and six individuals have been reported in the headwaters of Mill Creek, individuals have been trapped in the Lucas Heights area and the species is reported to occur within Holsworthy Military Area (S. Harris pers. comm.). It is likely that this feral goat population ranges into Georges River NP, but since no individuals have been recorded within the Park to date the species is not included within the species inventory in this report. Additionally, horses have been reported from the headwaters of Mill Creek (Cumberland Ecology 2011) and these may range into the reserve.

A pair of white-bellied sea-eagles nests annually in Georges River NP. Photo © D. Andrew

Map 10: Distribution of introduced bird records in Georges River National Park (only includes records from OEH (2013c))



Map 11: **Distribution of introduced mammal records in Georges River National Park, excluding those listed as a Key Threatening Process (only includes records from OEH (2013c))**



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, bats and introduced species.

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 BSP 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.

Threats in the Study Area

In this section Key Threatening Processes listed under the TSC Act and other threats known or potentially 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 may be identified.

Management Considerations

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

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

5.2 THREATENED SPECIES

GREEN AND GOLDEN BELL FROG		*Litoria aurea*
EPBC Act: Vulnerable	**TSC Act: Endangered**	**Study Area: Low Priority**

Green and golden bell frog. Photo © M. Schulz

Occurrence in the Study Area

The green and golden bell frog was not detected during the BSP survey nor has it been seen by any other observers in almost 20 years. The only record from the study area is of an individual found in January 1994 at Sandy Point, north-west of the mouth of Mill Creek (A. White in OEH 2013c). This individual may have originated from the sub-population at Hammondville (see below). It is possible that the species may exist in *Juncus* and *Phragmites*-dominated swampland on the inland fringe of Estuarine Saltmarsh areas. However during the BSP survey the weather was dry, meaning this frog was unlikely to call and hence unlikely to be detected.

Regional Conservation Significance

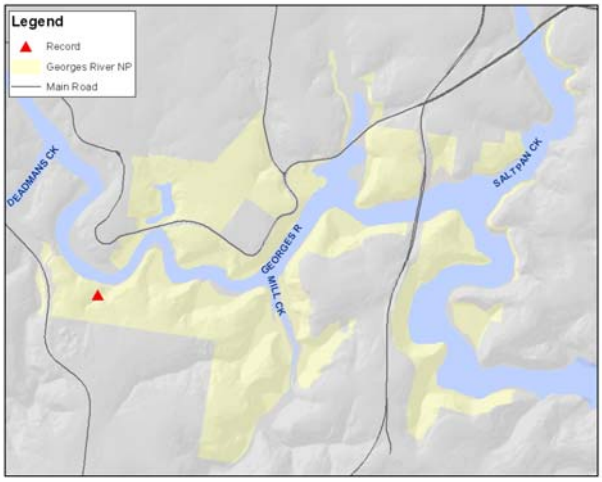
The green and golden bell frog has declined from being one of the most abundant frog species in the Sydney area to one that now has a fragmented distribution and is absent from at least 90 per cent of its former range (White and Pyke 1996). The decline was first noted in the 1980s (Osborne 1990) and the species is now limited to about 40 fragmented and isolated populations across the State (DEC 2005a). Three sub-populations of the green and golden bell frog occur along the Georges River, two of which are considered extinct: the Holsworthy and Liverpool subpopulations (Commonwealth of Australia 2009). The Hammondville sub-population, which occurs on the floodplains of the lower Georges River, is considered extant (in 2008) but has undergone severe declines in recent years and is of precarious status (DEC 2005a, Commonwealth of Australia 2009). The green and golden bell frog recorded at Sandy Point in 1994 may form an eastern extension of the Hammondville sub-population (DECC 2008a, Commonwealth of Australia 2009, A. White pers. comm.). At this point in time Georges River NP is not known to contribute to the regional conservation of this species. However, were this species found to currently occur in the Park it would be of high conservation significance.

Threats in the Study Area

Threats to potential habitat in the study area include: silting up/infilling of water bodies; changes to Saltmarshes and associated sedgeland environments due to changes in tidal regimes as a result of siltation in the Georges River; alteration of floodplain wetland characteristics associated with surrounding development; weed invasion (e.g. overgrowth of ponds by exotic aquatic plants); grazing and trampling of habitats by the rusa deer; and damage to wetland areas behind Saltmarshes by illegal motorbike access. If present then the species itself has the potential to be threatened by: herbicide spraying; Chytrid fungus; and introduced predators such as plague minnow (*Gambusia holbrooki*), fox, cat and black rat.

Management Considerations

- Conduct targeted surveys of ephemeral freshwater wetlands on the inland edge of Saltmarshes after heavy or prolonged rain episodes between mid-spring and summer. Recommended areas include Mickeys Point area, lower reaches of Mill Creek, west of Mill Creek mouth and on the south side of the River from Yeramba Lagoon downstream to the powerline easement.
- Encourage the reporting of any possible sightings or calls.
- In the event that individuals are discovered, management should be in accordance with draft species recovery plan (DEC 2005a).



RED-CROWNED TOADLET *Pseudophryne australis*

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

Red-crowned toadlet. Photo © M. Schulz

Red-crowned toadlet habitat. Photo © OEH

Occurrence in the Study Area

In October 2012 several individuals were heard calling from an ephemeral drainage line in Coastal Enriched Sandstone Sheltered Forest below a low escarpment upslope of Mill Creek. Prior to the BSP survey this species had been recorded in 2005 in a soak in a minor drainage line on the north side of the Georges River north of Mickeys Point in 2005 (OEH 2013c). It is likely that other populations occur in similar situations elsewhere within the Park, particularly given this species has also been recorded in ephemeral drainage lines in red bloodwood-smooth-barked apple woodland and dwarf apple-broad-leaved scribbly gum heath-woodland in the upper Mill Creek catchment (Cumberland Ecology 2011).

Regional Conservation Significance

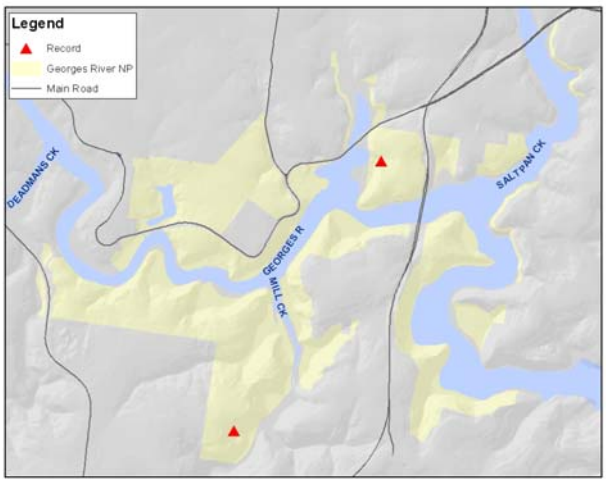
The red-crowned toadlet is endemic to the Sydney Basin Bioregion, with recognised core areas on the Woronora Plateau, the Royal-Heathcote reserves and the Blue Mountains between Glenbrook and Blackheath (DECC 2007). Adjacent to the study area the species occurs in various minor drainage lines and swampy depressions in Holsworthy Military Area (DECC 2008a). It has undergone declines in the region, particularly in northern Sydney (Wells 2002). The current status of the species within the Park is unknown. However due to the fact that the red-crowned toadlet has only been recorded from two sites and is well represented in other reserves to the south (such as Royal and Heathcote national parks) and to the west (Blue Mountains NP) (DECC 2007, DECCW 2011a), Georges River NP is not considered highly significant to the conservation of the species in the Sydney Basin Bioregion.

Threats in the Study Area

Low dispersal ability and high rates of reproductive failure (Thumm and Mahony 2002) make this species vulnerable to local extinction. Major threats are: changes to hydrological regime and water quality in drainage channels that feed from ridges that are currently developed or proposed for urban development; habitat alteration due to high frequency fires; road/management trail/walking track construction and maintenance; Chytrid fungus; trampling of seepage areas by rusa deer; predation by the fox and cat; and illegal motorbike activity.

Management Considerations

- Ensure the current hydrological regime and water quality in minor drainage lines and seepages in Heathlands and Dry Sclerophyll Forests is maintained, particularly in light of upslope current and future urban development.
- Ensure that road, walking track and management trail works do not impact potential habitat.
- Protect potential habitat from high frequency fire.
- Observe frog hygiene protocols (NPWS 2001) during any works in drainage and seepage areas.



ROSENBERG'S GOANNA *Varanus rosenbergi*

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

Rosenberg's goanna. Photo © M. Schulz

Rosenberg's goanna habitat above Mill Creek. Photo © OEH

Occurrence in the Study Area

The Rosenberg's goanna has only been recorded once in the Park; a single individual was seen during the BSP survey (October 2012) on the ecotone between Woronora Sandstone Exposed Bloodwood Woodland and Hinterland Sandstone Dwarf Apple Heath-Woodland on the plateau west of Mill Creek. This species is likely to be an uncommon resident, confined to the far south-west of the Park. To the south of the reserve individuals have been recorded in dwarf apple-broad-leaved scribbly gum heath-woodland, red bloodwood-smooth-barked apple woodland and heath-leaved banksia damp heath in the upper parts of the Mill Creek catchment and along Heathcote Road (DECC 2008a, Cumberland Ecology 2011). Modelling of the species in the greater southern Sydney region indicates a preference for ridgetops with high levels of rock and shrubs on flat ground (DECC 2007).

Regional Conservation Significance

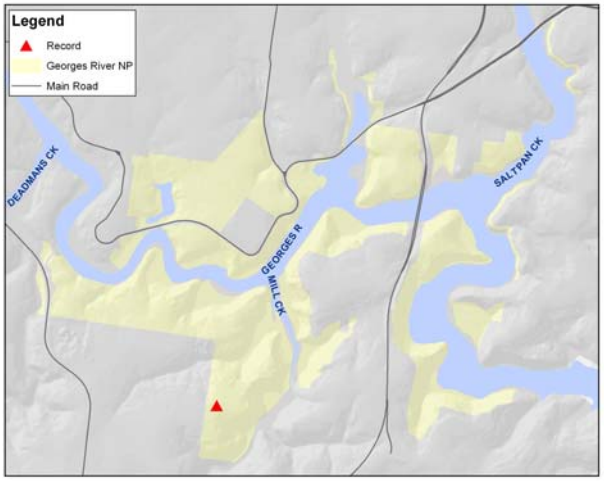
Georges River NP is situated on the northern edge of a key population centre for this species in New South Wales, which comprises Royal and Heathcote national parks and the Woronora Plateau extending to Holsworthy Military Area (DECC 2007). It is likely that only a small number of individuals are present in Park, with few having their entire home range confined to the reserve. Given this, Georges River NP is not considered highly significant to the conservation of the species in the Sydney Basin Bioregion.

Threats in the Study Area

Given that the home range of this species is large, and that no individuals' home range is likely be totally encompassed within the Park, the Rosenberg's goanna is particularly susceptible to habitat fragmentation and loss of habitat connectivity in the southern portion of the Park. It is also vulnerable to road fatality on Heathcote Road. Additional threats within the reserve include: frequent fire (particularly as it impacts termite mounds and logs that are used for shelter); predation by foxes, cats and dogs; potentially taking of fox baits; and the removal of dead trees and fallen logs.

Management Considerations

- Advocate the importance of the connectivity of native vegetation between Georges River NP and the Holsworthy Military Area and the importance of retaining native vegetation in the headwaters of Mill Creek and in the Sandy Point area.
- Protect ridgetops in the south-west portions of the Park from high frequency fire.
- Conduct fox control on the south side of the River, but ensure baits are not accessible to this species.
- Avoid the removal of dead trees and fallen timber.
- Minimise the impact of domestic dogs through patrols and public education.



BLUE-BILLED DUCK *Oxyura australis*

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

Blue-billed ducks. Photos © M. Schulz

Occurrence in the Study Area

This species is a vagrant to the Park. It was not recorded during the BSP survey or in the Atlas of NSW Wildlife, but is listed as occurring at Yeramba Lagoon by Eco Logical Australia (2009). This species prefers extensive areas of open water, particularly lakes and reservoirs greater than 100 hectares in area with little emergent vegetation (Marchant and Higgins 1990). In recent years Yeramba Lagoon has become infested with salvinia (*Salvinia molesta*) and other water weeds; virtually no open water is present making it unsuitable for this species.

Regional Conservation Significance

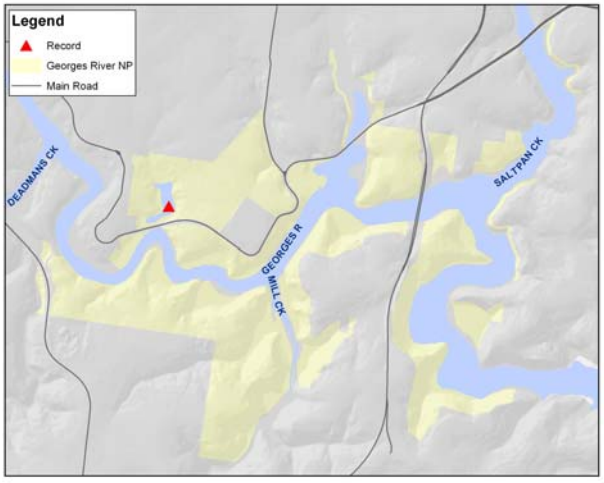
The blue-billed duck is a rare visitor to the Sydney area (Hoskin et al. 1991). Georges River NP does not significantly contribute to the conservation of this species.

Threats in the Study Area

Nil.

Management Considerations

Nil.



FRECKLED DUCK *Stictonetta naevosa*

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

Freckled ducks (top), open water patches providing potential freckled duck habitat on Yeramba Lagoon in 2011 (middle), weed cover of the lagoon in 2012 (bottom). Photos © M. Schulz

Management Considerations

Nil.

Occurrence in the Study Area

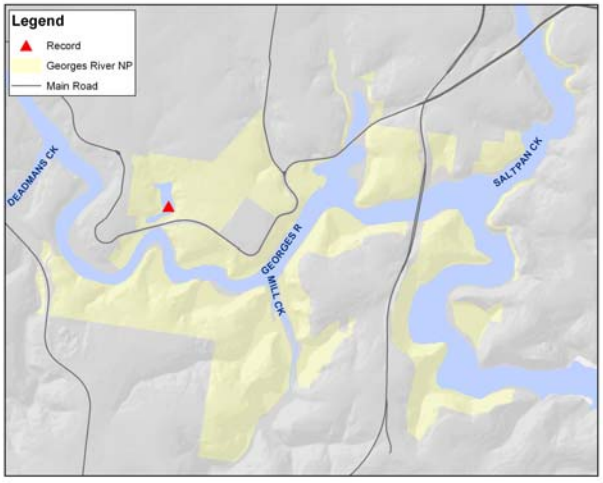
This species is a vagrant to the Park. It was not recorded during the BSP survey or in the Atlas of NSW Wildlife. The only documented record is of one female seen at Yeramba Lagoon in August 2002 during the 2002-03 drought (McKay 2002). This species prefers extensive areas of open water, particularly lakes and reservoirs greater than 100 hectares in area with little emergent vegetation (Marchant and Higgins 1990). In recent years Yeramba Lagoon has become infested with salvinia and other water weeds; virtually no open water is present making it unsuitable for this species. At the time of the BSP survey there was an influx of freckled duck into the Sydney region. However repeated visits to Yeramba Lagoon failed to detect the species, and no sightings were reported for the locality by other birdwatchers on Birdline NSW.

Regional Conservation Significance

This species is a very rare and sporadic visitor to the Sydney area. It was recorded in Sydney in 1897, but then not again until 1958 (Marchant and Higgins 1990, Hoskin et al. 1991). During the 2002-03 drought there were a number of sightings in the Illawarra and Sydney areas (e.g. Chafer 2004). In 2012-13 there have again been a number of reports in the Sydney and Illawarra areas on Birdline NSW, due to the drying period inland after several wet years. Given the lack of recent sightings and the current lack of suitable habitat Georges River NP does not significantly contribute to the conservation of this species.

Threats in the Study Area

Nil.



AUSTRALASIAN BITTERN *Botaurus poiciloptilus*

EPBC Act: Endangered	TSC Act: Endangered	Study Area: Moderate Priority

Australasian bittern. Photo © T. Shimba/OEH

Occurrence in the Study Area

The status of this species in the study area is uncertain. It was not recorded during the BSP survey or in the Atlas of NSW Wildlife. However, it is listed as occurring in the Yeramba Lagoon area by Eco Logical Australia (2009). It may also frequent other habitats within the reserve, such as extensive areas of sea rush adjoining Estuarine Saltmarsh and reedland areas dominated by the common reed. This species is likely to have been under-recorded due to its nocturnal habits, the fact that it frequents wetland habitats that are difficult to traverse, and due to its probable sporadic occurrence. The species can also be confused with the immature nankeen night heron.

Regional Conservation Significance

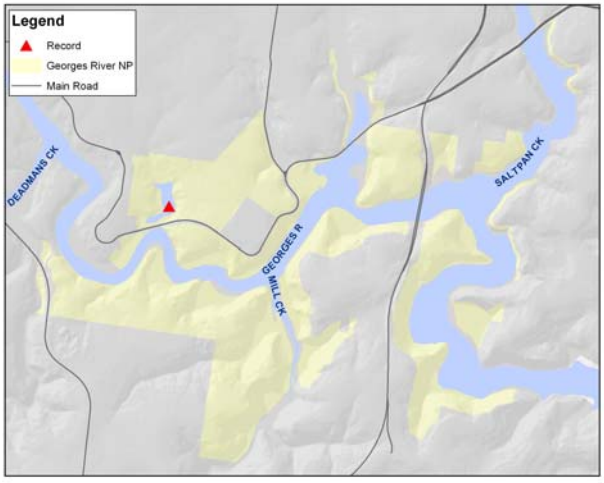
The Australasian bittern's global conservation status is Endangered; the total population in Australia, New Zealand and New Caledonia is estimated at between 1500 and 4000 individuals (BirdLife International 2013). Within New South Wales the overall population has dramatically declined and from surveys in 2009-10 is estimated at a maximum of 162 individuals (Birds Australia 2010). This secretive wetland species is rare and only occasionally recorded within the Sydney Basin Bioregion, with an increase in sightings during severe inland droughts (Hoskin et al. 1991, DECC 2007). There are no documented breeding records for the region (Chafer et al. 1999). The importance of wetlands within the study area to the conservation of the Australasian bittern is unclear and hence the species is of moderate management priority.

Threats in the Study Area

Potential threats include: habitat destruction; alteration in wetland hydrological characteristics; water pollution; weed infestation resulting in loss of foraging habitat; trampling of wetlands by the rusa deer; entanglement with fishing line and other refuse items; high frequency fires at wetland margins; predation by the fox; and loss of habitat as a result of climate change (Garnett and Crowley 2000, OEH 2012d).

Management Considerations

- Conduct targeted surveys over a number of years in spring and early summer using call playback, passive listening at dawn and dusk, and active searching. Recommended areas include sedgeland at the back of Yeramba Lagoon, extensive sea rush patches bordering Saltmarshes, and areas of common reed (see guidelines in Birdlife Australia 2010). Surveys would aim to improve the understanding of species occurrence and distribution and assess breeding status.
- Encourage the reporting of any possible sightings.
- Enter all sightings into the Birdlife Australia nationwide Australasian and Australian little bittern project (http://www.birdsaustralia.com.au/our-projects/bittern-survey.html).
- Consider undertaking fox control around Yeramba Lagoon.



BLACK BITTERN *Ixobrychus flavicollis*

EPBC Act: Not Listed	TSC Act: Vulnerable	Study Area: Moderate Priority

Black bittern. Photo © A. Taylor/OEH

Occurrence in the Study Area

The status of this species within the study area is uncertain. The single record in the Atlas of NSW Wildlife is from the BSP survey (October 2012) when a single individual was flushed from the edge of Mill Creek. This section of Mill Creek is tidal-influenced with a narrow band of Estuarine Mangrove Forest bordering Hinterland Flats Eucalypt Forest. The black bittern was also observed further upstream on the bank of Mill Creek (south of the current Park boundary) in 1994 (Engel and Chafer 1994). The species is likely to have been under-recorded in the Park due to its flighty nature (often disappearing before an observer makes a positive identification or simply being overlooked when other birds are present), the fact that it frequents upper tidal sections of watercourses that are rarely accessed by bird watchers, and due to its probable sporadic occurrence.

Regional Conservation Significance

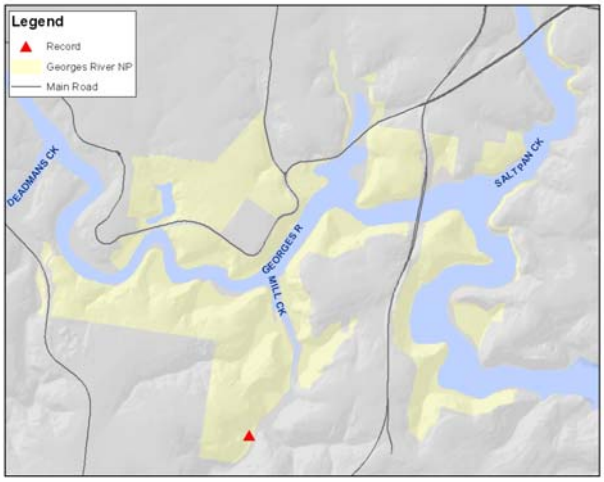
This secretive wetland species is an uncommon and patchily distributed breeding visitor in the region. The most regular sightings in Sydney occur in the Deep Creek-Narrabeen Lake-Warriewood Wetland area (DECC 2008a, Birdline NSW). Records in the broad vicinity of the study area include a single individual flushed from the upper reaches of Cabbage Tree Creek in Royal NP in January 2010, a single individual at the junction of Forbes and Loftus creeks in the Woronora River catchment in May 2007, along the upper reaches of the Woronora River in the Woronora Heights area in March 2010 and various records from the Quakers Hill section of the Western Sydney Parklands (DECC 2008a, DECCW 2011a, Birdline NSW). DECC (2007a) recommended that all known habitat in the greater southern Sydney region be considered of high conservation significance. The specific importance of wetlands within Georges River NP is currently unknown, and the species status in other conservation reserves in the Sydney region, such as Royal and Scheyville national parks is also uncertain (e.g. DECCW 2011a). Until further information is gained the black bittern is considered of moderate priority within the study area.

Threats in the Study Area

Potential threats include: clearing of riparian vegetation; alteration in watercourse quality and flow characteristics; predation of eggs and young by the fox and cat; the trampling of watercourse margins by rusa deer; entanglement with fishing line and other refuse items; and public disturbance, particularly in navigable sections of watercourses (Garnett and Crowley 2000).

Management Considerations

- Conduct targeted surveys over a number of years along Mill Creek to increase understanding of occupation rate and habitat usage.
- Avoid clearing of riparian vegetation along Mill Creek and other streams.
- Prepare a rusa deer management plan in consultation with the Royal NP Deer Working Group.
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.
- Seek to maintain the hydrological regime and water quality of Mill Creek, particularly in light of upslope current and future urban development.



EASTERN OSPREY *Pandion cristatus*

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

Eastern osprey. Photo © M. Schulz

Occurrence in the Study Area

The osprey is an irregular visitor to the study area. It is chiefly observed hunting for fish over the open waters of the Georges River, Saltpan and Little Saltpan creeks, occasionally resting in trees lining these watercourses (BSP survey and DECC 2008a). The species is more regularly observed as single individuals or pairs in the lower reaches of the Georges River, such as around the junction of the Woronora River.

Regional Conservation Significance

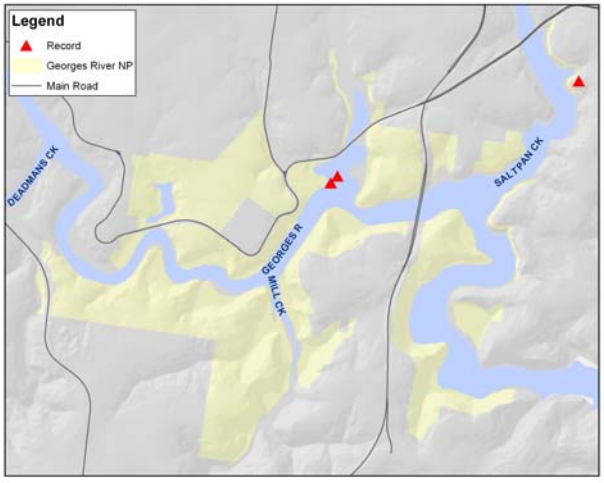
The eastern osprey occurs infrequently in the Sydney Basin Bioregion, mainly as single individuals in coastal estuaries and waterways (Hoskin et al. 1991). There are few nesting records in the region, with the exception of a pair that has nested on a number of occasions in the Narrabeen Lake area (DECC 2008a), and a pair that nested in Illawong in 2013 (D. Andrew pers. comm.). In recent years the eastern osprey has been regularly observed in the lower reaches of the Georges River, around Towra Point NR, along the ocean shoreline in Royal NP and in Port Hacking (DECCW 2011a, OEH 2013b, D. Andrew pers. comm.). A colour-banded individual seen in the lower reaches of the Georges River was banded as a chick on the Clarence River in north-east New South Wales (D. Andrew pers. comm.). Given that the osprey is an irregular visitor to the study area, and that it primarily occurs over the waters of the Georges River and on exposed mud banks that are actually outside of the Park boundary, Georges River NP itself is not considered highly significant to the conservation of the species in the Bioregion.

Threats in the Study Area

Potential threats include: disturbances to water quality, such as from stormwater runoff which increases turbidity in feeding areas; ingestion of fish containing discarded fishing tackle; pollution of inshore waters, including indirect impacts on prey species; entanglement with fishing line and other refuse items.

Management Considerations

- Protect any potential perch trees bordering watercourses.
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.



LITTLE EAGLE *Hieraaetus morphnoides*

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

Light phase little eagle. Photo © M. Schulz

Occurrence in the Study Area

The little eagle is an occasional visitor to the study area. The only record is of a single individual seen soaring over Woronora Sandstone Exposed Bloodwood Woodland and Hinterland Sandstone Dwarf Apple Heath-Woodland during the BSP survey (May 2013). It had not previously been recorded for the reserve in the Atlas of NSW Wildlife or by Eco Logical Australia (2009), nor in the Mill Creek headwaters (Cumberland Ecology 2011). It should be noted that the species is frequently mistaken for the more common whistling kite (Hoskin et al. 1991).

Regional Conservation Significance

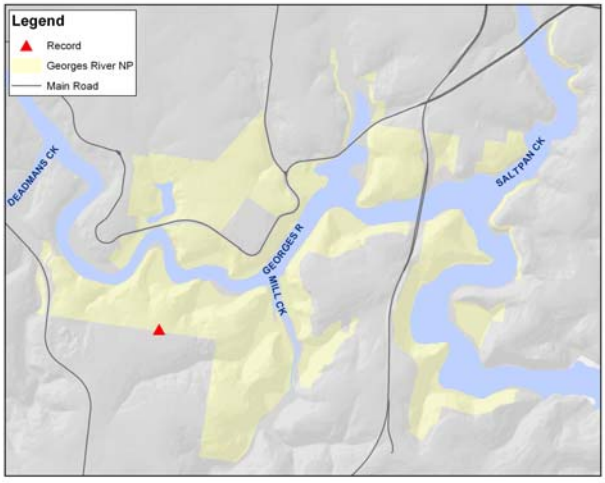
The range of the little eagle has been suggested to have increased in south-east Australia following the introduction and expansion of the rabbit (Marchant and Higgins 1993). However, there was a 14 per cent decrease in the reporting rate of this bird between 1984 and 2002 across the nation (Barrett et al. 2003). This species is scattered across the Sydney Basin Bioregion in small numbers, with the majority of sightings in woodlands often adjacent to open areas on near-coastal plains and foothills. The species is likely to occasionally range into the study area in the winter months from nearby areas to the south such as Holsworthy Military Area and Heathcote-Royal national parks (DECC 2008a, DECCW 2011a). Due to the paucity of sightings the reserve does not significantly contribute to the regional conservation of this species. Since the predominant dietary item is the rabbit (Marchant and Higgins 1993), this species is likely to be more prevalent within the survey area for a period of years following wildfire and other disturbance events when rabbit numbers are higher and then gradually diminish in numbers as rabbit populations decline.

Threats in the Study Area

Nil.

Management Considerations

Nil.



GLOSSY BLACK-COCKATOO *Calyptorhynchus lathami*

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

Glossy black-cockatoo. Photo © M. Schulz

Chewed *Allocasuarina* cones are telltale evidence of this species presence. Photo © M. Schulz

Occurrence in the Study Area

The glossy black-cockatoo was not recorded during the BSP survey or in the Atlas of NSW Wildlife. Nor was it recorded in a recent fauna survey of the headwaters of Mill Creek (Cumberland Ecology 2011). However, it is listed as occurring in the Yeramba Lagoon area by Eco Logical Australia (2009). This status of the species in the study area is uncertain, but it is probably a rare visitor to forest communities that contain black she-oak (*Allocasuarina littoralis*) or forest oak (*A. torulosa*), in particular Coastal Shale-Sandstone Forest, Coastal Enriched Sandstone Sheltered Forest, Hinterland Sandstone Gully Blackbutt-Apple Forest and Hinterland Sandstone Transition Grey Gum Forest.

Regional Conservation Significance

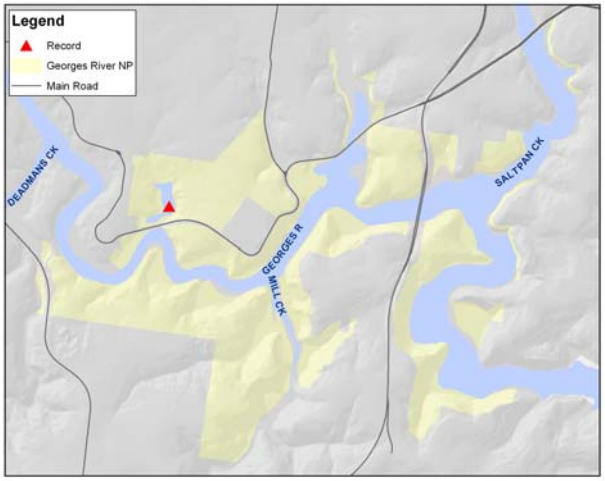
The glossy black-cockatoo is relatively common in the sandstone reserves west of the Cumberland Plain, including Nattai and Blue Mountains national parks (DECC 2007). It is very rare on the Woronora Plateau (e.g. Chafer et al. 1999), although numbers increased after extensive wildfires to the west of this area in 2001 (DECC 2007). The scarcity of this species on the Woronora Plateau is reflected in it being very rarely observed in Royal and Heathcote national parks (DECCW 2011a) and it has not been recorded from Holsworthy Military Area (DECC 2008a). Due to the paucity of records in the study area and surrounds, the Park is not considered to significantly contribute to the regional conservation of this species.

Threats in the Study Area

Potential threats include: loss of food trees (*Allocasuarina* spp.) (e.g. through high frequency fires); and impeded regeneration of food trees by the rusa deer.

Management Considerations

- During fire management planning ensure that feeding habitat (i.e. mature stands of *Allocasuarina littoralis/A. torulosa*) is retained.
- Prepare a rusa deer management plan in consultation with the Royal NP Deer Working Group.
- Encourage the reporting of sightings in the Atlas of NSW Wildlife.



LITTLE LORIKEET *Glossopsitta pusilla*

EPBC Act: Not Listed	TSC Act: Vulnerable	Study Area: Moderate Priority

Little lorikeet. © H. Cook

Occurrence in the Study Area

The little lorikeet was first recorded from the Park during the BSP survey (November 2012). Three individuals were observed in Woronora Sandstone Exposed Bloodwood Woodland on the plateau above Alfords Point and at least four individuals were found in flowering blackbutt in Hinterland Sandstone Transition Grey Gum Forest south of Sandy Point. There are no records of this species from immediately surrounding areas (e.g. Cumberland Ecology 2011, DECC 2008a, OEH 2013c, Birdline NSW). Important flowering trees within the Park include red bloodwood, blackbutt, swamp mahogany and forest red gum (taken from Higgins 1999). Movements of the little lorikeet are irregular. The species is nomadic, with the number of individuals present in a given area varying between years depending on the prevalence of key flowering trees. Sometimes the species does not return to the same locality for many years. Given this, the little lorikeet is likely to be an irregular visitor to the Park. Foraging habitat occurs in the Northern Hinterland Wet Sclerophyll Forests, Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests, Coastal Swamp Forests and Coastal Floodplain Wetlands habitat groups. It may nest within the Park during peak flowering events.

Regional Conservation Significance

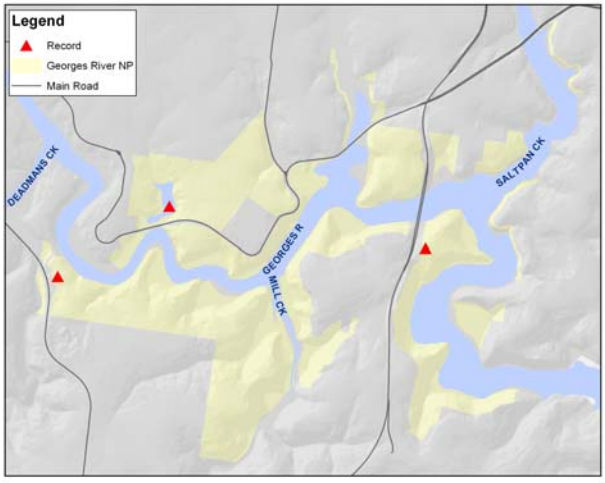
The little lorikeet is listed as threatened in New South Wales due to a moderate reduction in population size over 15 years (NSW Scientific Committee 2009a). Records are widespread in the Sydney Basin Bioregion, including in the sandstone reserves west of the Cumberland Plain such as Nattai and Blue Mountains national parks (DECC 2007). In southern Sydney it is a regular visitor in small numbers to Royal NP and the Woronora Plateau, Holsworthy Military Area and Leacock Regional Park (DECC 2008a, DECCW 2011a, Birdline NSW). The extent of use of the foraging habitat within Georges River NP is not currently known. Most breeding records in New South Wales come from the western slopes (NSW Scientific Committee 2009a), however there is a chance that the species may breed within the Park. Due to the fact that the relative importance of the Park to this species in the Bioregion context is not known, it has currently been given a moderate management priority ranking.

Threats in the Study Area

Loss of feed trees, particularly the swamp mahogany, is a threat through loss of trees around picnic areas due to public safety concerns, death without regeneration, suppression of regeneration by weeds and 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. Additional threats include the loss of hollow-bearing living and standing dead trees, competition with the introduced honeybee (*Apis mellifera*) for the occupation of tree hollows for nesting purposes, public disturbance in high visitation sites such as picnic areas, and potentially aggressive noisy miners in disturbed areas.

Management Considerations

- Ensure the ongoing health of stands of swamp mahogany, including in picnic areas through the maintenance of existing trees and assisting natural regeneration.
- Avoid removal of hollow-bearing living and dead standing trees, and remove any honeybee colonies encountered in tree hollows.
- Where necessary, undertake prescribed burns when key flowering tree species are not in flower and retain unburnt patches of the vegetation communities containing these species.



POWERFUL OWL *Ninox strenua*

EPBC Act: Not Listed	TSC Act: Vulnerable	Study Area: Moderate Priority

Powerful owl. Photo © N. Williams

Occurrence in the Study Area

A number of pairs have territories partly or entirely within the Park. At least six pairs occur, in the following areas: Moon Point area, opposite Moon Point in the Lugarno area, Mickeys Point area, middle reaches of Mill Creek, main picnic area, south side of the River west of Mill Creek mouth, and in the Yeramba Lagoon-Picnic Point-Sylvan Grove Native Gardens area (DECC 2008a, Birdlife Australia 2012, OEH 2013c, BSP survey records). Additionally, a pair occurs along Saltpan Creek north of Henry Lawson Drive (DECC 2008a). The species has been recorded in the Sydney Coastal Dry Sclerophyll Forests, Sydney Hinterland Dry Sclerophyll Forests and Coastal Floodplain Wetlands habitat groups. A number of roosts have been found, primarily in dense vegetation, and frequently the bird is observed holding a partially eaten common ringtail possum. Two pairs have been confirmed to nest in the Park, in the Moon Point and Yeramba Lagoon areas (Birdlife Australia 2012). It is likely that at least some of the other birds also nest in the Park, particularly the pair along Mill Creek and west of Mill Creek mouth. The powerful owl nests in hollows at least half a metre deep, such as broken-off trunks of trees or sloping spouts in large eucalypts (diameter at breast height 80-240 centimetres) that are at least 150 years old (OEH 2012a). Frequently birds will use the largest and oldest tree in a stand and often use the same hollow for two to three consecutive years (Higgins 1999).

Regional Conservation Significance

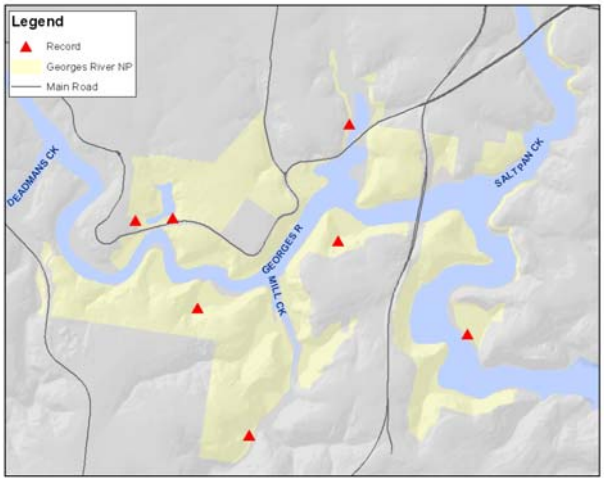
The powerful owl is a relatively common and widespread resident in the Sydney Basin Bioregion. It is well represented on the southern fringes of Sydney further east in the Loftus-Engadine area, further downstream on the lower reaches of the Georges River, along the Woronora River, Royal NP and Heathcote NP (DECC 2008a, DECCW 2011a, Birdlife Australia 2012, R. Jackson pers. comm.). Breeding pairs are centred on remnant bushland in sheltered forested gullies in many parts of Sydney, with foraging territories extending out across urban areas and parklands. However, the density of breeding pairs within Georges River NP appears high in the Sydney Basin Bioregion context (M. Schulz pers. obs.). The species has therefore been given a moderate management priority ranking. Information gleaned from the Birdlife Australia powerful owl project may lead to a review of this rank.

Threats in the Study Area

Potential threats include: loss of nest trees, sensitivity to disturbance around nest sites, road mortality, loss of habitat connectivity, predation of fledglings by the fox, feral/domestic cat and domestic dogs, and competition with the introduced honeybee for tree hollows.

Management Considerations

- Follow relevant management recommendations in the statewide recovery plan (DEC 2006a).
- Do not undertake hazard reduction burns in areas known to support nesting birds between May (when birds lay) and January (when the last chicks have fledged) (from Higgins 1999).
- Protect known nest trees and avoid removal of hollow-bearing living and dead standing trees.
- Encourage OEH staff and park visitors to participate in the Birdlife Australia powerful owl project.
- Consider the feasibility of undertaking fox control in the known territories, particularly around nest trees between May and January.



SOOTY OWL *Tyto tenebricosa*

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

Sooty owl. Photo © R. Jackson

Occurrence in the Study Area

The BSP survey detected the only record of sooty owl for Georges River NP when an individual responded to nocturnal call playback along the middle reaches of Mill Creek in Hinterland Flats Eucalypt Forest in May 2013. It had also not previously been recorded in the Mill Creek headwaters (Cumberland Ecology 2011). The status of the species in the Park is uncertain. Potential habitat is provided by forest with a mesic influence including Coastal Escarpment Littoral Rainforest, Coastal Enriched Sandstone Sheltered Forest and Coastal Sandstone Riparian Forest. The home range of the animal heard is unlikely to be entirely confined to the reserve.

Regional Conservation Significance

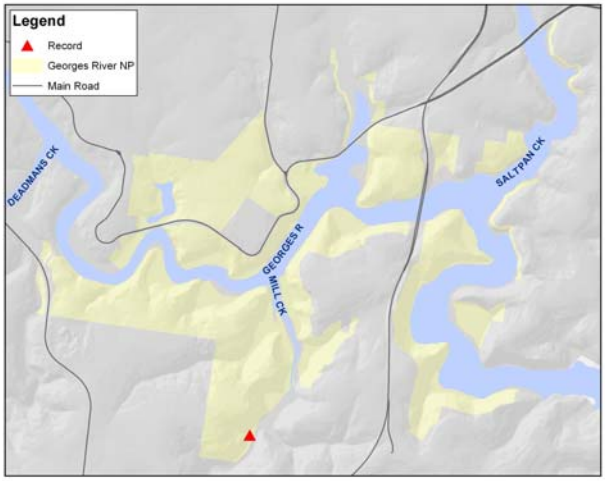
The sooty owl is considered relatively common in suitable habitat within the Sydney Basin Bioregion with small numbers present in larger tracts of moist forest with a mesic understorey (DECC 2007). This species is well known from deep gullies in Royal NP, Heathcote NP and Garawarra SCA and also along the Woronora River and its tributaries, such as in the Loftus-Engadine area (Kavanagh and Jackson 1997, DECCW 2011a, R. Jackson pers. comm.). Due to the fact that the sooty owl has only been recorded once and is well represented in other reserves to the south and to the west, Georges River NP is not considered highly significant to the conservation of the species in the Sydney Basin Bioregion.

Threats in the Study Area

Potential threats include: loss of moist forest habitat through high frequency fire, the loss of hollow-bearing trees, and loss of habitat connectivity with important populations to the south.

Management Considerations

- Follow relevant management recommendations in the statewide recovery plan (DEC 2006a).
- Protect moist forest in the Mill Creek catchment from high frequency or high intensity fire including Coastal Enriched Sandstone Sheltered Forest and Coastal Sandstone Riparian Forest.
- Avoid removal of hollow-bearing living and dead standing trees.



PAINTED HONEYEATER *Grantiella picta*

EPBC Act: Not Listed	TSC Act: Vulnerable	Study Area: Nil as Unconfirmed/Extinct

Painted honeyeater. Photo © Henry Cook

Occurrence in the Study Area

There is a single record of painted honeyeater in the Yeramba Lagoon section of the reserve, with no details provided (Eco Logical 2009). This species was formerly an uncommon breeding visitor to County of Cumberland, occurring most regularly in shale areas with plentiful mistletoe (Hoskin et al. 1991). Today it is considered extinct within the Sydney area with the last confirmed record at Castlereagh on the Cumberland Plain in 1960 (DECC 2007). As there have been no recent records and little suitable habitat is present in the study area, the species is considered unconfirmed and unlikely to occur.

Regional Conservation Significance

Within the Sydney Basin Bioregion records of painted honeyeater are concentrated between Sydney, Newcastle and Mudgee, particularly around the Hunter Valley (OEH 2013c). The species is very poorly represented in reserves in the Bioregion, but has been recorded in Munghorn Gap Nature Reserve, Wollemi NP and at the boundary of Goulburn River NP. As the species has not been confirmed in Georges River NP and is considered extinct within the Sydney area, the study area does not make any contribution to the conservation of this species in the Sydney Basin Bioregion.

Threats in the Study Area

Nil.

Management Considerations

Nil.

BLACK-CHINNED HONEYEATER (EASTERN SUBSPECIES)

Melithreptus gularis gularis

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

Black-chinned honeyeater. Photo © M. Schulz

Occurrence in the Study Area

The only record is of one individual seen adjacent to Yeramba Lagoon in January 1999 (OEH 2013c). There are no records of this species from immediately surrounding areas (e.g. Cumberland Ecology 2011, DECC 2008a, OEH 2013c, Birdline NSW). The species can be considered a vagrant to the Park. Potential habitat does occur, primarily Cumberland Riverflat Forest and Hinterland Flats Eucalypt Forest where the forest red gum occurs. Other potentially suitable habitats include Coastal Shale-Sandstone Forest, Hinterland Sandstone Gully Blackbutt-Apple Forest, Hinterland Sandstone Transition Grey Gum Forest and Coastal Flats Swamp Mahogany Forest. However in the Sydney Basin Bioregion the species preferred habitat is low elevation grassy woodlands (DECC 2007). This habitat type is not present within Georges River NP. The black-chinned honeyeater can readily be confused with the more common white-naped honeyeater (*M. lunatus*) and the brown-headed honeyeater (*M. brevirostris*). Therefore any sightings must be accompanied by photographs or call recordings to confirm the presence of this species within the reserve.

Regional Conservation Significance

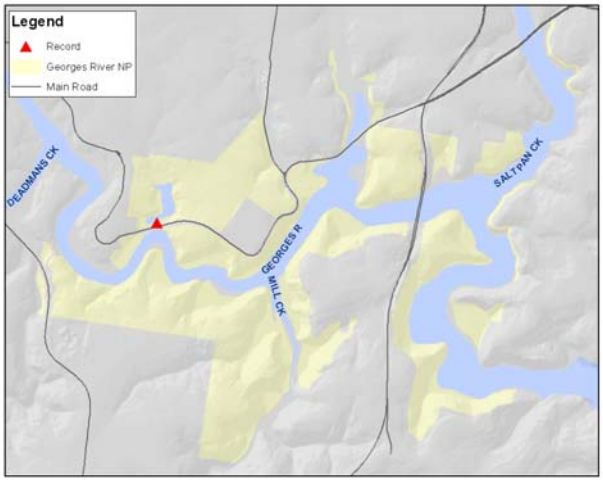
Most records of black-chinned honeyeater in the Sydney Basin Bioregion come from drier areas with fertile soils such as the Capertee, Burragorang and lower Hunter valleys (DECC 2007, 2008b; Birdline NSW). There are a small number of records on the edge of the Cumberland Plain to the west of the survey area, such as along the upper Georges River and Myrtle Creek in the Minto Heights area (DEC 2006b, DECC 2007). Due to the fact that there have been no recent records from the reserve or surrounding areas, and that preferred primary habitat is not present, Georges River NP is not considered to significantly contribute to the regional conservation of this species.

Threats in the Study Area

Potential threats include: the degradation or loss of Cumberland Riverflat Forest (including remnant trees in picnic areas), exclusion by other aggressive honeyeaters especially the noisy miner and particularly in picnic areas.

Management Considerations

- Avoid any removal of remnant trees from picnic areas.



VARIED SITTELLA *Daphoenositta chrysoptera*

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

Varied sittella. Photo © M. Schulz

Occurrence in the Study Area

The varied sittella is an uncommon visitor or breeding resident. It was recorded twice during the BSP survey; three individuals were observed foraging in trees along a small drainage line on the western side of Mill Creek in Coastal Enriched Sandstone Sheltered Forest and several birds were encountered behind Yeramba Lagoon in Coastal Flats Swamp Mahogany Forest. All other records for the species from the Park are from forest adjacent to Yeramba Lagoon: two individuals in July 1995 (OEH 2013c) a record in 2002 (Birdline NSW); and nest building observed in October 2009 (D. Andrew pers. comm.). This species was also recorded adjacent to the Park in the headwaters of Mill Creek (Cumberland Ecology 2011) and has been recorded from a number of localities in the nearby Holsworthy Military Area (DECC 2008a).

Regional Conservation Significance

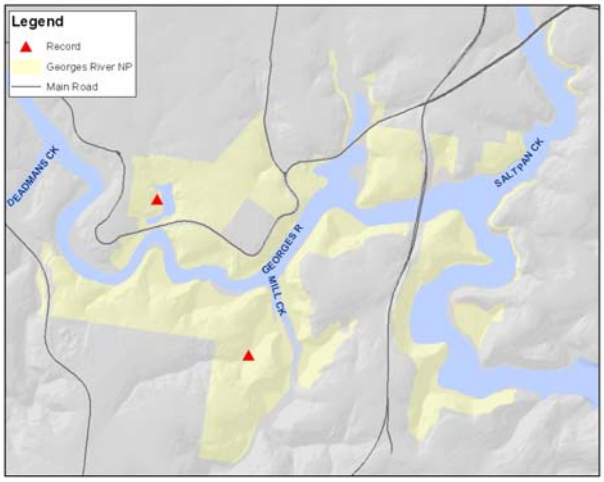
The varied sittella is widespread in small numbers across the Sydney Basin Bioregion (DECC 2007). However, there was a greater than 20 per cent decrease in the reporting rate of this bird between 1984 and 2002 in this Bioregion (Barrett et al. 2003). Its preferred habitat is flatter environments with moderately tall trees, particularly in dry box woodland and forests on more fertile soils (DECC 2007). In the Sydney area it is more commonly encountered in larger forest remnants in the Cumberland Plain such as at Bents Basin State Conservation Area, Shanes Park and in the Riverstone area (Birdline NSW). Due to the small number of sightings in the Park compared to other reserves within the Bioregion, the survey area is not considered to make a highly significant contribution to conservation of the species.

Threats in the Study Area

Potential threats include: high frequency fires, with the species requiring a mosaic of different age classes to ensure the presence of refugia in times of wildfire and colonisation of habitat that has recovered after fire; the removal of dead standing trees; predation by the black rat and both feral and domestic cats; and the presence of aggressive species such as the noisy miner in some habitats.

Management Considerations

- Ensure a mosaic of time since fire classes in forest types across the Park.
- Avoid removal of hollow-bearing living and dead standing trees.
- Manage feral and wide-ranging domestic cats.



SCARLET ROBIN *Petroica boodang*

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

Scarlet robin male (top) and female (bottom). Photos © M. Schulz

Occurrence in the Study Area

The scarlet robin was not recorded during the BSP survey or previously in the Atlas of NSW Wildlife. It was not recorded in a fauna survey of the headwaters of Mill Creek (Cumberland Ecology 2011), although there is a record in May 2011 at Bardens Ridge upslope of Mill Creek (OEH 2013c). However, it is listed as occurring in the Yeramba Lagoon area by Eco Logical Australia (2009). There do not appear to be any resident birds present in the reserve. The species is expected to be an irregular non-breeding visitor predominantly in the winter months, coming from nearby areas to the south such as Holsworthy Military Area and Heathcote NP (DECC 2008a; DECCW 2011a). It would prefer drier forest communities with an open shrub and ground layer, particularly on ridgetops such as Woronora Sandstone Exposed Bloodwood Woodland and Hinterland Sandstone Transition Grey Gum Forest.

Regional Conservation Significance

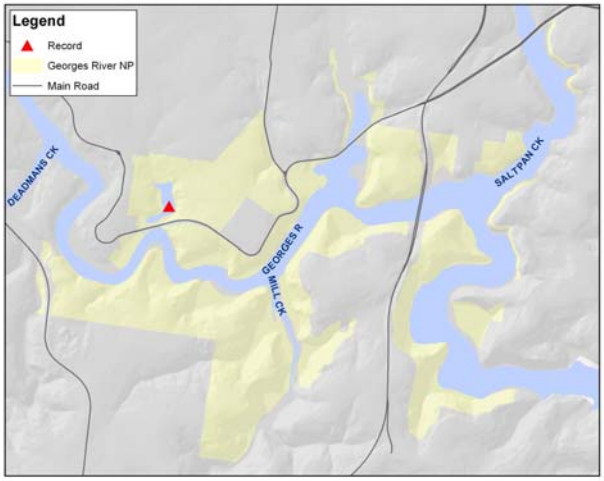
The scarlet robin is widespread in small numbers across the Sydney Basin Bioregion (DECC 2007). There was a greater than 20 per cent decrease in the reporting rate of this bird between 1984 and 2002 within the Bioregion and 31 per cent across the nation (Barrett et al. 2003). Due to the paucity of records, the survey area does little to contribute toward the regional conservation of this species.

Threats in the Study Area

Potential threats include: high frequency fires, with the species requiring a mosaic of different age classes to ensure the presence of refugia in times of wildfire and colonisation of habitat that has recovered after fire; the removal of fallen timber and dead standing trees; predation by the black rat and both feral and domestic cats; and the presence of aggressive species such as the noisy miner in some woodland habitats.

Management Considerations

- Ensure a mosaic of time since fire classes in drier vegetation types across the Park.
- Avoid removal of hollow-bearing living and dead standing trees.
- Avoid removing fallen timber (such as fallen whole trees) from ridgetops.
- Manage feral and wide-ranging domestic cats.



PINK ROBIN *Petroica rodinogaster*

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

Female pink robin. Photo © M. Schulz

Occurrence in the Study Area

The pink robin is an extremely rare winter visitor/vagrant, with one old record of a single bird identified at Yeramba Lagoon in August 1972 (Hoskin et al. 1991). There are no documented records from surrounding areas (e.g. DECC 2008a, Cumberland Ecology 2011, OEH 2013c, Birdline NSW). This species is an extremely rare winter migrant to the Sydney area (Hoskin et al. 1991). It is readily confused with the more common rose robin, particularly drab-coloured females and immatures. Therefore any sightings must be accompanied by photographs or call recordings to confirm the presence of this species within the reserve.

Regional Conservation Significance

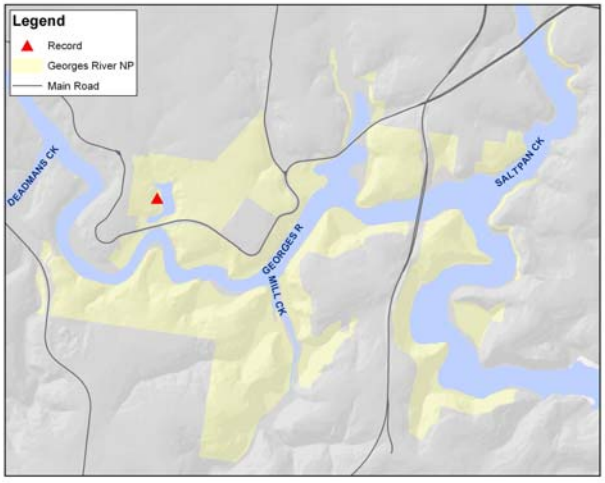
The pink robin is an extremely rare visitor to the Sydney and Illawarra regions, with the only accepted records being of single birds at Yeramba Lagoon in 1972, Castle Hill in April 1975, Ku-ring-gai Wildflower Garden in June 1985, Korrungulla Swamp at Primbee in September 1987 and Bulli in September 1988 (Hoskin et al. 1991, Higgins and Peter 2002, Birdline NSW). The study area does little to contribute to the conservation of this species.

Threats in the Study Area

Nil.

Management Considerations

Nil.



KOALA *Phascolarctos cinereus*

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

Koala. Photo © P. Madden

Koalas are regularly killed on Heathcote Road, particularly near Deadmans Creek. Photo © M. Schulz

Occurrence in the Study Area

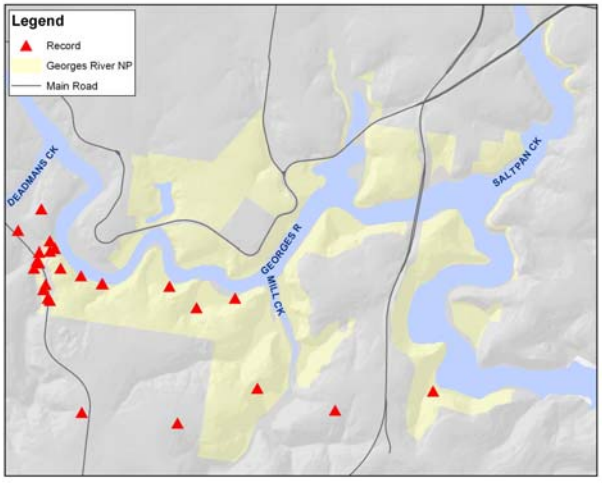
The koala is probably a breeding resident in Georges River NP, with all records on the south side of the River. It is likely to be under-recorded in the Park as little targeted survey work has been undertaken. Single individuals were recorded at a number of locations during the BSP survey. It was found on several occasions in Hinterland Flats Eucalypt Forest to the west of Mill Creek mouth and in the same habitat west of the transmission lines opposite the main picnic area. There were a number of documented records prior to the BSP survey, primarily adjacent to Sandy Point, including where Deadmans Creek crosses Heathcote Road and in the vicinity of Heathcote Road/Georges Crescent junction (eight records, including several roadkills) and south-east of Sandy Point opposite Picnic Point (two records) (OEH 2013c). Elsewhere in the Park it has been recorded on one occasion from the middle reaches of Mill Creek and at Little Moon Bay. There are a number of records within one kilometre to the west of the Park, primarily along Heathcote Road between Deadmans Creek and Pleasure Point. It has also been recorded in the suburb of Alfords Point upslope of Mill Creek, to the west of Mill Creek near Sandy Point and along Heathcote Road south of the old quarry (OEH 2013c). It is widespread in the western section of Holsworthy Military Area (DECC 2008a) and animals within the Park may regularly move between these two areas. The koalas in the Park and in adjacent areas form the eastern edge of the Campbelltown population which has been identified as a significant population (Commonwealth of Australia 2010). Prime koala habitat in the Park comprises grey gum-dominated forest associated with shale benching or outcropping shale deposits including on plateau tops (after Phillips and Callaghan 1998). Additionally stands of forest red gum are considered potentially important (Phillips and Callaghan 1998), as confirmed by sightings made during the BSP survey.

Regional Conservation Significance

The koala has a number of well known populations within the Sydney Basin Bioregion, including near Campbelltown, in the Avon/Upper Nepean catchments of the Metropolitan Special Area, Glenbrook and in southern Nattai NP (DECC 2007). The southern portion of the Park and adjacent areas form the eastern edge of the Campbelltown population. Due to the number of sightings in and immediately adjacent to the north-west edge of the reserve it is considered that the Park contributes significantly to a component of the Campbelltown population. Hence the Park contributes significantly to the conservation of the species in the region.

Threats in the Study Area

Potential threats include: high-frequency fire (which even at low intensity can result in reduced habitat quality); high intensity fires which result in canopy scorch including hazard reduction burns; hazard reduction burns in refuge habitat; habitat fragmentation which causes koalas to spend more time on the ground therefore making them vulnerable to predation by foxes and dogs; road mortality; loss of habitat connectivity in the southern portion of the Park; habitat degradation as a result of weed infestation (e.g. lantana); and infection by *Chlamydia* which causes keratoconjunctivitis (an



infection of the eyes) and infertility (Callaghan et al. 2003, DECC 2008c, OEH 2012c).

Management Considerations

- Follow relevant management recommendations in the statewide recovery plan (DECC 2008c) and devise site-specific prescriptions specifically aimed at protecting koalas and their habitat in the Park.
- Investigate and pursue the ongoing cooperative involvement of OEH, other agencies and the community in the implementation of the regional monitoring and conservation program for the eastern component of the statewide significant Campbelltown koala population. A component of the program should seek to define the distribution, abundance and habitat preferences of the koala in the Park and adjacent areas and assess the importance of Georges River NP to conservation of the Campbelltown population.
- Advocate the importance of the connectivity of native vegetation between Georges River NP and Holsworthy Military Area and the importance of retaining native vegetation in the headwaters of Mill Creek and in the Sandy Point area.
- Ensure that hazard reduction burns in areas known to include koala habitat are maintained at low intensity, or are managed to minimise risks to resident koalas. If koalas are found to be present in a proposed burn area, delay the fire until they have moved into other areas.
- Liaise with councils, road authorities and adjacent landholders to promote the design and implementation of a plan to limit the risk of wildlife road mortality on Heathcote Road. Provide recommendations to road managers wherever the opportunity arises. Measures to discuss might include: maintaining koala signs on Heathcote Road in the Deadmans Creek area; installing additional lighting on Heathcote Road (from 200 metres south of the St George Crescent junction to the Pleasure Point Road junction); erecting permanent speed camera(s) near the Deadmans Creek bridge to slow traffic and thus potentially reduce koala strike; and consideration of the need to retain connectivity between the southern portion of the Park and the Holsworthy Military Area during any upgrade of Heathcote Road (e.g. through over or under-passes in the Deadmans Creek area).
- Conduct fox control on the south side of the River.
- Manage feral and wide-ranging domestic cats.
- Minimise the impact of domestic dogs through regular patrols of formal and informal tracks between Sandy Bay and Mill Creek.
- Undertake bush regeneration in forest red gum-dominated vegetation communities that are infested with lantana and other weeds which may inhibit the movements of koalas between trees.

Important koala habitat within the Park: Hinterland Sandstone Transition Grey Gum Forest dominated by grey gum (left); Hinterland Flats Eucalypt Forest dominated by forest red gum (right). Photos © OEH

GREY-HEADED FLYING-FOX *Pteropus poliocephalus*

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

Grey-headed flying-fox. Photo © M. Schulz

Occurrence in the Study Area

The grey-headed flying-fox is a common visitor. In the BSP survey this species was recorded at 17 localities in a variety of vegetation communities on both sides of the River. It was observed feeding on a number of flowering tree species including blue box, forest red gum, blackbutt, red bloodwood, swamp mahogany and grey mangrove. Other important food plants in the Park include smooth-barked apple, heath-leaved banksia and various fruiting and flowering rainforest trees. A camp occupied by a small number of individuals (50+) was recorded on the south side of the River in 2002 (I. Drinnan pers. comm.). It was on the western side of Mill Creek in Estuarine Swamp Oak Forest and Hinterland Flats Eucalypt Forest. However, this camp was not in use during the BSP survey or during recent visits by I. Drinnan and is considered irregularly-used. The foraging individuals more often seen are likely to come from nearby camps outside of the Park, such as Kareela to the south-east, Macquarie Fields to the west and Cabramatta Creek Lanvale to the north-west (Ku-ring-gai Bat Conservation Society 2012).

Regional Conservation Significance

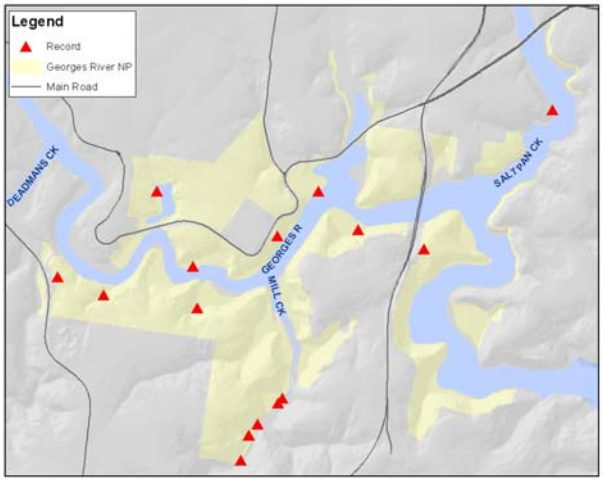
The grey-headed flying-fox is widespread across the Sydney Basin Bioregion, with approximately 16 camps present (Eby et al. 1999). The reserve is considered important to this species due to the presence of an irregularly used camp located away from houses, and the presence of a range of high quality coastal foraging habitat which is likely to support individuals from nearby camps including the permanent camp on Cabramatta Creek.

Threats in the Study Area

Threats in the Park include the loss of important feed trees (particularly swamp mahogany, blue box and forest red gum) around picnic areas due to public safety concerns, death without regeneration, suppression of regeneration by weeds, altered soil hydrology and disturbance. Anything that inhibits flowering of key species e.g. drought or timing of fire would reduce the availability of foraging resources. When the camp is in use threats would include: disturbance and noise by the public particularly illegal motorbike riding; impacts on vegetation by the rusa deer; and weed infestation which results in a lack of regeneration (DECC 2009b, Department of Sustainability, Environment, Water, Population and Communities 2013, OEH 2013a). In nearby urban areas threats include: road mortality, electrocution on powerlines, loss of feeding habitat and entanglement in netted fruit trees.

Management Considerations

- Follow relevant management recommendations in the draft national recovery plan (DECC 2009b).
- Ensure the ongoing health of stands of swamp mahogany, blue box and forest red gum including in picnic areas through the maintenance of existing trees and assisting natural regeneration.
- Do not undertake hazard reduction burns in the temporary camp area when it is occupied.
- Where necessary, undertake prescribed burns when key flowering tree species (i.e. red bloodwood, swamp mahogany, blue box, blackbutt, forest red gum and smooth-barked apple) are not in flower and always leave unburnt patches of the vegetation communities containing these species.
- Prepare a rusa deer management plan in consultation with the Royal NP Deer Working Group.
- Maintain habitat quality at the site of the temporary camp including protection from damage by trail bikes and if necessary bush regeneration to control exotic vines and subcanopy species.



EASTERN BENTWING-BAT *Miniopterus schreibersii oceanensis*

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

Eastern bentwing-bat. Photo © M. Schulz

Occurrence in the Study Area

Uncommon. The eastern bentwing-bat was detected by ultrasonic call recording at two sites in the BSP survey: in Cumberland Riverflat Forest along Mill Creek and in a small Coastal Escarpment Littoral Rainforest patch in Lugarno. However, it was not captured in any of the 13 harp traps set across the Park. This species was detected by ultrasonic call recording in two locations in the Mill Creek headwaters (Cumberland Ecology 2011). It has also been recorded further downstream along the Georges River in the Jewfish Point-Oatley Park areas (DECC 2008a, D. Andrew pers. comm.). There are no documented roosts within the site or adjacent areas and the species is thought to be uncommon within the Park.

Regional Conservation Significance

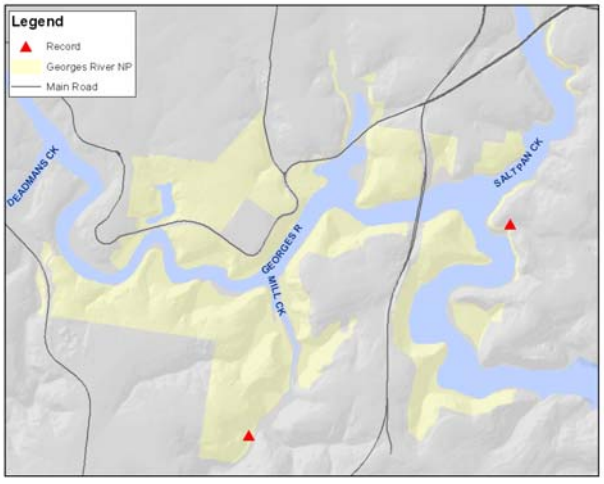
The eastern bentwing-bat is widespread across the Sydney Basin Bioregion, occurring in a wide range of habitats including in urban areas (DECC 2007, 2008a). There are no confirmed maternity roost sites in the Bioregion. Due to the small number of records and the lack of documented roosts in the Park, the study area is considered to be of low significance to regional conservation of this species. However, if a roost was located the species management priority rank would be elevated to high.

Threats in the Study Area

Nil as no known roosts in the Park.

Management Considerations

Nil as no known roosts in the Park.



5.3 Non-threatened Species Covered by International Migratory Bird Agreements

White-bellied sea-eagle *Haliaeetus leucogaster*

EPBC Act: CAMBA	Study Area: High Priority

White-bellied sea-eagle. Photo © M. Schulz

Occurrence in the Study Area

This raptor occurs along all larger watercourses, associated wetlands, mangroves and adjacent forest areas in the Park, with one and possibly two pairs nesting. One nest has been used in recent years in a large smooth-barked apple on the slope below a low escarpment on the west side of the River north-west of Soily Bottom Point. However, this site was not used in 2012 (BSP survey), but a nest was observed approximately 300 metres to the north (D. Andrew pers. comm.). During the BSP survey two adult birds were observed exhibiting potential nesting behaviour to the west side of Mill Creek.

Regional Conservation Significance

Given that at least one pair nests annually in the Park, and that there are few nesting records within urban Sydney (including the study area, Towra Point NR, Royal NP and Homebush Bay), this species has been given a high management priority ranking.

Threats in the Study Area

Potential threats include: disturbance around the nest site; fire at the nest site; hydrological changes to shorelines; water pollution, including indirect impacts on intertidal invertebrates; and entanglement in fishing tackle and other refuse.

Management Considerations

- Before undertaking hazard reduction burns assess that no white-bellied sea-eagle nest is present in the proposed burn area and if present do not undertake any burns while the nest is active (June to December, after Marchant and Higgins 1993).
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.

LATHAM'S SNIPE *Gallinago hardwickii*

EPBC Act: CAMBA, JAMBA, ROKAMBA | **Study Area: Moderate Priority**

Latham's snipe. Photo © M. Schulz

Occurrence in the Study Area

This species is likely to be under-recorded in the Park due to its cryptic nature. It occupies dense sedgeland/rushland areas bordering wetlands which are rarely traversed by birdwatchers, particularly on the south side of the River. One individual was flushed in the BSP survey (October 2012) from the edge of a pool in sea rush-dominated swampland south-east of Mickeys Point. It has also been recorded on the edge of Yeramba Lagoon in October 1994 and in 2002 (OEH 2013c, Birdline NSW). There are few records of the species from nearby areas, with the majority of sightings from Deepwater Park in Milperra (OEH 2013c)

Regional Conservation Significance

Many of the former haunts of this species in the Sydney area have been reclaimed for residential, industrial or sports park development and little suitable habitat remains. The status of the species in the Park and surrounding areas is uncertain. Given this, the species has been allocated to the moderate priority category.

Threats in the Study Area

The primary potential threat to this species within the Park is predation by the fox and cat.

Management Considerations

- Conduct fox control on the south side of the River and around Yeramba Lagoon.
- Manage feral and wide-ranging domestic cats.

CATTLE EGRET *Ardea ibis*

EPBC Act: CAMBA, JAMBA | **Study Area: Low Priority**

Cattle egrets. Photo © M. Schulz

Occurrence in the Study Area

The cattle egret was not recorded during the BSP survey or previously in the Atlas of NSW Wildlife. However, it is listed as occurring in the Yeramba Lagoon area (Eco Logical 2009). This species is likely to be an irregular visitor, particularly during the winter months.

Regional Conservation Significance

Due to the paucity of records and the likelihood that this species is an irregular visitor, the reserve contributes little to conservation of this species.

Threats in the Study Area

Nil.

Management Considerations

Nil.

EASTERN GREAT EGRET *Ardea modesta*

EPBC Act: CAMBA, JAMBA	Study Area: Low Priority

Eastern great egret. Photo © M. Schulz

Occurrence in the Study Area

The eastern great egret is infrequently observed as single birds on exposed intertidal flats and adjoining Estuarine Mangrove Forest along the Georges River, Mill and Little Saltpan creeks, and other major tributaries. This species also regularly occurs around Yeramba Lagoon. It is not known to breed in the reserve.

Regional Conservation Significance

This species is an infrequently recorded non-breeding visitor that primarily occurs in low numbers on exposed mudflats outside of the actual Park boundary. Georges River NP thus makes little contribution to the conservation of the species.

Threats in the Study Area

Potential threats include: disturbance by the public; bait collection of intertidal invertebrates by fisherman; disturbance by domestic dogs; hydrological changes to shorelines; water pollution, including indirect impacts on intertidal invertebrates; and entanglement in fishing tackle and other refuse.

Management Considerations

- Minimise the impact of domestic dogs through regular patrols.
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.

EASTERN REEF EGRET *Egretta sacra*

EPBC Act: CAMBA	Study Area: Nil as Unconfirmed

Occurrence in the Study Area

There is a single record of the eastern reef egret from the Sandy Point area (OEH 2013c). In New South Wales this species predominantly occurs on rocky shorelines and reefs (Marchant and Higgins 1990). Although it does occasionally occur on intertidal areas of estuarine mudflats, mangrove-lined shores and tidal reaches of watercourses it is considered unlikely to occur this far upstream in the Georges River.

Regional Conservation Significance

Due to the lack of habitat Georges River NP does not contribute to the conservation of this species.

Threats in the Study Area

Nil.

Management Considerations

Nil.

COMMON GREENSHANK *Tringa nebularis*

EPBC Act: CAMBA, JAMBA, ROKAMBA	Study Area: Low Priority

Occurrence in the Study Area

The only record of this species in the Park was during the BSP survey (October 2012) when a single bird was observed foraging with black-winged stilts in shallow open water with a muddy substrate between Estuarine Mangrove Forest and Estuarine Saltmarsh on the south side of the River south of Blackwall Rock.

Regional Conservation Significance

This species is a rare visitor to the lower reaches of the Georges River with no documented adjacent records (DECC 2008a, OEH 2013c, D. Andrew pers. comm.). Due to the rarity of this species occurrence, the reserve contributes little to conservation of this species.

Threats in the Study Area

Potential threats include: disturbance by the public; bait collection of intertidal invertebrates by fisherman; disturbance by domestic dogs; hydrological changes to shorelines; water pollution, including indirect impacts on intertidal invertebrates; and entanglement in fishing tackle and other refuse.

Management Considerations

- Minimise the impact of domestic dogs through regular patrols.
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.

SHARP-TAILED SANDPIPER *Calidris acuminata*

EPBC Act: CAMBA, JAMBA, ROKAMBA	Study Area: Low Priority

Sharp-tailed sandpiper. Photo © M. Schulz

Occurrence in the Study Area

The only record of this species in the Park was made during the BSP survey (November 2012) when two individuals were observed foraging on the edge of Estuarine Saltmarsh in the same locality as the common greenshank.

Regional Conservation Significance

This species is a rare summer visitor to the lower reaches of the Georges River with no documented adjacent records (DECC 2008a, OEH 2013c, D. Andrew pers. comm.). Due to the rarity of this species occurrence, the reserve contributes little to conservation of this species.

Threats in the Study Area

Potential threats include: disturbance by the public; bait collection of intertidal invertebrates by fisherman; disturbance by domestic dogs; hydrological changes to shorelines; water pollution, including indirect impacts on intertidal invertebrates; and entanglement in fishing tackle and other refuse.

Management Considerations

- Minimise the impact of domestic dogs through regular patrols.
- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.

CASPIAN TERN *Hydroprogne caspia*

EPBC Act: CAMBA, JAMBA	Study Area: Low Priority

Caspian tern. Photo © M. Schulz

Occurrence in the Study Area

The caspian tern is an occasional visitor to waters of the Georges River, resting on intertidal flats such as off the main picnic area and at the mouth of Saltpan and Little Saltpan creeks (M. Schulz pers. obs., OEH 2013c). These individuals would be ranging upstream from more regular haunts in Botany Bay and the mouth of the Woronora and Georges rivers (DECC 2008a, OEH 2013b).

Regional Conservation Significance

This species primarily occurs in low numbers on exposed mudflats outside of the actual Park boundary. It is regularly sighted further downstream along the Georges River, such as in the Oatley area (D. Andrew pers. comm.). Georges River NP itself makes little contribution to the conservation of the species.

Threats in the Study Area

Potential threats include disturbance by the public; water pollution, including indirect impacts on intertidal invertebrates; and entanglement in fishing tackle and other refuse.

Management Considerations

- Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.

WHITE-THROATED NEEDLETAIL *Hirundapus caudacutus*

EPBC Act: CAMBA, JAMBA, ROKAMBA	Study Area: Low Priority

White-throated needletail. Photo © M. Schulz

Occurrence in the Study Area

This swift is regularly observed foraging over Sydney, often ahead of storms or cold fronts in the summer and early autumn months. The BSP survey was not undertaken at this time of the year, and there are no records of this species in the reserve in the Atlas of NSW Wildlife. It has been recorded from the Yeramba Lagoon area (Eco Logical Australia 2009) and the headwaters of Mill Creek (Cumberland Ecology 2011). It is certain to be a regular summer and autumn visitor over the airspace above all vegetation communities occurring within the Park.

Regional Conservation Significance

The white-throated needletail is widespread and common over the Sydney Basin Bioregion feeding over a wide variety of natural and disturbed habitats. Georges River NP contributes little to the conservation of this species.

Threats in the Study Area

Nil.

Management Considerations

Nil.

5.4 INTRODUCED SPECIES

DOG	*Canis lupus familiaris*
EPBC Act: Not Listed	TSC Act: Key Threatening Process

Dog. Photo © M. Schulz

Occurrence in the Study Area

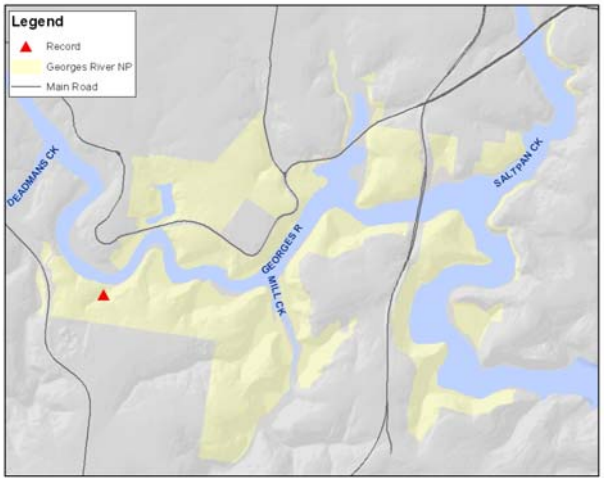
No feral dogs were recorded during the current study, either by direct sighting or indirect signs such as footprints or scats. There are no current or recent reports from the reserve (B. Hodgson pers. comm.). The only records in the Atlas of Wildlife are from the Sandy Point area in 1996, but the accuracy is only to one kilometre; it is not clear whether these records were within the reserve or comprised feral or domestic dogs. However, single individuals or packs have recently been reported adjacent to Georges River NP in the Sandy Point area, crossing Heathcote Road in the vicinity of White Rocks, Mill Creek headwaters and in the Lucas Heights area (S. Harris pers. comm.). It appears there may be a small feral dog population in the general area of Lucas Heights-Sandy Point and it is likely that these individuals range into the reserve. A number of domestic dogs, both on and off-leash, were encountered in the Park during the BSP 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 Park. 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 (NSW Scientific Committee 2009b). Even domestic dogs that are heavily reliant on humans for sustenance nonetheless may hunt native fauna in the reserve and can be a serious problem to native fauna if uncontrolled (NSW Scientific Committee 2009b). Species in the reserve that are known to be threatened from predation by dogs include Rosenberg's goanna and koala.

Management Considerations

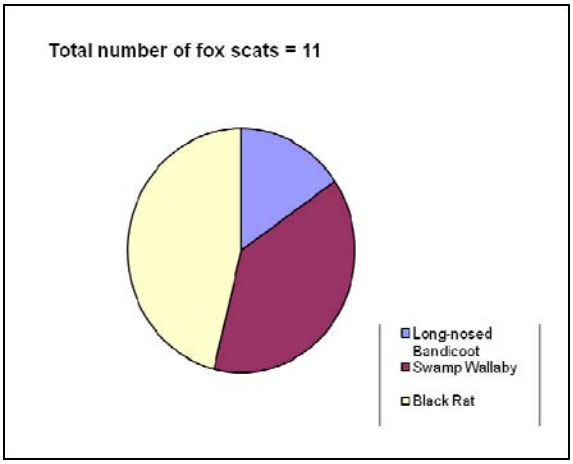
- Work in partnership with Sutherland Shire Council and surrounding landholders to eliminate the recently reported feral dogs in the Lucas Heights-Sandy Point area, which may include southern sections of the reserve.
- Undertake regular patrols and enforcement to stop domestic dogs being brought into the Park, particularly on the south side of the River between Mill Creek and Sandy Point as this is the principal area occupied by the koala and Rosenberg's goanna.
- 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, particularly in the Sandy Point area.



Fox *Vulpes vulpes*

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

Fox. Photo © M. Schulz



Results of prey analysis from fox scats collected during the current survey.

Occurrence in the Study Area

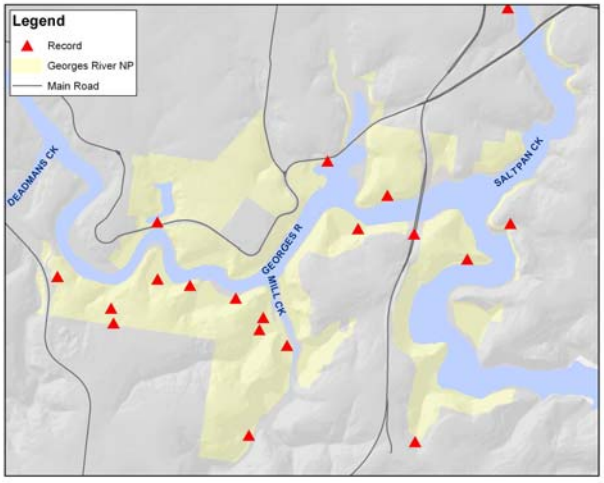
The fox is common and widespread on both sides of the River, within the reserve and surrounding areas. During the BSP survey the species was detected in most habitat groups, including Estuarine Saltmarsh and from the edge of Estuarine Mangrove Forest. It was recorded at 36 per cent of infra-red camera sites (BSP survey and WildCount survey combined). The analysis of 11 scats revealed three mammalian prey species, which in order of abundance were the black rat, swamp wallaby and long-nosed bandicoot. There are currently no fox control programs being undertaken within the reserve (B. Hodgson pers. comm.).

Impacts in the Study Area

Predation by the fox is listed as a Key Threatening Process under both the EPBC Act and TSC Act due to the major threat posed to the survival of native Australian fauna, with non-flying mammals weighing between 35 and 5500 grams and ground-nesting birds at the greatest risk (e.g. NSW Scientific Committee 2008a). Reptiles and amphibians are also preyed upon, although the impact of this predation within the reserve is unknown. Threatened species within the Park that are particularly at risk include the Rosenberg's goanna, fledgling powerful owls, black bittern and if present the green and golden bell frog.

Management Considerations

- Investigate the feasibility of conducting a fox control program, particularly on the south side of the River. Other potential focus sites include around Yeramba Lagoon and around powerful owl nest trees.
- During any fox control programs implement protocols that minimise the take of non-target species, especially the Rosenberg's goanna. Investigate the feasibility of using M44 ejectors to minimise the risk of non-target bait take by Rosenberg's goanna.
- Undertake feral cat and rabbit control, where required, in concert with any fox baiting programs.
- Support a cross-tenure approach to fox management through cooperation and integration of programs with neighbouring landholders.



CAT *Felis catus*

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

Feral cat. Photo © M. Schulz

Occurrence in the Study Area

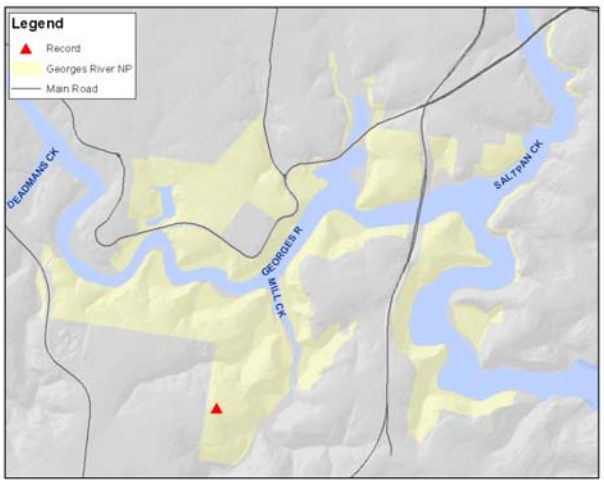
The BSP survey results and the lack of records by ranger staff (B. Hodgson pers. comm.) suggest that the cat is rare within the Park. The only record in the BSP survey was a number of footprints located on the edge of a muddy puddle on the plateau west of Mill Creek on the south-west boundary of the reserve. Surprisingly, this species was not photographed by any of the infra-red cameras. There are no additional records within the Park in the Atlas of NSW Wildlife. During the BSP survey a number of domestic cats were observed adjacent to houses in the Picnic Point and Padstow Heights sections of the Park. Domestic adult cats and kittens are also likely to be regularly dumped in the area. Occasional domestic cats are target-trapped within the reserve (B. Hodgson pers. comm.).

Impacts in the Study Area

The feral cat is listed as a Key Threatening Process under the EPBC Act and by the World Conservation Union as among 100 of the 'World's Worst Invaders' (Lowe et al. 2004). In New South Wales, predation by the feral cat is listed as a Key Threatening Process since 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 impact of feral cats on birds, frogs, reptiles and small to medium-sized mammals within the reserve is currently unknown.

Management Considerations

- Instigate an intermittent trapping program for feral and wide-roaming domestic cats in association with any fox baiting program.
- Encourage members of the public, including bird watchers, to report cat sightings made within the Park. Follow up these sightings with trapping to remove individual cats/dumped cats and kittens, as appropriate.
- 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 programs with neighbouring landholders.



RABBIT *Oryctolagus cuniculus*

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

Rabbit. Photo © M. Schulz

Occurrence in the Study Area

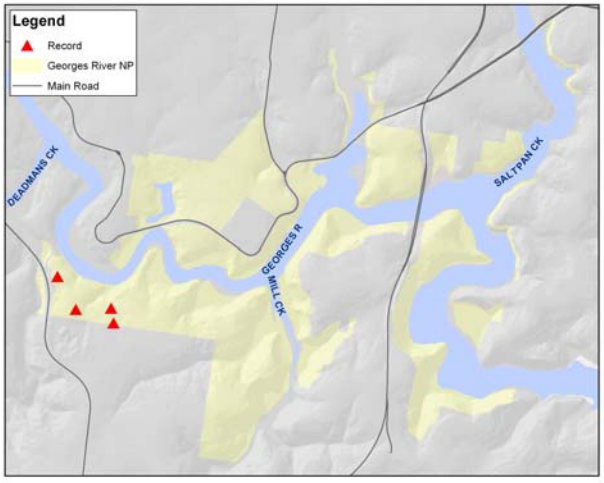
The BSP survey results suggest that the rabbit is uncommon and patchily distributed in the Park. The only records made during the BSP survey were between Sandy Point and the Telstra tower and on the south-west Park boundary between the quarry and powerline easement. No rabbit remains were found in the fox scats collected across the reserve, nor was the species photographed by the infra-red cameras. There are no additional records within the Park in the Atlas of NSW Wildlife. The species has been recorded adjacent to the Park in the headwaters of Mill Creek (Cumberland Ecology 2011). There are currently no rabbit control programs being undertaken within the reserve (B. Hodgson pers. comm.).

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' (Lowe et al. 2004). Potential threats posed in the reserve 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 the elevation of feral predator numbers resulting in increased pressure on native fauna when sharp declines in rabbit numbers occur. Rabbit occurrence in the Park is currently restricted in extent and the species is not posing a direct threat to any threatened fauna species.

Management Considerations

- On site control of rabbits is not currently a high management priority due to the low numbers and limited distribution of the species.
- If rabbits increase in numbers or distribution in the reserve then targeted management through trapping or other techniques should be considered.



RUSA DEER *Cervus timorensis*

EPBC Act: Not Listed	TSC Act: Key Threatening Process

Rusa deer stag. Photo © M. Schulz

Occurrence in the Study Area

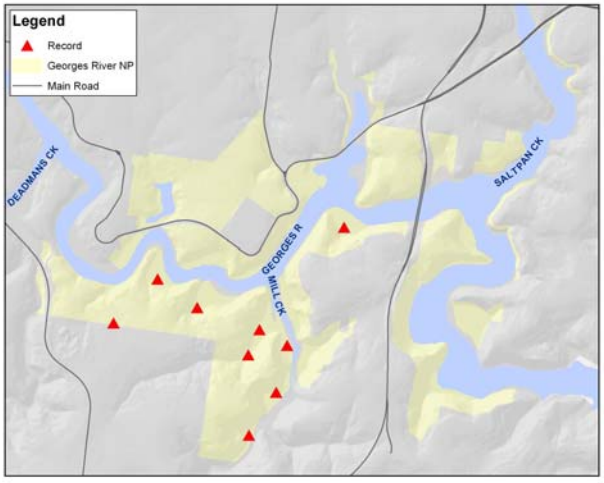
The rusa deer is common on the south side of the River west of Alford Point Road bridge, particularly in the Mill Creek valley. On the south side of the River it was recorded in a range of vegetation communities, particularly on flat terrain, including Estuarine Reedland, Coastal Sand Swamp Paperbark Scrub, Hinterland Riverflat Paperbark Swamp Forest, Estuarine Swamp Oak Forest, Hinterland Flats Eucalypt Forest, Estuarine Saltmarsh, the edge of Estuarine Mangrove Forest and beaches. Footprints and droppings were also found during the BSP survey on the south-west boundary of reserve between the quarry and the high tension powerline easement. Here it was recorded in shrubland associated with the powerline easement, Woronora Sandstone Exposed Bloodwood Woodland and Hinterland Sandstone Dwarf Apple Heath-Woodland. There are currently no rusa deer control programs being undertaken within the reserve (B. Hodgson pers. comm.).

Impacts in the Study Area

Key potential impacts in the Park include: degradation of vegetation through grazing; trampling of fragile habitats, including the creation of well-defined pads in wetlands that foxes can then use for access; and the loss of viability of plant populations through the curtailment of seed production and seedling recruitment (Keith and Pellow 2005).

Management Considerations

- Prepare a rusa deer management plan for Georges River NP in consultation with the Royal NP 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 (2011c).

HABITAT GROUP LABEL

EPBC Act: Whether the vegetation communities currently conform to any Commonwealth TEC	TSC Act: Whether the vegetation communities currently conform to any State TEC	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 2012 and 2013. This information was augmented by a qualitative assessment of all fauna records for the reserve, fauna occurrence in nearby areas such as Kamay Botany Bay NP (DECCW 2011b), Royal NP and Heathcote NP (DECCW 2011a) and expert knowledge of likely habitat preferences.

Commonly Observed Herpetofauna

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

Commonly Observed Birds

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

Commonly Observed Mammals

This section provides a list of native and introduced mammals that were commonly encountered.

Priority Species For Which Habitat Is Provided

This section provides a list of native priority fauna species (see section 3.1.1) for which the habitat group provides known or potential habitat. It is divided into: a) *Known Occurrence* – recorded during OEH surveys; and b) *Potential Occurrence* – species that are known from the reserve but were not recorded during OEH surveys in the particular habitat group yet would be expected to occur.

Note: the white-throated needletail is not listed under any habitat group since being an aerial insectivore it would occur over all habitats within the reserve but would not be expected to land in any habitats present in the area (after Higgins 1999).

Species	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 reserve.
	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 RAINFORESTS

EPBC Act: Not Listed	TSC Act: Part of Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions	Study Area: Not a Priority Fauna Habitat

Littoral Rainforests occur in two small patches, with the largest being in a small gully in the Lugarno section of the reserve and the adjoining Evatt Park Reserve. This site is situated downslope of houses and is subject to heavy visitation pressure as well as weed species such as Chinese privet (*Ligustrum sinense*) and wandering Jew (*Tradescantia fluminernsis*).

Photo © OEH

Commonly Observed Herpetofauna

Only limited survey work was conducted in this area, with no frogs recorded. The only reptile species located in the single systematic reptile census (and during other visits) was the eastern water dragon. Other species that would be expected to occur include the dark-flecked garden sunskink and weasel skink.

Commonly Observed Birds

Due to the small size of the patches only one systematic bird census was undertaken, with few bird species located. The species recorded during the bird census and by camera trapping were the brown thornbill, white-browed scrubwren, eastern yellow robin and the introduced Eurasian blackbird. A number of additional species were recorded on the fringes of the patch which are commonly associated with the surrounding disturbed urban environments, including the sulphur-crested cockatoo, rainbow lorikeet, channel-billed cuckoo, noisy miner, Australian magpie, grey butcherbird, pied currawong and the Australian raven. Several other species occurred in mangroves bordering this rainforest patch, in particular the sacred kingfisher.

Commonly Observed Mammals

Native mammal species recorded during the limited survey work included the common ringtail possum, little forest bat, Gould's wattled bat and eastern bentwing-bat. Two introduced species were recorded: black rat and fox.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Grey-headed flying-fox	Infrequent
Eastern bentwing-bat	General (above canopy)
Potential Occurrence	
Powerful owl	General (especially as roosting habitat)

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 drainage lines from adjoining urban areas; fire.

NORTHERN HINTERLAND WET SCLEROPHYLL FORESTS

EPBC Act: Not Listed	TSC Act: The legal status of this community is unclear. Some stands are described elsewhere as a variant of the Duffys Forest Ecological Community in the Sydney Basin Bioregion.	Study Area: Not a Priority Fauna Habitat

A small area (2.5 hectares) of this forest type occurs on the northern margins of the Picnic Point portion of the reserve. It is characterised by the local abundance of blackbutt, turpentine and mahogany species together with a grassy ground cover. This patch is situated close to houses and is subject to high public visitation, frequent fires and exposure to domestic cats and dogs.

Photo © OEH

Commonly Observed Herpetofauna

The single systematic herpetofauna search undertaken yielded the dark-flecked garden sunskink, three-toed skink and the weasel skink. The only frog recorded was Peron's tree frog.

Commonly Observed Birds

Species recorded during the single late afternoon bird census were the brown thornbill, eastern spinebill, red wattlebird, noisy miner, black-faced cuckoo-shrike, pied currawong and Australian raven. Repeat visits during different seasons would result in a far greater range of bird species. Introduced species recorded on the edge of the interface of this forest and adjoining houses included the spotted dove and common myna.

Commonly Observed Mammals

Species occurring within this habitat group include the common brushtail possum, grey-headed flying-fox and little forest bat. No introduced species were recorded during the BSP survey.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Potential Occurrence	
Glossy black-cockatoo	Infrequent
Little lorikeet	Infrequent
Powerful owl	Infrequent
Varied sittella	Infrequent
Black-chinned honeyeater	Infrequent
Grey-headed flying-fox	Infrequent
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Loss of hollow-bearing trees; frequent fires, predation by domestic cats and dogs; disturbance from feral birds, particularly the common myna; and weed invasion.

SYDNEY COASTAL DRY SCLEROPHYLL FORESTS

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

Sydney Coastal Dry Sclerophyll Forests is the most widespread vegetation class, occupying 293 hectares of the reserve. It occurs on the broad flat ridgetops above the River, as well as on slopes and along sections of watercourses. Much of this habitat group is in good condition.

The two most extensive communities within this habitat group are Woronora Sandstone Exposed Bloodwood Woodland (top) and Coastal Enriched Sandstone Sheltered Forest (bottom). Photos © OEH

Commonly Observed Herpetofauna

The only frog recorded in this habitat in the BSP survey was the red-crowned toadlet. The most frequently encountered reptiles were the dark-flecked garden sunskink, copper-tailed skink, Cunningham's skink, barred-sided skink and broad-tailed gecko.

Commonly Observed Birds

Bird species recorded from all four systematic sites within this habitat group were the rainbow lorikeet, crimson rosella and eastern spinebill. Species recorded from three sites were the sulphur-crested cockatoo, spotted pardalote, variegated fairy-wren, brown thornbill, yellow-faced and scarlet honeyeaters. Common winter migrants included the pied currawong and golden whistler.

Commonly Observed Mammals

The most frequently encountered mammal species recorded from two or more sites were the swamp wallaby, common ringtail possum and white-striped freetail-bat. Introduced species recorded were the feral cat and fox.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Red-crowned toadlet	Predominant
Rosenberg's goanna	Predominant
White-bellied sea-eagle	Predominant (nesting habitat)
Little eagle	Infrequent
Little lorikeet	General
Powerful owl	Predominant (including nesting site)
Varied sittella	General
Grey-headed flying-fox	General
Potential Occurrence	
Osprey	Infrequent
Glossy black-cockatoo	Infrequent
Scarlet robin	Infrequent
Koala	Infrequent
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Loss of connectivity with other bushland areas; frequent fire; predation by feral predators; predation by domestic cats and dogs; loss of hollow-bearing trees; erosion as a result of motorbike activity; weed invasion, particularly along minor drainage lines from upslope urban areas; and poaching of reptiles.

This white-bellied sea-eagle nest was found in a large smooth-barked apple in Coastal Enriched Sandstone Sheltered Forest at Great Moon Bay. Photo © M. Schulz

SYDNEY HINTERLAND DRY SCLEROPHYLL FORESTS

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

Sydney Hinterland Dry Sclerophyll Forests is the second most widespread fauna habitat group, comprising 108 hectares of the reserve. This habitat group comprises two vegetation communities, with the Hinterland Sandstone Gully Blackbutt-Apple Forest being the second most abundant vegetation community. The Hinterland Sandstone Transition Grey Gum Forest is confined to the Sandy Point area and is subject to a number of pressures, particularly erosion from motorbike activity.

This habitat group comprises two vegetation communities: Hinterland Sandstone Gully Blackbutt-Apple Forest (top) and Hinterland Sandstone Transition Grey Gum Forest (bottom) Photos © OEH

Commonly Observed Herpetofauna

No frogs were recorded in the BSP survey. Common reptile species were the dark-flecked garden sunskink, red-throated skink and Lesueur's velvet gecko.

Commonly Observed Birds

Frequently encountered species included the Australian owlet-nightjar, sulphur-crested cockatoo, musk lorikeet, rainbow lorikeet, eastern rosella, superb fairy-wren, spotted pardalote, eastern spinebill, red wattlebird, yellow-faced honeyeater, white-eared honeyeater, noisy miner, noisy friarbird, golden whistler (winter), grey shrike-thrush and mistletoebird.

Commonly Observed Mammals

The most frequently encountered mammal species were the swamp wallaby, common brushtail possum, grey-headed flying-fox and the white-striped freetail-bat. Introduced species recorded were the fox and rabbit.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Little lorikeet	General
Powerful owl	General
Grey-headed flying-fox	General
Potential Occurrence	
Glossy black-cockatoo	Infrequent
Black-chinned honeyeater	Infrequent
Varied sittella	General
Scarlet robin	Infrequent
Koala	Predominant
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Habitat fragmentation; frequent fire; predation by feral predators; predation by domestic cats and dogs; loss of remaining hollow-bearing trees; rubbish dumping; erosion as a result of motorbike activity; weed invasion; and poaching of reptiles.

SYDNEY COASTAL HEATHS

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

Sydney Coastal Heaths are restricted to small areas of skeletal soils along ridgetops on both sides of the Georges River, occupying nine hectares of the reserve.

Photo © OEH

Commonly Observed Herpetofauna

One systematic herpetofauna survey was conducted in this habitat group. The most commonly encountered species were the dark-flecked garden sunskink and copper-tailed skink. Other species located included the only records of the jacky lizard and thick-tailed gecko in the BSP survey. Frogs are not well represented in this habitat group, with the only species recorded being the common eastern froglet.

Commonly Observed Birds

No systematic bird censuses were undertaken in this habitat group. Frequently encountered bird species included the rainbow lorikeet, variegated fairy-wren, brown thornbill, little wattlebird, New Holland honeyeater, yellow-faced honeyeater, white-eared honeyeater, welcome swallow and Australian raven. The tawny-crowned honeyeater occurs in this habitat group on the plateau south of the Georges River.

Commonly Observed Mammals

No systematic mammal survey techniques or camera trapping was undertaken in this habitat group. Frequently encountered mammal species included the swamp wallaby, grey-headed flying-fox, little forest bat and Gould's wattled bat. Introduced species recorded were the fox, feral cat, rabbit and rusa deer.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Rosenberg's goanna	Predominant
Little eagle	Infrequent
Grey-headed flying-fox	General
Potential Occurrence	
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Proliferation of tracks and erosion from trail bike riding; rubbish dumping; frequent fire; habitat fragmentation; weed invasion; predation by feral predators; predation by domestic cats and dogs adjacent to urban areas; presence of the rabbit, and poaching of reptiles.

COASTAL FRESHWATER LAGOONS

EPBC Act: Not Listed	TSC Act: Part of Sydney Freshwater Wetlands and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South Corner Bioregions. Yeramba Lagoon is excluded as it is an artificial wetland.	Study Area: Priority Fauna Habitat

The Coastal Freshwater Lagoons group is limited in occurrence, with the most widespread community being Estuarine Reedland. This occurs in areas frequently inundated by saline or brackish water, such as on the landward side of saltmarsh flats, low-lying alluvium on riverbanks, riverflat depressions, and banks on coastal lagoons that are open to tidal influence. The other two vegetation communities are restricted in distribution. Coastal Freshwater Reedland occurs on poorly drained alluvial flats bordering parts of Yeramba Lagoon while Coastal Sand Swamp Paperbark Scrub occurs in three small areas adjoining the Georges River and Mill Creek. Open freshwater or brackish water areas are primarily restricted to the artificial Yeramba Lagoon.

Two types of coastal freshwater lagoons in the reserve: Estuarine Reedland (top) and Coastal Sand Swamp Paperbark Scrub (bottom). Photos © OEH

Commonly Observed Herpetofauna

A variety of frog species occur, with the most frequently recorded being the common eastern froglet, brown-striped frog and Peron's tree frog. Species common around Yeramba Lagoon but infrequently encountered elsewhere were Tyler's tree frog and the eastern dwarf tree frog. Reptiles were infrequently seen, although a number of the eastern snake-necked turtle were located in Yeramba Lagoon and the dark-flecked garden sunskink was common around the lagoons edges.

Commonly Observed Birds

Commonly observed species were the pacific black duck, white-faced heron, sacred kingfisher, superb fairy-wren, white-browed scrubwren, willie wagtail, Australian raven, welcome swallow and red-browed finch. A number of waterbird species were regularly observed at Yeramba Lagoon but rarely elsewhere in the reserve, including Pacific black duck, Eurasian coot, dusky moorhen and the purple swamphen. Many other bird species range into this habitat from adjoining vegetation types.

Commonly Observed Mammals

Commonly recorded species were the swamp wallaby, white-striped freetail-bat, Gould's wattled bat and chocolate wattled bat. Introduced species regularly encountered were the fox and rusa deer (south side of the River west of Alfords Point).

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Green and golden bell frog	Predominant, but probably locally extinct
Blue-billed duck	Predominant but vagrant
Freckled duck	Predominant but vagrant
Australasian bittern	Predominant
White-bellied sea-eagle	General
Cattle egret	Predominant
Eastern great egret	Predominant
Latham's snipe	Predominant

Common name	Relative importance of this habitat group
Grey-headed flying-fox	Infrequent
Potential Occurrence	
Eastern bentwing-bat	General

Potential Threats to Native Fauna

Changes to hydrology, water flow patterns and water table level leading to wetlands permanently drying out; changes to water quality; weed invasion including reducing the ratio of open water to reedlands; habitat degradation by the rusa deer; infection of frogs with amphibian Chytrid fungus; predation by plague minnow; predation by feral predators; predation by domestic cats and dogs; frequent fire; erosion from trail bike riding; invasion of the cane toad; and rising sea level associated with global warming.

Open water habitat of Yeramba Lagoon. Photo © OEH

COASTAL SWAMP FORESTS

EPBC Act: Not Listed	TSC Act: Part of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions	Study Area: Priority Fauna Habitat

The Coastal Swamp Forests comprises two vegetation communities which are limited in occurrence. Hinterland Riverflat Paperbark Swamp Forest which is dominated by tall paperbarks (*Melaleuca linariifolia* and *M. styphelioides*) primarily occurs near Mill Creek junction. Coastal Flats Swamp Mahogany Forest is primarily restricted to an area of impeded drainage behind Yeramba Lagoon. This community is characterised by swamp mahogany with a smaller tree layer dominated by swamp oak, paperbarks, cheese tree and cabbage tree palm.

Two types of Coastal Swamp Forests: Hinterland Riverflat Paperbark Swamp Forest (top) and Coastal Flats Swamp Mahogany Forest (bottom). Photos © OEH

Commonly Observed Herpetofauna

A variety of frog species occur, with the most commonly recorded being the common eastern froglet, brown-striped frog and Peron's tree frog. Commonly observed reptiles included the dark-flecked garden sunskink and barred-sided skink.

Commonly Observed Birds

Commonly encountered birds included the purple swamphen, sulphur-crested cockatoo, rainbow lorikeet, eastern koel, superb fairy-wren, brown thornbill, white-browed scrubwren, eastern spinebill, yellow-faced honeyeater and eastern yellow robin.

Commonly Observed Mammals

Regularly encountered native mammals were the common ringtail possum and swamp wallaby. The introduced rusa deer was common in Hinterland Riverflat Paperbark Swamp Forest in the Mill Creek area. Other common introduced species were the black rat and fox.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
White-bellied sea-eagle	Infrequent
Powerful owl	General (in swamp mahogany forest)
Varied sittella	General (in swamp mahogany forest)
Grey-headed flying-fox	General
Potential Occurrence	
Latham's snipe	Infrequent
Little lorikeet	General (in flowering swamp mahogany forest)
Black-chinned honeyeater	Infrequent (in swamp mahogany forest)
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Changes to hydrology, water flow patterns and water table level leading to wetlands permanently drying out; changes to water quality; weed invasion; frequent fire; habitat degradation by the rusa deer; infection of frogs with amphibian Chytrid fungus; predation by plague minnow; predation by feral predators; predation by domestic cats and dogs; invasion of the cane toad; and rising sea level associated with global warming.

COASTAL FLOODPLAIN WETLANDS

EPBC Act: Not Listed	TSC Act: Swamp Oak Floodplain Forest is listed as a TEC; Cumberland Riverflat Forest and Hinterland Flats Eucalypt Forest are part of the River-flat Eucalypt Forest on Coastal Floodplains	Study Area: Priority Fauna Habitat

Coastal Floodplain Wetlands are restricted to low-lying areas. Of the three vegetation communities in this habitat group the most widespread is Estuarine Swamp Oak Forest which forms a narrow fringing forest on tidal flats between mangroves and terrestrial forests adjacent to larger waterways. Cumberland Riverflat Forest is situated on the broad alluvial flats of the Georges River; with all stands being highly disturbed such as at Cattle Dufffers Flat and Fitzgibbon Reserve. Hinterland Flats Eucalypt Forest occurs along the sandy riverbanks of the Georges River and its tributaries, including along Mill Creek.

Three types of coastal floodplain wetlands: Estuarine Swamp Oak Forest (top), Cumberland Riverflat Forest (middle), Hinterland Flats Eucalypt Forest (bottom). © OEH

Commonly Observed Herpetofauna

The most frequently recorded frogs were the bleating tree frog and common eastern froglet. The most commonly encountered reptile was the dark-flecked garden sunskink.

Commonly Observed Birds

Commonly encountered birds included the sulphur-crested cockatoo, rainbow lorikeet, crimson rosella, sacred kingfisher, spotted pardalote, superb and variegated fairy-wrens, brown thornbill, white-browed scrubwren, brown gerygone (winter), noisy miner, noisy friarbird, eastern spinebill, yellow-tufted honeyeater (winter), yellow-faced honeyeater, scarlet honeyeater, golden whistler (winter), rose robin (winter), eastern yellow robin, olive-backed oriole, grey butcherbird, Australian raven and silvereye. In the highly modified Cumberland Riverflat Forest a variety of other species were common including the Australian wood duck, little corella, galah, eastern rosella, crested pigeon, masked lapwing, dollarbird and magpie-lark. Introduced bird species present included the red-whiskered bulbul and Eurasian blackbird.

Commonly Observed Mammals

Regularly encountered native mammals were the short-beaked echidna, long-nosed bandicoot, sugar glider, common ringtail possum, common brushtail possum, swamp wallaby, grey-headed flying-fox, white-striped freetail-bat, Gould's and chocolate wattled bats and the little forest bat. The introduced rusa deer was common in this habitat group in the Mill Creek area. Other common introduced species were the black rat and fox.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
White-bellied sea-eagle	General
Black bittern	Predominant (bordering Mill Creek)
Powerful owl	General
Sooty owl	Predominant
Koala	Predominant

Common name	Relative importance of this habitat group
Grey-headed flying-fox	General
Eastern bentwing-bat	Infrequent
Potential Occurrence	
Cattle egret	Infrequent (open parkland areas)
Latham's snipe	Infrequent
Little lorikeet	General (in eucalypt forests)
Black-chinned honeyeater	Infrequent (in eucalypt forests)
Varied sittella	General (in eucalypt forests)

Potential Threats to Native Fauna

Changes to hydrology and water table level, weed invasion; habitat degradation by the rusa deer; frequent fire; proliferation of tracks and erosion from trail bike riding; infection of frogs with amphibian Chytrid fungus; predation by plague minnow; predation by feral predators; predation by domestic cats and dogs; invasion of the cane toad; and rising sea level associated with global warming.

Hinterland Flats Eucalypt Forest bordering the mid-reaches of Mill Creek. Photo © M. Schulz

MANGROVE SWAMPS

EPBC Act: Not Listed	TSC Act: Not Listed. Note that mangroves are protected under the NSW *Fisheries Act 1994*	Study Area: Priority Fauna Habitat

Mangrove Swamps fringe extensive margins of tidal-influenced major watercourses, with the largest stands occurring at the Mill Creek mouth and in the Great and Little Moon Bay areas. In some sections of the reserve there is evidence of the mangroves invading into the Estuarine Saltmarsh as seen elsewhere in New South Wales. This encroachment is considered either to be in response to global warming and/or increased sedimentation following development in the Georges River catchment (Mitchell and Adam 1989, Pickthall et al. 2004).

Tall Estuarine Mangrove Forest in the Great Moon Bay area (top) and mangroves lining lower Mill Creek (bottom). Photos © M. Schulz

Commonly Observed Herpetofauna

Reptiles are uncommon in this environment, with the exception of the dark-flecked garden sunskink on the landward fringes. The barred-sided skink was observed sheltering in hollows of tall grey mangroves in the Great Moon Bay area.

Commonly Observed Birds

Commonly observed birds, including species that roost in mangroves and forage in adjacent waters or at low tide on exposed intertidal mudflats, were the chestnut teal, Australasian darter, little pied cormorant, great cormorant, pied cormorant, little black cormorant, white-faced heron, striated heron, Australian white ibis, white-bellied sea-eagle, sulphur-crested cockatoo, crimson rosella, sacred kingfisher, brown thornbill, brown gerygone (winter), yellow-faced honeyeater, Australian raven and silvereye. The introduced spotted turtle-dove occurred frequently on the fringes of the mangroves.

Commonly Observed Mammals

A variety of bats were common in this habitat including the white-striped freetail-bat, Gould's and chocolate wattled bats. The introduced black rat was also common in this environment. The rusa deer occurred on the landward fringes of this habitat group in the Mill Creek area.

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Osprey	Predominant
White-bellied sea-eagle	Predominant
Eastern great egret	Predominant
Black bittern	Predominant (bordering Mill Creek)
Grey-headed flying-fox	General
Potential Occurrence	
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Changes to water quality; alteration of drainage and current flow patterns; entanglement in anthropogenic debris washed ashore; trampling of pneumatophores; and rising sea level associated with global warming.

SALTMARSHES

EPBC Act: Not Listed	TSC Act: Coastal Saltmarsh is listed as a TEC	Study Area: Priority Fauna Habitat

The reserve supports patches of Saltmarshes, particularly in the Mill Creek area. The seaward margin and tidal channels support colonising grey mangrove and the more elevated areas such as the terrestrial margin support extensive patches of sea rush. The dominant species is generally beaded glasswort (*Sarcocornia quinqueflora*), with other species represented including seablite (*Suaeda australis*) and creeping brookweed.

Estuarine Saltmarsh adjacent to Mill Creek (top) and extensive sea rushland on edge of Saltmarsh west of Mill Creek (bottom). Photo © M. Schulz

Commonly Observed Herpetofauna

No frog species were recorded in this habitat group, although some species may occur in freshwater seepages on the landward fringes. No reptiles were encountered in the open saltmarsh habitat dominated by beaded glasswort. However on higher ground the most frequently encountered species were the dark-flecked garden sunskink and cream-striped shinning-skink (where there were standing or fallen swamp oaks).

Commonly Observed Birds

In open beaded glasswort dominated saltmarsh: white-faced heron, masked lapwing, willie wagtail, Australian magpie, Australian raven and welcome swallow. The introduced common myna was also observed in this habitat.

In dense sea rush dominated rushland: chestnut teal, white-faced heron, Australian white ibis, buff-banded rail, superb fairy-wren, southern emu-wren (between Mill Creek and Alfords Point) and welcome swallow.

In open scalds and mudflat areas: a variety of waterbirds including the chestnut teal, white-faced heron, eastern great egret, masked lapwing, black-fronted dotterel and black-winged stilt.

Commonly Observed Mammals

Swamp wallaby, Gould's and chocolate wattled bats, little forest bat, and swamp rat (in dense rushland). The lesser long-eared bat was only recorded in this habitat, sheltering under exfoliating bark of a standing swamp oak. Introduced mammal species commonly located were the rusa deer, house mouse and fox.

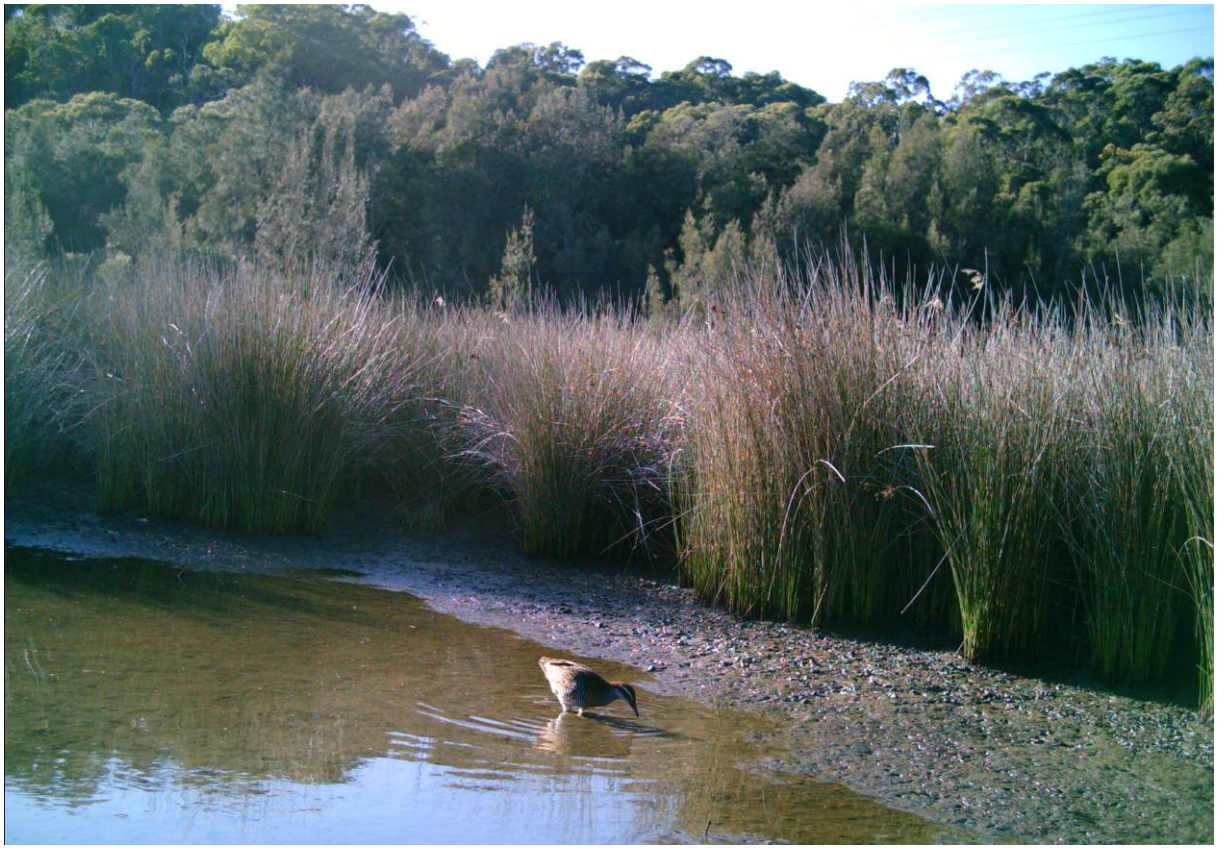
Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
White-bellied sea-eagle	General
Latham's snipe	Predominant
Common greenshank	Predominant
Sharp-tailed sandpiper	Predominant
Potential Occurrence	
Green and golden bell frog	Predominant, but not known to currently occur
Osprey	Infrequent
Australasian bittern	Infrequent
Cattle egret	Infrequent

Common name	Relative importance of this habitat group
Eastern great egret	Infrequent
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Changes to water quality; alteration of drainage and current flow patterns; invasion by mangroves; weed infestation (including invasion by the spiny rush); habitat isolation; habitat degradation by the rusa deer; proliferation of tracks and erosion from trail bike riding; predation by feral predators; predation by domestic cats and dogs; pollution of inshore waters; entanglement in anthropogenic debris washed ashore; and rising sea level associated with global warming.



A buff-banded rail foraging on the edge of an ephemeral pool in dense sea rushland west of Mill Creek. This vegetation also supported a population of southern emu-wrens and swamp rats which were either rare (latter species) or not recorded elsewhere (former species) in the reserve. Photo © OEH

SHORELINES

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

This habitat group included tidal waterways, exposed intertidal flats and the immediate shoreline, excluding mangrove areas.

Commonly Observed Herpetofauna

On the terrestrial edge of the shoreline commonly encountered species were the dark-flecked garden sunskink, barred-sided skink and the cream-striped shinning-skink.

Commonly Observed Birds

Chestnut teal, Australasian darter, little pied cormorant, great cormorant, pied cormorant, little black cormorant, Australian pelican, eastern great egret, white-faced heron, striated heron, Australian white ibis, white-bellied sea-eagle, silver gull, sacred kingfisher, Australian magpie, willie wagtail, Australian raven and welcome swallow. The introduced rock dove roosts and possibly nests in Alfords Point Road bridge.

Commonly Observed Mammals

Some microbat species forage over the shoreline and waterways, in particular the white-striped freetail-bat and Gould's wattled bat. Common introduced species along the shoreline include the black rat and fox.

This habitat group included exposed intertidal flats (top) and open waterways (below). Photo © M. Schulz

Priority Species For Which Habitat Is Provided

Common name	Relative importance of this habitat group
Known Occurrence	
Osprey	Predominant
White-bellied sea-eagle	Predominant
Eastern great egret	Predominant
Black bittern	Infrequent
Caspian tern	Infrequent
Potential Occurrence	
Cattle egret	Infrequent
Common greenshank	Predominant
Eastern bentwing-bat	Infrequent

Potential Threats to Native Fauna

Entanglement in fishing debris; disturbance and predation by domestic dogs; disturbance by the public; water pollution; predation by feral predators; and rising sea level associated with global warming.

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 rapid fauna habitat assessment of the Sydney Metropolitan Catchment Management Authority (SMCMA) area. These priority habitats were compared to the fauna habitat groups profiled in section 6.2. Table 8 shows how the fauna habitat groups in Georges River NP have been aligned to priority fauna habitats of DECC (2008a), along with the High and Moderate Conservation Management Priority native species for which the habitat group forms the most important habitat available in the Park.

The fauna habitat groups in Georges River NP are all listed below in order of the number of High and Moderate Conservation Management Priority species recorded, together with notes on species occurrence. Notes on the representation of the corresponding statewide vegetation class in reserves in the Sydney Basin Bioregion are also made.

Sydney Coastal Dry Sclerophyll Forests provide foraging habitat for the grey-headed flying fox, while the only nest of the white-bellied sea-eagle known in the reserve was found in this habitat group. This habitat group is also likely to support foraging habitat for the koala, particularly where grey gum or smooth-barked apple is present. The little lorikeet and the powerful owl both occur, including at least one known nest site for the latter species. Additionally, this group provided the only habitat for the low priority red-crowned toadlet and one of the main habitat groups for the Rosenberg's goanna and varied sittella. Sydney Coastal Dry Sclerophyll Forests are well represented in reserves in the Sydney Basin Bioregion including Heathcote, Royal and Ku-ring-gai national parks.

Coastal Floodplain Wetlands in the reserve have supported a temporary grey-headed flying-fox camp. All of the koala records from the BSP survey derive from this habitat group. Additionally, the black bittern was observed on shoreline bordering this habitat along Mill Creek and the grey-headed flying-fox forages in this habitat group when canopy species are in blossom. A number of other threatened species were recorded in this habitat group including the powerful owl and the sooty owl. Coastal Floodplain Wetlands are degraded across the State, with little area protected in reserves (Keith 2004).

Sydney Hinterland Dry Sclerophyll Forests provide foraging habitat for the high priority grey-headed flying-fox as well as for the little lorikeet and powerful owl. This habitat group is also likely to provide important foraging habitat for the koala, although the species was not recorded in this habitat in the BSP survey. Sydney Hinterland Dry Sclerophyll Forests are very well represented in reserves in the Sydney Basin Bioregion including Wollemi and Yengo national parks.

Coastal Freshwater Lagoons may have formerly supported the green and golden bell frog. The Australasian bittern has been recorded from Yeramba Lagoon and may occur in other wetlands such as those fringing Estuarine Saltmarsh. The grey-headed flying-fox forages in scattered paperbark trees when they flower. Coastal Freshwater Lagoons are degraded across the State (Keith 2004) with limited representation in reserves in the Sydney basin including in Royal and Kamay Botany Bay national parks.

Mangrove Swamps provide foraging habitat for the grey-headed flying fox and the black bittern. They also provided roosting habitat for the eastern osprey bordering the Georges River. There is limited representation of Mangrove Swamps in coastal reserves in the Sydney basin such as in Towra Point NR, Newington NR, Ku-ring-gai Chase NP and Royal NP.

Coastal Swamp Forests provide foraging habitat for the grey-headed flying-fox. Additionally, Coastal Flats Swamp Mahogany Forest behind Yeramba Lagoon provides habitat for the powerful owl and the varied sittella. This habitat is also likely to support important foraging habitat for the little lorikeet when the swamp mahogany is flowering. Coastal Swamp Forests are limited in extent in the Sydney area and poorly represented in the reserve system, with some patches in Royal and Garigal national parks for example.

Sydney Coastal Heaths provide foraging habitat for the grey-headed flying-fox and also for the Rosenberg's goanna (in part together with heathy Sydney Coastal Dry Sclerophyll Forest). Sydney Coastal Heaths are moderately well represented in reserves in the Sydney basin including in Royal, Ku-ring-gai and Kamay Botany Bay national parks.

Littoral Rainforests provide foraging habitat for the grey-headed flying fox. Due to the small size of patches within the reserve it did not support a distinct suite of fauna such as occurs in larger patches in Royal NP and along the Illawarra escarpment.

Shorelines provide habitat for the black bittern though the status of this species is uncertain within the reserve. Additionally, this habitat group provides habitat for a number of waterbirds listed under international migratory bird agreements. Shoreline habitats are not well represented within reserves of the Sydney basin, though are present around the edges of Royal, Towra and Kamay Botany Bay reserves for example.

Two habitat groups in which no high or moderate ranked threatened species were recorded in the BSP survey were the **Northern Hinterland Wet Sclerophyll Forests** and the **Saltmarshes**. However, particularly in the former group this was likely to be a function both of the size of the single patch present and the limited survey effort. A number of priority species have the potential to occur (see profile in section 6.2). Saltmarshes support a number of waterbird species listed under international migratory bird agreements, in particular the Latham's snipe and the only records for the reserve of the common greenshank and the sharp-tailed sandpiper (see section 6.2). Saltmarshes are restricted in size and area in New South Wales, with as much as half of their original area in the State destroyed for clearing or landfill (Keith 2004).

Table 8: Comparison of fauna habitat groups to 'priority fauna habitats' previously identified in the SMCMA area (DECC 2008a)

Georges River NP fauna habitat group (corresponding to statewide vegetation class)	Corresponding priority fauna habitat (from DECC 2008a)	Predominant or general habitat in Georges River NP for High and Moderate Conservation Management Priority species	Priority fauna habitat for Georges River NP?
Littoral Rainforests	Rainforest	Nil	No
Northern Hinterland Wet Sclerophyll Forests	None	Nil	No
Sydney Coastal Dry Sclerophyll Forests	None	White-bellied sea-eagle, little lorikeet, powerful owl, grey-headed flying-fox	No
Sydney Hinterland Dry Sclerophyll Forests	None	Little lorikeet, powerful owl, grey-headed flying-fox, koala	No
Sydney Coastal Heaths	Heathland	Grey-headed flying-fox	No
Coastal Freshwater Lagoons	Freshwater wetland	Australasian bittern, white-bellied sea-eagle, Latham's snipe	Yes
Coastal Swamp Forests	Forested wetland	Grey-headed flying-fox	Yes
Coastal Floodplain Wetlands	Alluvial forest/forested wetland	Koala, grey-headed flying-fox (temporary camp), black bittern, white-bellied sea-eagle, powerful owl	Yes
Mangrove Swamps	Saltwater wetland	Grey-headed flying-fox, white-bellied sea-eagle, black bittern	Yes
Saltmarshes	Saltwater wetland	White-bellied sea-eagle, Latham's snipe	Yes
Shoreline (not a statewide class)	None	White-bellied sea-eagle	Yes

7 THREATS TO NATIVE FAUNA

7.1 KEY CURRENT THREATS

7.1.1 Fire regime including ecological consequences of high frequency fires

Rationale: High frequency fire has the potential to significantly impact on an array of fauna through habitat modification, loss of feeding habitat and direct mortality. Hazard reduction 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 9), 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 three High Conservation Management Priority species and three Moderate Conservation Management Priority species (see Table 10). This threat is also likely to impact a number of the Low Conservation Management Priority species, such as the red-crowned toadlet and Rosenberg's goanna.

Table 9: Main breeding season of threatened bird species that may potentially breed within the study area and be affected by timing of fire

Species	Breeding period	Source
Powerful owl	May-February	Higgins 1999
Sooty owl	Throughout year	Higgins 1999
Little lorikeet	June-January	Higgins 1999
Varied sittella	August-February	Higgins and Peter 2002
Australasian bittern	October-February	Marchant and Higgins 1990

High frequency fire may threaten a number of species (left); weeds covering Yeramba Lagoon (right).
Photos © M. Schulz

7.1.2 Weed invasion

Rationale: Yeramba Lagoon is heavily infested with salvinia and other water weeds including the yellow waterlily (*Nymphaea mexicana*) and the alligator weed (*Alternanthera philoxeroides*) resulting in it no longer providing suitable habitat for a number of open water species such as the blue-billed and freckled ducks. The impact of such weed infestation on the Australasian bittern which forages in shallow water on the margins is unknown. Additionally, weed infestation by species such as lantana may inhibit the movements of the koala in some vegetation communities within the reserve, such as Hinterland Flats Eucalypt Forest. Weed infestation may also impede regeneration in and around the temporary grey-headed flying-fox camp. Invasion and establishment of exotic vines and scramblers is listed as a Key Threatening Process under the TSC Act.

Priority species threatened: At least two High Conservation Management Priority species and one Moderate Management Priority species (Table 10), with unknown impacts on additional species.

7.1.3 Loss of key feed tree species

Rationale: The swamp mahogany and red gum species are key flowering feed trees for threatened species such as the grey-headed flying-fox, little lorikeet and potentially occurring species such as the swift parrot. These trees have a limited distribution within Georges River NP, with some trees in high public usage areas and modified parkland landscapes. Other important flowering feed trees for threatened nectarivorous species include the bangalay, red bloodwood and smooth-barked apple. The grey gum and red gum species on the south side of the Georges River are important food trees for the koala.

Priority species threatened: Two High Conservation Management Priority species and one Moderate Conservation Management Priority species (see Table 10), with unknown impacts on additional potentially occurring species.

7.1.4 Road mortality

Rationale: The diversity and number of animals killed on the sealed roads within and bordering the Park, in particular Heathcote Road and Henry Lawson Drive, has not been documented. A number of threatened species have been documented road-killed on Heathcote Road adjoining or in proximity to Georges River NP, including the koala (particularly in the Deadmans Creek area), spotted-tailed quoll, grey-headed flying-fox and Rosenberg's goanna (DECC 2008a, OEH 2013c, M. Schulz pers. obs.). Road mortality is of concern at any location where a koala population or regularly used movement path is bisected by a traffic corridor, particularly where speeds exceed 60 kilometres per hour, where traffic volume is high and where visibility of road edges is low due to vegetation or lack of lighting (DECC 2008c), all of which apply to Heathcote Road.

During the survey a number of species not listed under the TSC Act were found road-killed on Henry Lawson Drive adjacent to Yeramba Lagoon, including the eastern snake-necked turtle, purple swamphen and dusky moorhen. A powerful owl nest is located close to this road and there is potential for fledglings to be hit by vehicles on first leaving the nest hole.

Priority species threatened: At least two High Conservation Management Priority species and one Moderate Conservation Management Priority species (see Table 10), with unknown impacts on additional potentially occurring species.

7.1.5 Predation by the fox

Rationale: The fox is widespread across the reserve 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 2007). Additionally, this species can aid the spread of some weed species, such as the bitou bush (*Chrysanthemoides monilifera*), through the deposition of seeds in faeces.

Priority species threatened: At least one High Conservation Management Priority species and four Moderate Conservation Management Priority species (see Table 10). This threat is also likely to impact a number of the Low Conservation Management Priority species, such as the red-crowned toadlet and Rosenberg's goanna.

7.1.6 Public disturbance

Rationale: Much of the reserve has a high rate of visitation, including for legal and illegal uses. Some public disturbance of wildlife is therefore expected. However, some fauna species are particularly susceptible to certain types of human disturbance, either during a particular stage within their daily or annual cycle or if they only utilise restricted, accessible habitat. These types of disturbances include: disturbance of roosting grey-headed flying-foxes when the temporary camp on the western side of Mill Creek is occupied, particularly by motorbikers and mountain bikers; disturbance of shorebirds such as the black bittern and other waterbirds by watercraft along navigable sections of watercourses; disturbance of little lorikeets and grey-headed flying-foxes foraging in flowering swamp mahoganies and other trees in picnic areas and other high use visitor areas. The actual impacts of these disturbances on fauna species are not known.

Priority species threatened: At least two High Conservation Management Priority species and three Moderate Conservation Management Priority species (see Table 10).

The swamp mahogany (left) is a key feed tree species; rusa deer (right) are widespread on the south side of the River. Photo © M. Schulz

7.1.7 Spread and establishment of rusa deer

Rationale: The BSP survey documented extensive evidence of rusa deer on the south side of the River, principally below the escarpment west of Alfords Point Road bridge. Additionally, footprints were found above the escarpment on the western boundary south of Sandy Point in the vicinity of the Telstra tower and in the reserve bordering the quarry. The presence of the rusa deer is likely to impact on native fauna both directly and indirectly through the degradation of vegetation by grazing; trampling of fragile habitats, including the creation of well-defined pads in wetlands that introduced predators can then use for access; trampling of mud/sand edges of wetlands that impact on foraging areas for shorebirds and some large wading birds such as egrets and bitterns; the trampling of the nests of ground-breeding fauna; and the loss of viability of plant populations through the curtailment of seed production and seedling recruitment (Keith and Pellow 2005, DECCW 2011a). Some habitats are particularly susceptible to trampling and development of runways, especially Estuarine Reedland and Hinterland Riverflat Paperbark Swamp Forest. Species potentially impacted included the Australasian and black bitterns (through the trampling of habitat and creation of runways within dense habitat allowing the penetration of the fox and other introduced predators) and the grey-headed flying-fox (through the inhibition of vegetation regeneration at the temporary camp site).

Priority species threatened: At least one High Conservation Management Priority species and two Moderate Conservation Management Priority species (see Table 10) as well as impacts on priority fauna habitats.

7.1.8 Disturbance and predation by domestic dogs

Rationale: Domestic dogs were frequently encountered in Georges River NP either on- or off-leash. Dogs were most frequently encountered south of Sandy Point, an area that supports koala habitat.

Priority species threatened: One High Conservation Management Priority species and one Moderate Conservation Management Priority species (see Table 10), with unknown impacts on additional species.

7.1.9 Loss of habitat connectivity

Rationale: Many portions of the Park are small and isolated in highly urbanised surroundings. However, the largest portion of the Park south of the River is currently linked to extensive forest areas to the south, extending as far as Budderoo and Morton national parks and beyond. This habitat connectivity is important for many bushland species that occur in the southern portion of the Park, yet is under continued threat from urban development. Loss of this habitat connectivity may negatively affect the ability of some species to persist in the Park, including koala and Rosenberg's goanna. Were this habitat connectivity lost, the southern portion of the Park would become relatively small and isolated like the other portions, and hence subject to increased pressures in the urban landscape.

Priority species threatened: At least one High Conservation Management Priority species and one Moderate Conservation Management Priority species (see Table 10) as well as impacts on an array of Low Conservation Management Priority species and other fauna.

7.1.10 Infection by *Chlamydia* in the koala

Rationale: Infection of koalas by *Chlamydia* which causes keratoconjunctivitis (an infection of the eyes) and infertility may impact on the occurrence of this species within the reserve. The incidence of *Chlamydia* within the reserve is unknown.

Priority species threatened: One High Conservation Management Priority species (see Table 10).

7.1.11 Water pollution and siltation

Rationale: Water pollution principally originates from overflowing or burst sewage pipes following heavy rain events within the reserve or from industrial, urban and stormwater sources upstream of the reserve in the Mill Creek catchment and the Georges River. Siltation originates from land clearing and building on undeveloped sites upstream or upslope of the reserve. Such deposition impacts on the suitability of intertidal areas as foraging habitat for the black bittern and shorebirds listed under international migratory bird agreements. In the past large amounts of fill have been dumped along parts of the shoreline, such as the eastern mouth of Saltpan Creek.

Priority species threatened: One High Conservation Management Priority species and least two Moderate Conservation Management Priority species (see Table 10) as well as a number of shorebird species listed under international migratory bird agreements..

7.1.12 Predation by the feral cat and domestic cat

Rationale: The feral cat appears rare within the reserve. However, domestic cats were frequently encountered during the BSP survey and are likely fairly common given the reserves residential setting. The actual impact on native fauna is unknown, but many species are vulnerable to this threat.

Priority species threatened: At least three Moderate Conservation Management Priority Species (see Table 10).

7.1.13 Loss of hollow-bearing and standing dead trees

Rationale: A number of threatened species require tree hollows in living trees for nesting and/or roosting. These species include the powerful owl and little lorikeet. Additionally, standing dead trees provide potential breeding habitat for the little lorikeet and the varied sittella. Removal of hollow-bearing trees would result in the loss of breeding and sheltering sites for these species.

Priority species threatened: At least two Moderate Conservation Management Priority species (see Table 10), with potential impacts on a number of threatened bat species which may occur in the reserve.

Hollows are a critical resource for many species. Photo © M. Schulz

7.1.14 Entanglement in or ingestion of anthropogenic debris

Rationale: A large amount of plastics, discarded fishing line and other materials are deposited along the shoreline by fishermen, or washed ashore. Such material has the potential to entangle or be ingested by a variety of birds and other fauna that use the shoreline and tidal-influenced wetlands, including the Australasian and black bitterns, eastern osprey and species listed under international migratory bird agreements. In the BSP survey the silver gull and white-faced heron were observed with fishing line entanglement.

Priority species threatened: One High Conservation Management Priority species and at least two Moderate Conservation Management Priority species (see Table 10) as well as a variety of waterbird species identified as of Low Conservation Management Priority.

7.1.15 Competition from feral honeybees

Rationale: Hollow-dependent species, particularly in parkland landscapes and on the fringes of the reserve, may be impacted by the competition for hollow space by the feral honeybee. Species in this category include the powerful owl, little lorikeet and a variety of microbats.

Priority species threatened: At least two Moderate Conservation Management Priority species (see Table 10), with potential impacts on a number of tree-hole roosting microbats and other hollow-dependent species, including several potentially occurring threatened bat species.

7.1.16 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 little lorikeet (a known occupant of the reserve) and swift parrot (a potential visitor to the reserve).

Priority species threatened: One Moderate Conservation Management Priority species (see Table 10), in addition to other parrot species including potentially occurring threatened species.

7.1.17 Aggressive exclusion by abundant noisy miners

Rationale: The NSW Scientific Committee has made a preliminary determination to list decline in woodland and forest birds due to aggressive exclusion by abundant noisy miners as a Key Threatening Process under the TSC Act. Noisy miners occur in all sections of the Park with a concentration of records around Yeramba Lagoon. The species is most likely to be an issue in modified habitats including parkland/picnic areas supporting disturbed Cumberland Riverflat Forest and Coastal Flats Swamp Mahogany Forest. Species potentially affected include the little lorikeet, varied sittella and possibly the swift parrot (NSW Scientific Committee 2013). The current impact of this threat in the Park is not known.

Priority species threatened: One Moderate Conservation Management Priority species (see Table 10) in addition to other woodland bird 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 Management Priority, as follows:

- Competition from introduced bird species, particularly the common starling and common myna.
- Impacts of grazing by the rabbit (listed as a Key Threatening Process).
- Rubbish dumping including the dumping of garden clippings and the dumping and burning of motor vehicles.
- Clearing and habitat modification associated with high tension powerline easements.
- Predation by the black rat.
- Infection of frog species by amphibian Chytrid fungus, particularly if a population of the green and golden bell frog is rediscovered in the reserve.
- Predation of tadpoles by the plague minnow (*Gambusia holbrooki*), particularly if a population of the green and golden bell frog is rediscovered in the reserve.
- Predation and competition by the red-eared slider and other introduced freshwater turtle species.
- Use of herbicides, pesticides and other chemicals near wetland areas.
- Erosion associated with illegal motorbike and off-road vehicle activity.
- Poaching of reptiles.

7.3 FUTURE THREATS

- Human-induced climate change (listed as a Key Threatening Process), including sea level rise and other hydrological changes to the shoreline along the Georges River and tributaries (e.g. impacting on the intertidal mudflat, Estuarine Mangrove Forest, Estuarine Saltmarsh, freshwater wetlands backing Estuarine Saltmarsh, Hinterland Flats Eucalypt Forest, Coastal Flats Swamp Mahogany Forest and Cumberland Riverflat Forest).

- Invasion of the cane toad (listed as a Key Threatening Process) into wetlands within the reserve, such as Yeramba Lagoon, has the potential to impact on native fauna species. In 2010 over 200 cane toads were collected in the Sutherland Shire with a concentration around Taren Point downstream from Georges River NP (A. White pers. comm.). If this outbreak of cane toads becomes established it has the potential to spread to reserves adjacent to Taren Point, including GRNP. One individual has been found in the suburb of Alfords Point (Atlas of NSW Wildlife) but no individuals have been reported from the reserve (B. Hodgson pers. comm.).

7.4 RELATIVE PRIORITY OF THREATS

Table 10 displays the priority ranking of the key current threats according to the number of High and Moderate Conservation Management Priority fauna species they potentially impact.

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 conservation management priority as they emerge.

Table 10: Prioritisation of key current threats to high and moderate priority fauna species occurring within the reserve

Threat priority ranking	Very high				High						Moderate						
Key current threat	Fire regime including high frequency fire	Weed invasion	Loss of key feed trees	Road mortality	Predation by the fox	Public disturbance	Spread and establishment of the rusa deer	Disturbance and predation by the domestic Dog	Loss of reserve connectivity	Spread of *Chlamydia*	Water pollution and siltation	Predation by the feral cat and domestic cat	Loss of hollow-bearing and standing dead trees	Entanglement in or ingestion of anthropogenic debris	Competition from feral honeybees	Beak and Feather Disease	Exclusion by noisy miner
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																	
White-bellied sea-eagle	X					X					X			X			
Koala	X	X	X	X	X			X	X	X							
Grey-headed flying-fox	X	X	X	X		X	X										
Moderate Priority Species																	
Australasian bittern	X	X			X		X				X			X			
Black bittern					X	X	X				X	X		X			
Little lorikeet	X		X			X							X		X	X	X
Powerful owl	X			X	X	X		X	X			X	X		X		
Latham's snipe					X							X					

8 RECOMMENDATIONS FOR FAUNA MANAGEMENT

8.1 MANAGEMENT OF VERY HIGH THREATS

Table 11: Recommendations for management of very high threats

Threat	Management response	Target areas or habitats	Key species issues
Fire regime including ecological consequences of high frequency fires	Revise current fire management plans to incorporate new vegetation mapping for the reserve.	All	
	Follow the recommendation of the 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.	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, Coastal Freshwater Lagoons, Coastal Swamp Forest and Coastal Floodplain Wetlands.	All	
	Protect Littoral Rainforest, Coastal Freshwater Lagoons, Coastal Swamp Forest and Coastal Floodplain Wetlands from fire (as per DECC 2009a for wetlands)	Littoral Rainforest, Coastal Freshwater Lagoons, Coastal Swamp Forest and Coastal Floodplain Wetlands	Maintain integrity of habitat for fauna species such as Australasian bittern.
	Where prescribed burns are necessary conduct them in autumn to minimise overlap with the breeding seasons of priority threatened species which nest in trees.	All.	Minimise impacts on priority species as the majority predominantly breed between May and midsummer.
	Prescribed burns should be planned to avoid burning forest habitat types when key tree species are in flower, particularly swamp mahogany, red gum species and blackbutt.	Both sides of the River in Coastal Swamp Forests, Sydney Coastal Dry Sclerophyll Forests, Coastal Floodplain Wetlands and Sydney Hinterland Dry Sclerophyll Forests	Protect the feeding resources of nectarivorous threatened species such as the little lorikeet, black-chinned honeyeater and grey-headed flying-fox, as well as potentially the swift parrot.
	Avoid felling or damage to hollow-bearing or standing dead trees during fire operations.	All	Protection of fauna dependant on hollows.

Threat	Management response	Target areas or habitats	Key species issues
	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.	All	
	Incorporate findings of this report, including habitat group profiles, when writing, updating and implementing park management plans, fire plans and other management documents.	All.	
	Ensure that prescribed burns in areas known to include koala habitat are maintained at low intensity, are not frequent, and are managed to reduce risks to resident koalas. If koalas are found to be present in a proposed burn area then delay fire until they have moved into other areas.	South side of Georges River especially west of Mill Creek. Particularly important habitat groups are Coastal Floodplain Wetlands and Sydney Hinterland Dry Sclerophyll Forests. Sydney Coastal Dry Sclerophyll Forests also provide habitat.	Protect koalas and their habitat from impacts of fire.
	Before undertaking prescribed burns in the area of the temporary flying-fox camp, check that roosting bats are not present. Do not undertake burns in the area if/when the camp is occupied.	West side of Mill Creek.	Protect roosting grey-headed flying-fox from fire.
	Follow DECC (2009a) and do not burn in and around ephemeral drainage lines at the headwaters of creeks.	Ephemeral drainage lines north and south of the River.	Protect red-crowned toadlet habitat from high frequency fire.
	In areas known to support nesting powerful owls do not undertake prescribed burns between May and January.	All, especially currently known nest trees as these are frequently used over a number of years.	Protect powerful owl nest sites from fire.
	In areas known to support white-bellied sea-eagle nests do not undertake prescribed burns when the nest is active. Assess nest activity in the proposed burn area and if active delay burn until nesting is complete.	All, especially currently known nest trees.	Protect white-bellied sea-eagle nest sites from fire.
	Ensure that some mature stands of *Allocasuarina littoralis/A. torulosa* are left unburnt.	Northern Hinterland Wet Sclerophyll Forests, Sydney Coastal Dry Sclerophyll Forests and Sydney Hinterland Dry Sclerophyll Forests.	Ensure availability of glossy black-cockatoo feeding habitat.
	Encourage the awareness and implementation of hygiene protocols to avoid spread of amphibian Chytrid fungus or weeds during operations.	All	Red-crowned toadlet, green and golden bell frog.

Threat	Management response	Target areas or habitats	Key species issues
Weed invasion	Harvest salvinia at Yeramba Lagoon and undertake necessary measures to ensure this weed is not spread during lagoon management operations.	Yeramba Lagoon.	Waterbird species.
	Continue to support bush regeneration programs around Yeramba Lagoon (currently being undertaken by the Yeramblers Bushcare Group and the Friends of Yeramba Lagoon).	Coastal Swamp Forests and Coastal Freshwater Lagoons around Yeramba Lagoon.	Maintain habitat quality for Australasian bittern, little lorikeet, grey-headed flying-fox and other native fauna species.
	Avoid spraying of herbicide within 50 metres of freshwater wetlands and other water bodies.	All water bodies and wetlands.	Minimise potential impacts on frog and waterbird species, including the Australasian bittern.
	Undertake weed removal in koala habitat to ensure that individuals can readily move between trees.	South side of the Georges River, especially west of Mill Creek, in Hinterland Flats Eucalypt Forest, Cumberland Riverflat Forest and Hinterland Sandstone Transition Grey Gum Forest.	Maintain habitat quality for koala.
	Undertake weed removal in grey-headed flying-fox temporary camp area where necessary to ensure natural regeneration of vegetation.	Hinterland Flats Eucalypt Forest and Estuarine Swamp Oak Forest on the west side of Mill Creek.	Maintain habitat quality grey-headed flying-fox.
	Undertake removal of exotic vines and scramblers, particularly on the north side of the Georges River.	Cumberland Riverflat Forest, Hinterland Flat Eucalypt Forest, Estuarine Swamp Oak Forest and Coastal Flats Swamp Mahogany Forest.	Maintain habitat quality for various fauna species.
Loss of key feed trees	Ensure retention of key koala food trees.	Red gum and grey gum trees on the south side of the Georges River, especially west of Mill Creek in: Hinterland Flats Eucalypt Forest, Cumberland Riverflat Forest and Hinterland Sandstone Transition Grey Gum Forest	Maintain koala habitat.

Threat	Management response	Target areas or habitats	Key species issues
	Retain swamp mahogany and red gum trees wherever they occur, including all remnant trees in parkland/picnic areas.	Coastal Swamp Forests, Coastal Floodplain Wetlands and parkland/picnic areas with native tree canopy.	Retain/increase foraging resources for nectarivorous birds and bats including Priority species such as the little lorikeet and grey-headed flying-fox.
	Assist natural regeneration of swamp mahogany and red gum stands, where necessary by bush regeneration.	Coastal Swamp Forest (particularly behind Yeramba Lagoon) and Coastal Floodplain Wetlands	As above.
	Consider strategic planting of canopy trees in parkland/picnic areas, in line with the mapped vegetation community (as mapped in DECCW 2011c).	Cumberland Riverflat Forest and Coastal Flats Swamp Mahogany Forest on the north side of the River.	As above.
	Advocate the protection of swamp mahogany and red gum trees (and vegetation communities featuring them) on adjoining private and council lands.		
Road mortality	Liaise with councils, road authorities and adjacent landholders to promote the design and implementation of a plan to limit the risk of wildlife road mortality on Heathcote Road. Provide recommendations to road managers wherever the opportunity arises. Measures to discuss might include additional lighting (from 200 metres south of the St George Crescent junction to the Pleasure Point Road junction), speed camera(s) (in the Deadmans Creek area), and consideration of the need to retain connectivity between the southern portion of the Park and the Holsworthy Military Area during any upgrade of Heathcote Road (e.g. through over- or under-passes in the Deadmans Creek area).	Heathcote Road	Reduce mortality of koalas and other native species.
	Liaise with road authorities to design and implement a plan to reduce wildlife road mortality near Yeramba Lagoon. Elements could include a speed camera on Henry Lawson Drive.	Henry Lawson Drive adjacent to Yeramba Lagoon.	Reduce mortality of various wetland species.

8.2 MANAGEMENT OF HIGH THREATS

Table 12: Recommendations for management of high threats

Threat	Management response	Target areas or habitats	Key species issues
Predation by the fox	Investigate the feasibility of conducting a fox control program focussing on areas supporting priority threatened species.	South side of the Georges River, Yeramba Lagoon area, and potentially around powerful owl nest trees particularly between May and January.	Koala, Australasian bittern, powerful owl.
	During any fox control programs implement protocols that minimise the take of non-target species.	All baited areas.	Variety of native species including Rosenberg's goanna.
	Undertake feral cat and rabbit control, where required, in concert to any fox baiting programs.	All baited areas.	
	Support a cross-tenure approach to fox management through cooperation and integration of programs with neighbouring landholders.	All.	
Public disturbance	Continue efforts to exclude trail bikes and other off-road vehicles from the Park.	Formal and informal tracks on the south side of the Georges River including the grey-headed flying-fox temporary camp area.	Koala and grey-headed flying-fox temporary camp area.
	Restrict knowledge of the location of powerful owl and white-bellied sea-eagle nest trees to reduce the possible risk of disturbance.	Powerful owl and white-bellied sea-eagle nest trees.	Powerful owl and white-bellied sea-eagle.
	Continue to keep the Park closed to public vehicles at night to minimise disturbance to foraging bats.	Picnic areas on the north side of the Georges River.	Minimise disturbance to foraging grey-headed flying-fox.
Spread and establishment of the rusa deer	Prepare a rusa deer management plan for Georges River NP in consultation with the Royal NP Deer Working Group.	South side of Georges River west of Alfords Point Road bridge including on the escarpment adjacent to the Park boundary.	Reduce potential impacts on the Australasian bittern, black bittern and other wetland fauna. Also reduce potential impacts at the grey-headed flying-fox temporary camp.
Predation and disturbance by the domestic dog	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.	Particularly the Sandy Point area.	Koala, Rosenberg's goanna, powerful owl, reptiles and ground/shrub-frequenting birds and mammals.
	Work in partnership with Sutherland Shire Council and surrounding landholders to eliminate the recently reported feral dogs in the Lucas Heights-Sandy Point area, which may include southern sections of the reserve.	Lucas Heights and Sandy Point area.	As above.

Threat	Management response	Target areas or habitats	Key species issues
	Undertake regular patrols and enforcement to stop domestic dogs being brought into the Park. Include weekends, and early in the morning and towards dusk on week days.	Particularly south side of the Georges River between Mill Creek and Sandy Point.	As above.
Loss of habitat connectivity	Advocate the importance of the connectivity between Georges River NP and Holsworthy Military Area.	Park boundary adjoining Heathcote Road.	Many native species including koala and Rosenberg's goanna.
	Improve habitat quality in western parts of the reserve abutting Heathcote Road and Holsworthy Military Area. Measures include excluding trail bikes, closing tracks and bush regeneration of disturbed and weedy areas.	Western parts of Park south of Sandy Point.	Many native species including koala and Rosenberg's goanna.
Spread of *Chlamydia*	The incidence of *Chlamydia* in koalas in the reserve is unknown.		Koala.

Many intertidal areas, such as lower Mill Creek, support foraging waterbirds at low- and mid-tide. Photo © M. Schulz

8.3 MANAGEMENT OF MODERATE THREATS

Table 13: Recommendations for management of moderate threats

Threat	Management response	Target areas or habitats	Key species issues
Water pollution and siltation	Liaise with relevant authorities to cooperatively maintain the hydrological regime and water quality of Mill and Saltpan creeks and upstream along the Georges River.	Tidal areas.	Black bittern, eastern osprey, waterbirds listed under international migratory bird agreements and various other species.
	Work with Sydney Water to minimise sewage overflows in the catchment. Additionally, maintain vigilance to engage Sydney Water to act quickly when sewage pipes burst in the Yeramba Lagoon and Alfords Point areas.	Tidal areas.	Black bittern, eastern osprey, waterbirds listed under international migratory bird agreements and various other species.
	Ensure current hydrological regime and water quality are maintained above known and potential red-crowned toadlet habitat.	Minor drainage lines, stream headwaters and seepages.	Red-crowned toadlet.
Predation by the feral cat and domestic cat	Encourage staff and reserve visitors to report cat sightings and follow these up with trapping and removal, as appropriate.	All.	A variety of native species.
	Instigate an intermittent trapping program for feral and wide-roaming domestic cats in association with any fox baiting program.	All.	As above.
	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.	All.	As above.
Loss of hollow-bearing and standing dead trees	Avoid removal of hollow-bearing and dead standing trees and fallen timber during OEH works.	All.	Native species that use hollows especially the powerful owl, little lorikeet, various microbats, and Rosenberg's goanna (fallen logs).
Entanglement or ingestion of anthropogenic debris	Conduct clean up days to remove discarded fishing line and associated rubbish.	Popular shore-based fishing localities as well as elsewhere along the Georges River shoreline.	Black bittern, eastern osprey, waterbirds listed under international migratory bird agreements and various other species.

Threat	Management response	Target areas or habitats	Key species issues
	Erect signs to educate recreational fishers about the potential impact of discarded fishing tackle on native wildlife.	Popular shore-based fishing localities.	As above.
Competition from feral honeybees	Remove feral honeybees that establish in hollows within the reserve.	Across the reserve, particularly on flats adjacent to the Georges River in Cumberland Riverflat Forest and Hinterland Flats Eucalypt Forest.	Powerful owl, little lorikeet, microbats and other hollow-nesting mammal or bird species.
Beak and feather disease	Remove any aviary escapee parrots.	Predominantly the main picnic areas.	Reduce risk of spread of disease to wild parrot populations.
Aggressive exclusion by abundant noisy miners	Consider involving local birdwatchers to assess the abundance and behaviour of noisy miners in select priority fauna habitats.	Cumberland Riverflat Forest, Coastal Flats Swamp Mahogany Forest and Hinterland Flats Eucalypt Forest including parkland/picnic areas.	A range of native bird species including little lorikeet.

8.4 MANAGEMENT OF OTHER FAUNA THREATS

Additional strategies to reduce the impact of other threats to native fauna include the following.

- Destroy nests of common starling and common myna where they are noticed in tree hollows within the Park.
- Minimise rubbish dumping by maintaining gates and fences on the western boundary and ensuring the closure at night of picnic areas and parklands on the north side of the Georges River.
- Ensure that staff, contractors and bush regeneration teams follow the *Hygiene protocol for the control of disease in frogs* (NPWS 2001).
- Undertake trapping for red-eared slider at Yeramba Lagoon and remove any captured animals. Encourage the public to report red-eared slider sightings and follow these up with trapping. Enter sighting details into the Atlas of NSW Wildlife.
- Encourage locals to report suspicious activity which may be associated with reptile poaching, particularly on the south side of the Georges River.

The common myna is an aggressive introduced species known to outcompete a variety of hollow-nesting birds and mammals (top left); a cut fence on the western reserve boundary allowing access by trail bikes and other vehicles (top right); deeply eroded track south of Sandy Point (bottom left); overturned exfoliated rock suggesting potential reptile poaching activity in the reserve (bottom right). Photo © M. Schulz

8.5 POTENTIAL IMPACT OF REMOVING THE WEIR AT YERAMBA LAGOON

There is currently a proposal to remove the weir at Yeramba Lagoon, thereby opening it to tidal influence. This could have both positive and negative affects on threatened species in the area. Removal of the weir may reduce habitat quality for the Australasian bittern. However, the lagoon is currently so overgrown with aquatic weeds that it is doubtful whether this species (or other previously recorded threatened species such as the blue-billed and freckled ducks) currently occurs. Removal of

the weir would result in removal of salvinia and other water weeds, and it is likely that a large part of the lagoon would provide suitable habitat for birds such as the Australasian bittern even once the weir is removed. Removal of the weir may also result in an expansion of the Coastal Flats Swamp Mahogany Forest patch that is restricted to the back of the lagoon, which would enhance foraging habitat for nectarivorous threatened species such as the little lorikeet, grey-headed flying-fox and potentially the swift parrot.

8.6 Potential Discovery of New or Presumed Lost Species

This report documents the most accurate possible current inventory of terrestrial vertebrate fauna species for Georges River NP. 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.

8.7 Maintaining Wildlife Data Systems

A survey such as the BSP 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 encourage OEH 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.

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 New South Wales, the reasons why monitoring programs often fail and to suggest monitoring projects that are relevant to fauna within the reserve that is 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 Georges River 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).

NPWS (part of OEH) recently initiated a program called ParkIQ to improve the strategic approach to coordinating survey, monitoring, evaluation and research work on reserves across the State. The program has three main components: development of a Monitoring and Evaluation Guide (MEG, DECCW 2010); compilation of a Monitoring, Survey and Research Inventory (MSR inventory); 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 New South Wales reserve system.

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 Georges River 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 OEH 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 14 presents a summary of the issues that confront fauna monitoring programs.

Table 14: 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 reserve.

- The first phase of WildCount will concentrate on fauna monitoring using digital cameras across reserves in the east of the State. One site (four cameras) was set up in Georges River NP in 2012, with the intention to repeat the survey every year. OEH 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).
- Staff or volunteers are encouraged to contribute to regular national or statewide surveys for priority species. Programs include: Birdlife Australia annual census for regent honeyeater and swift parrot (in the reserve survey vegetation communities supporting swamp mahogany and forest red gum); Birdlife Australia survey for Australia's bitterns (Birdlife Australia 2010); Birdlife Australia powerful owl project (Birdlife Australia 2012).

9.2 FURTHER FAUNA SURVEY

At the completion of the 2012-13 survey it is considered that all vertebrate fauna groups except amphibians and nocturnal birds have been systematically sampled to an adequate level to provide a baseline understanding of terrestrial vertebrate fauna in Georges River NP and enable the setting of conservation management priorities. The species inventory in Appendix A presents the current list of vertebrate fauna for the Park. However this list would surely be expanded upon with additional survey.

The full range of habitats used by the koala, and its frequency of occurrence, is currently unknown. Photo © M. Schulz

Compilation of a more exhaustive species inventory for the Park over time would require: additional amphibian surveys between late spring and mid-summer; additional insectivorous bat surveys between late spring and mid-summer using harp traps and bat ultrasonic call recorders and targeting species listed under the TSC Act in particular the large-footed myotis, little bentwing-bat, east-coast freetail-bat and greater broad-

nosed bat; and additional nocturnal call playback surveys for threatened owls (particularly masked owl).

In addition, in order to improve understanding of the status of species that are known from the Park, and enable effective management in the long term, the following surveys are recommended.

- Work with other agencies and the community to expand the conservation program for the eastern component of the Campbelltown koala population to include Georges River NP. A component of the program should seek to define the distribution, abundance and habitat preferences of the koala in the Park and adjacent areas and assess the importance of Georges River NP to conservation of the Campbelltown population. Survey for the koala should consider use of the spot assessment technique (Callaghan et al. 2003).
- Conduct targeted surveys for the Australasian bittern over a number of years in spring and early summer using call playback, passive listening at dawn and dusk, and active searching. Recommended areas include sedgeland at the back of Yeramba Lagoon, extensive sea rush patches bordering Saltmarshes, and areas supporting common reed (see guidelines in Birdlife Australia 2010).
- Conduct targeted surveys for the black bittern over a number of years along Mill Creek to increase the understanding of occupation rates and habitat usage.
- Conduct targeted surveys for the green and golden bell frog in ephemeral freshwater wetlands on the inland edge of Saltmarshes following heavy or prolonged rain episodes between mid-spring and summer. Recommended areas include Mickeys Point area, lower reaches of Mill Creek, west of Mill Creek mouth and on the south side of the River from Yeramba Lagoon downstream to the powerline easement.

Female chestnut teal. Photo © M. Schulz

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APPENDIX A: VERTEBRATE FAUNA OF GEORGES RIVER NATIONAL PARK

INTRODUCTION

This appendix provides a list of vertebrate fauna (excluding fish) that currently occur or have previously been accurately recorded within the study area. The list is based on records extracted from the Atlas of NSW Wildlife on 20 June 2013. Additional species have been added to the list that are not recorded on the Atlas of NSW Wildlife but cited in other sources, as noted. Species that are only represented by records with high spatial inaccuracy, by unconfirmed sightings, by probable misidentifications or database errors, or are introduced and non-local species that do not have established wild populations in or adjacent to the study area have been removed from this list (see Table 6 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 list provided below presents all fauna confidently and accurately recorded within the study area, whether historically or in the present. Some of these species may no longer occur in the reserve. Other species have suffered declines within or outside of the reserve (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 list has therefore been annotated to summarise the current status of all fauna species in the study area.

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).

TABLE DEFINITIONS

Column heading	Definition of terms used
NSW legal status	Current listing under the TSC Act (as of May 2013). Codes used are CE=Critically Endangered, E=Endangered, EP=Endangered Population, V=Vulnerable, P=Protected, U=Unprotected (introduced species)
Commonwealth legal status	Current listing under the EPBC Act (as of May 2013). E=Endangered, V=Vulnerable. Current listing under international migratory bird agreements. C=CAMBA (Commonwealth of Australia 1995a), J=JAMBA (Commonwealth of Australia 1995b), R=ROKAMBA (Commonwealth of Australia 2006)
Current status	Summary of the way that the species currently uses the study area. NR=No confirmed sightings documented within the last 25 years. SU=Status uncertain; species for which the current status cannot be 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 BSP surveys. Vag=Vagrant; species which are outside their currently accepted normal distribution. IV=Irregular visitor. R=Resident; species that are regularly recorded. Not all these species breed in the study area. SM=Predominantly a summer migrant. WM=Predominantly a winter migrant.
Record source	The sources of these records are as follows: 1=OEH surveys including the BSP survey; 2=other observers in the Atlas of NSW Wildlife; 3=Birding Aus and Birdline NSW; 4=Eco Logical Australia (2009); 5=B. Hodgson (OEH) pers. comm.; 6=WildCount survey; 7=K. Griffiths pers. comm.. If Atlas records are only from 1950 or earlier, another source has been provided.

Table 15: Fauna species accurately recorded in Georges River National Park

Family	Scientific name	Common name	NSW legal status	Commonwealth legal status	Current status	Record source
Frogs						
Myobatrachidae	*Crinia signifera*	Common eastern froglet	P		R	1
Myobatrachidae	*Limnodynastes dumerilii grayi*	Eastern banjo frog	P		R	2
Myobatrachidae	*Limnodynastes peronii*	Brown-striped frog	P		R	1
Myobatrachidae	*Limnodynastes tasmaniensis*	Striped grass frog	P		SU	2
Myobatrachidae	*Pseudophryne australis*	Red-crowned toadlet	V,P		R	1
Myobatrachidae	*Pseudophryne bibronii*	Bibron's toadlet	P		SU	4,7
Myobatrachidae	*Uperoleia laevigata*	Smooth toadlet	P		SU	2
Hylidae	*Litoria aurea*	Green and golden bell frog	E,P	V	**NR**	2
Hylidae	*Litoria caerulea*	Green tree frog	P		SU	4
Hylidae	*Litoria dentata*	Bleating tree frog	P		R	1
Hylidae	*Litoria fallax*	Eastern dwarf tree frog	P		R	1
Hylidae	*Litoria freycineti*	Freycinet's frog	P		R	2
Hylidae	*Litoria peronii*	Peron's tree frog	P		R	1
Hylidae	*Litoria phyllochroa*	Leaf-green tree frog	P		R	1
Hylidae	*Litoria tyleri*	Tyler's tree frog	P		R	1
Hylidae	*Litoria verreauxii*	Verreaux's frog	P		R	2
Reptiles						
Chelidae	*Chelodina longicollis*	Eastern snake-necked turtle	P		R	1
Chelidae	*Emydura* sp.	Unidentified Emydura	P Not locally native		SU	2
Emydidae	*Trachemys scripta elegans*	Red-eared slider	U		SU	5,7
Gekkonidae	*Diplodactylus vittatus*	Wood gecko	P		R	1
Gekkonidae	*Oedura lesueurii*	Lesueur's velvet gecko	P		R	1
Gekkonidae	*Phyllurus platurus*	Broad-tailed gecko	P		R	1
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed gecko	P		R	1
Scincidae	*Acritoscincus platynota*	Red-throated skink	P		R	1

Family	Scientific name	Common name	NSW legal status	Commonwealth legal status	Current status	Record source
Scincidae	*Cryptoblepharus virgatus*	Cream-striped shinning-skink	P		R	1
Scincidae	*Ctenotus robustus*	Robust ctenotus	P		SU	7
Scincidae	*Ctenotus taeniolatus*	Copper-tailed skink	P		R	1
Scincidae	*Egernia cunninghami*	Cunningham’s skink	P		R	1
Scincidae	*Eulamprus quoyii*	Eastern water-skink	P		R	1
Scincidae	*Eulamprus tenuis*	Barred-sided skink	P		R	1
Scincidae	*Lampropholis delicata*	Dark-flecked garden sunskink	P		R	1
Scincidae	*Lampropholis guichenoti*	Pale-flecked garden sunskink	P		R	1
Scincidae	*Liopholis whitii*	White's skink	P		R	1
Scincidae	*Saiphos equalis*	Three-toed skink	P		R	1
Scincidae	*Saproscincus mustelinus*	Weasel skink	P		R	1
Scincidae	*Tiliqua scincoides*	Eastern blue-tongue	P		R	1
Agamidae	*Amphibolurus muricatus*	Jacky lizard	P		R	1
Agamidae	*Physignathus lesueurii*	Eastern water dragon	P		R	1
Agamidae	*Pogona barbata*	Bearded dragon	P		SU	2
Varanidae	*Varanus rosenbergi*	Rosenberg’s goanna	V,P		SU	1
Varanidae	*Varanus varius*	Lace monitor	P		R	1
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish blind snake	P		R	2
Pythonidae	*Morelia spilota*	Diamond python	P		SU	4
Colubridae	*Dendrelaphis punctulatus*	Common tree snake	P		SU	2
Elapidae	*Cacophis squamulosus*	Golden-crowned snake	P		SU	4
Elapidae	*Demansia psammophis*	Yellow-faced whip snake	P		SU	2
Elapidae	*Notechis scutatus*	Tiger snake	P		SU	5
Elapidae	*Pseudechis porphyriacus*	Red-bellied black snake	P		R	1
Elapidae	*Pseudonaja textilis*	Eastern brown snake	P		SU	2
Elapidae	*Vermicella annulata*	Eastern bandy-bandy	P		SU	4
Birds						
Phasianidae	*Coturnix ypsilophora*	Brown quail	P		SU	4
Anatidae	*Anas castanea*	Chestnut teal	P		R	1

Family	Scientific name	Common name	NSW legal status	Commonwealth legal status	Current status	Record source
Anatidae	*Anas gracilis*	Grey teal	P		IV	2
Anatidae	*Anas platyrhynchos*	Northern mallard	U		IV	2
Anatidae	*Anas rhynchotis*	Australasian shoveler	P		IV	1
Anatidae	*Anas superciliosa*	Pacific black duck	P		R	1
Anatidae	*Aythya australis*	Hardhead	P		IV	1
Anatidae	*Biziura lobata*	Musk duck	P		Vag	2
Anatidae	*Chenonetta jubata*	Australian wood duck	P		R	1
Anatidae	*Cygnus atratus*	Black swan	P		R	1
Anatidae	*Oxyura australis*	Blue-billed duck	V,P		SU	4
Anatidae	*Stictonetta naevosa*	Freckled duck	V,P		Vag	3
Podicipedidae	*Podiceps cristatus*	Great crested grebe	P		Vag	4
Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed grebe	P		IV	4
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe	P		R	1
Columbidae	*Columba leucomela*	White-headed pigeon	P		IV	4
Columbidae	*Columba livia*	Rock dove	U		R	1
Columbidae	*Geopelia striata*	Peaceful dove	P		SU	2
Columbidae	*Lopholaimus antarcticus*	Topknot pigeon	P		IV	1
Columbidae	*Macropygia amboinensis*	Brown cuckoo-dove	P		IV	4
Columbidae	*Ocyphaps lophotes*	Crested pigeon	P		R	1
Columbidae	*Phaps elegans*	Brush bronzewing	P		SU	4
Columbidae	*Streptopelia chinensis*	Spotted dove	U		R	1
Podargidae	*Podargus strigoides*	Tawny frogmouth	P		R	1
Aegothelidae	*Aegotheles cristatus*	Australian owlet-nightjar	P		R	1
Apodidae	*Hirundapus caudacutus*	White-throated needletail	P	C,J,R	SM	4
Anhingidae	*Anhinga novaehollandiae*	Australasian darter	P		R	1
Phalacrocoracidae	*Microcarbo melanoleucos*	Little pied cormorant	P		R	1
Phalacrocoracidae	*Phalacrocorax carbo*	Great cormorant	P		R	1
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little black cormorant	P		R	1
Phalacrocoracidae	*Phalacrocorax varius*	Pied cormorant	P		R	1

Family	Scientific name	Common name	NSW legal status	Commonwealth legal status	Current status	Record source
Pelecanidae	*Pelecanus conspicillatus*	Australian pelican	P		R	1
Ardeidae	*Ardea modesta*	Eastern great egret	P	C,J	R	1
Ardeidae	*Ardea ibis*	Cattle egret	P	C,J	IV	4
Ardeidae	*Ardea intermedia*	Intermediate egret	P		IV	4
Ardeidae	*Ardea pacifica*	White-necked heron	P		IV	4
Ardeidae	*Botaurus poiciloptilus*	Australasian bittern	E,P	E	SU	4
Ardeidae	*Butorides striatus*	Striated heron	P		R	1
Ardeidae	*Egretta garzetta*	Little egret	P		R	1
Ardeidae	*Egretta novaehollandiae*	White-faced heron	P		R	1
Ardeidae	*Egretta sacra*	Black bittern	V,P		SU	1
Ardeidae	*Ixobrychus dubius*	Australian little bittern	P		Vag	4
Ardeidae	*Nycticorax caledonicus*	Nankeen night heron	P		R	1
Threskiornithidae	*Platalea flavipes*	Yellow-billed spoonbill	P		IV	4
Threskiornithidae	*Platalea regia*	Royal spoonbill	P		IV	1
Threskiornithidae	*Threskiornis molucca*	Australian white ibis	P		R	1
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked ibis	P		IV	4
Accipitridae	*Accipiter fasciatus*	Brown goshawk	P		R	1
Accipitridae	*Circus approximans*	Swamp harrier	P		IV	1
Accipitridae	*Haliaeetus leucogaster*	White-bellied sea-eagle	P	C	R	1
Accipitridae	*Haliastur sphenurus*	Whistling kite	P		R	1
Accipitridae	*Hieraaetus morphnoides*	Little eagle	V,P		IV	1
Accipitridae	*Pandion cristatus*	Eastern osprey	V,P		IV	1
Falconidae	*Falco cenchroides*	Nankeen kestrel	P		IV	1
Falconidae	*Falco longipennis*	Australian hobby	P		IV	1
Falconidae	*Falco peregrinus*	Peregrine falcon	P		SU	1
Rallidae	*Fulica atra*	Eurasian coot	P		R	1
Rallidae	*Gallinula tenebrosa*	Dusky moorhen	P		R	1
Rallidae	*Gallirallus philippensis*	Buff-banded rail	P		R	1
Rallidae	*Lewinia pectoralis*	Lewin's rail	P		SU	1

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Rallidae	*Pophyrio porphyrio*	Purple swamphen	P		R	1
Rallidae	*Porzana fluminea*	Australian spotted crake	P		IV	4
Rallidae	*Porzana pusilla*	Baillon's crake	P		IV	1
Rallidae	*Porzana tabuensis*	Spotless crake	P		SU	1
Recurvirostridae	*Himantopus himantopus*	Black-winged stilt	P		IV	1
Charadriidae	*Charadrius bicinctus*	Double-banded plover	P		Vag	2
Charadriidae	*Elseyornis melanops*	Black-fronted dotterel	P		IV	1
Charadriidae	*Vanellus miles*	Masked lapwing	P		R	1
Scolopacidae	*Calidris acuminata*	Sharp-tailed sandpiper	P	C,J,K	SU	1
Scolopacidae	*Gallinago hardwickii*	Latham's snipe	P	C,J,K	SU	1
Scolopacidae	*Tringa nebularia*	Common greenshank	P	C,J,K	SU	1
Turnicidae	*Turnix varius*	Painted button-quail	P		SU	4
Laridae	*Chroicocephalus novaehollandiae*	Silver gull	P		R	1
Laridae	*Hydroprogne caspia*	Caspian tern	P	C	IV	1
Cacatuidae	*Cacatua galerita*	Sulphur-crested cockatoo	P		R	1
Cacatuidae	*Cacatua sanguinea*	Little corella	P		R	1
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed black-cockatoo	P		R	1
Cacatuidae	*Calyptorhynchus lathami*	Glossy black-cockatoo	V,P		SU	4
Cacatuidae	*Eolophus roseicapillus*	Galah	P		R	1
Psittacidae	*Alisterus scapularis*	Australian king-parrot	P		R	1
Psittacidae	*Glossopsitta concinna*	Musk lorikeet	P		IV	1
Psittacidae	*Glossopsitta pusilla*	Little lorikeet	V,P		IV	1
Psittacidae	*Platycercus elegans*	Crimson rosella	P		R	1
Psittacidae	*Platycercus eximius*	Eastern rosella	P		R	1
Psittacidae	*Trichoglossus chlorolepidotus*	Scaly-breasted lorikeet	P		IV	4
Psittacidae	*Trichoglossus haematodus*	Rainbow lorikeet	P		R	1
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed cuckoo	P		SM	1
Cuculidae	*Cacomantis pallidus*	Pallid cuckoo	P		Vag	4

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Cuculidae	*Cacomantis variolosus*	Brush cuckoo	P		SM	4
Cuculidae	*Chalcites basalis*	Horsfield's bronze-cuckoo	P		SM	1
Cuculidae	*Chalcites lucidus*	Shining bronze-cuckoo	P		SM	1
Cuculidae	*Eudynamys orientalis*	Eastern koel	P		SM	1
Cuculidae	*Scythrops novaehollandiae*	Channel-billed cuckoo	P		SM	1
Strigidae	*Ninox novaeseelandiae*	Southern boobook	P		R	1
Strigidae	*Ninox strenua*	Powerful owl	V,P		R	1
Tytonidae	*Tyto tenebricosa*	Sooty owl	V,P		SU	1
Alcedinidae	*Ceyx azureus*	Azure kingfisher	P		IV	4
Halcyonidae	*Dacelo novaeguineae*	Laughing kookaburra	P		R	1
Halcyonidae	*Todiramphus sanctus*	Sacred kingfisher	P		SM	1
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		SM	1
Climacteridae	*Cormobates leucophaea*	White-throated treecreeper	P		R	1
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin bowerbird	P		SU	1
Maluridae	*Malurus cyaneus*	Superb fairy-wren	P		R	1
Maluridae	*Malurus lamberti*	Variegated fairy-wren	P		R	1
Maluridae	*Stipiturus malachurus*	Southern emu-wren	P		R	1
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped thornbill	P		SU	4
Acanthizidae	*Acanthiza lineata*	Striated thornbill	P		R	1
Acanthizidae	*Acanthiza nana*	Yellow thornbill	P		IV	4
Acanthizidae	*Acanthiza pusilla*	Brown thornbill	P		R	1
Acanthizidae	*Acanthiza reguloides*	Buff-rumped thornbill	P		SU	1
Acanthizidae	*Gerygone albogularis*	White-throated gerygone	P		IV	1
Acanthizidae	*Gerygone mouki*	Brown gerygone	P		SU	1
Acanthizidae	*Hylacola pyrrhopygia*	Chestnut-rumped heathwren	P		SU	1
Acanthizidae	*Origma solitaria*	Rockwarbler	P		R	1
Acanthizidae	*Sericornis frontalis*	White-browed scrubwren	P		R	1
Acanthizidae	*Smicrornis brevirostris*	Weebill	P		SU	4
Pardalotidae	*Pardalotus punctatus*	Spotted pardalote	P		R	1

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Pardalotidae	*Pardalotus striatus*	Striated pardalote	P		IV	3
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern spinebill	P		R	1
Meliphagidae	*Anthochaera carunculata*	Red wattlebird	P		R	1
Meliphagidae	*Anthochaera chrysoptera*	Little wattlebird	P		R	1
Meliphagidae	*Gliciphila melanops*	Tawny-crowned honeyeater	P		SU	1
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced honeyeater	P		R	1
Meliphagidae	*Lichenostomus fuscus*	Fuscous honeyeater	P		IV	1
Meliphagidae	*Lichenostomus leucotis*	White-eared honeyeater	P		R	1
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted honeyeater	P		IV	1
Meliphagidae	*Lichenostomus penicillatus*	White-plumed honeyeater	P		SU	2
Meliphagidae	*Lichmera indistincta*	Brown honeyeater	P		Vag	2
Meliphagidae	*Manorina melanocephala*	Noisy miner	P		R	1
Meliphagidae	*Manorina melanophrys*	Bell miner	P		Vag	3
Meliphagidae	*Meliphaga lewinii*	Lewin’s honeyeater	P		Vag	2
Meliphagidae	*Melithreptus brevirostris*	Brown-headed honeyeater	P		IV	1
Meliphagidae	*Melithreptus gularis gularis*	Black-chinned honeyeater (eastern subspecies)	V,P		SU	1
Meliphagidae	*Melithreptus lunatus*	White-naped honeyeater	P		IV	3
Meliphagidae	*Myzomela sanguinolenta*	Scarlet honeyeater	P		R	1
Meliphagidae	*Philemon corniculatus*	Noisy friarbird	P		R	1
Meliphagidae	*Phylidonyris niger*	White-cheeked honeyeater	P		SU	2
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland honeyeater	P		R	1
Meliphagidae	*Phylidonyris pyrrhopterus*	Crescent honeyeater	P		Vag	4
Psophodidae	*Psophodes olivaceus*	Eastern whipbird	P		R	1
Psophodidae	*Cinclosoma punctatum*	Spotted quail-thrush	P		SU	6
Neosittidae	*Daphoenositta chrysoptera*	Varied sittella	V,P		IV	1
Campephagidae	*Coracina novaehollandiae*	Black-faced cuckoo-shrike	P		R	1
Campephagidae	*Coracina papuensis*	White-bellied cuckoo-shrike	P		IV	4
Campephagidae	*Coracina tenuirostris*	Cicadabird	P		SM	4
Pachycephalidae	*Colluricincla harmonica*	Grey shrike-thrush	P		R	1

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Pachycephalidae	*Pachycephala pectoralis*	Golden whistler	P		R	1
Pachycephalidae	*Pachycephala rufiventris*	Rufous whistler	P		SM	1
Oriolidae	*Oriolus sagittatus*	Olive-backed oriole	P		IV	1
Oriolidae	*Sphecotheres vieilloti*	Australasian figbird	P		IV	1
Artamidae	*Artamus cyanopterus*	Dusky woodswallow	P		IV	1
Artamidae	*Artamus personatus*	Masked woodswallow	P		Vag	1
Artamidae	*Artamus superciliosus*	White-browed woodswallow	P		IV	1
Artamidae	*Cracticus tibicen*	Australian magpie	P		R	1
Artamidae	*Cracticus torquatus*	Grey butcherbird	P		R	1
Artamidae	*Strepera graculina*	Pied currawong	P		R	1
Dicruridae	*Dicrurus bracteatus*	Spangled drongo	P		IV	2
Rhipiduridae	*Rhipidura albiscapa*	Grey fantail	P		R	1
Rhipiduridae	*Rhipidura leucophrys*	Willie wagtail	P		R	1
Rhipiduridae	*Rhipidura rufifrons*	Rufous fantail	P		SM	1
Corvidae	*Corvus coronoides*	Australian raven	P		R	1
Monarchidae	*Grallina cyanoleuca*	Magpie-lark	P		R	1
Monarchidae	*Monarcha melanopsis*	Black-faced monarch	P		SM	2
Monarchidae	*Myiagra inquieta*	Restless flycatcher	P		IV	1
Monarchidae	*Myiagra rubecula*	Leaden flycatcher	P		SM	1
Petroicidae	*Eopsaltria australis*	Eastern yellow robin	P		R	1
Petroicidae	*Petroica boodang*	Scarlet robin	V,P		SU	4
Petroicidae	*Petroica rodinogaster*	Pink robin	V,P		Vag	2
Petroicidae	*Petroica rosea*	Rose robin	P		WM	1
Cisticolidae	*Cisticola exilis*	Golden-headed cisticola	P		IV	1
Acrocephalidae	*Acrocephalus australis*	Australian reed-warbler	P		SM	4
Megaluridae	*Megalurus gramineus*	Little grassbird	P		IV	1
Megaluridae	*Megalurus timoriensis*	Tawny grassbird	P		SU	1
Timaliidae	*Zosterops lateralis*	Silvereye	P		R	1
Hirundinidae	*Hirundo neoxena*	Welcome swallow	P		R	1

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Hirundinidae	*Petrochelidon ariel*	Fairy martin	P		SM	4
Hirundinidae	*Petrochelidon nigricans*	Tree martin	P		IV	4
Pycnonotidae	*Pycnonotus jocosus*	Red-whiskered bulbul	U		R	1
Turdidae	*Turdus merula*	Eurasian blackbird	U		SU	1
Turdidae	*Zoothera lunulata*	Bassian thrush	P		SU	4
Sturnidae	*Sturnus tristis*	Common myna	U		R	1
Sturnidae	*Sturnus vulgaris*	Common starling	U		IV	1
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird	P		R	1
Estrildidae	*Lonchura castaneothorax*	Chestnut-rumped mannikin	P		SU	4
Estrildidae	*Lonchura punctulata*	Nutmeg mannikin	U		SU	4
Estrildidae	*Neochmia temporalis*	Red-browed finch	P		R	1
Estrildidae	*Taeniopygia bichenovii*	Double-barred finch	P		SU	1
Passeridae	*Passer domesticus*	House sparrow	U		IV	4
Motacillidae	*Anthus novaeseelandiae*	Australian pipit	P		NR	2
Mammals						
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked echidna	P		R	1
Dasyuridae	*Antechinus stuartii*	Brown antechinus	P		R	1
Peramelidae	*Perameles nasuta*	Long-nosed bandicoot	P		R	1
Phascolarctidae	*Phascolarctos cinereus*	Koala	V,P	V	SU	1
Petauridae	*Petaurus breviceps*	Sugar glider	P		R	1
Pseudocheiridae	*Pseudocheirus peregrinus*	Common ringtail possum	P		R	1
Phalangeridae	*Trichosurus vulpecula*	Common brushtail possum	P		R	1
Macropodidae	*Wallabia bicolor*	Swamp wallaby	P		R	1
Pteropodidae	*Pteropus poliocephalus*	Grey-headed flying-fox	V,P	V	R	1
Molossidae	*Mormopterus* “species 2”	Eastern freetail-bat	P		R	1
Molossidae	*Tadarida australis*	White-striped freetail-bat	P		R	1
Vespertilionidae	*Chalinolobus gouldii*	Gould's wattled bat	P		R	1
Vespertilionidae	*Chalinolobus morio*	Chocolate wattled bat	P		R	1
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern bentwing-bat	V,P		R	1

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Vespertilionidae	*Nyctophilus geoffroyi*	Lesser long-eared bat	P		R	1
Vespertilionidae	*Nyctophilus gouldi*	Gould's long-eared bat	P		R	1
Vespertilionidae	*Scotorepens orion*	Eastern broad-nosed bat	P		R	1
Vespertilionidae	*Vespadelus vulturnus*	Little forest bat	P		R	1
Muridae	*Mus musculus*	House mouse	U		R	1
Muridae	*Rattus fuscipes*	Bush rat	P		R	1
Muridae	*Rattus lutreolus*	Swamp rat	P		R	1
Muridae	*Rattus rattus*	Black rat	U		R	1
Canidae	*Canis lupus familiaris*	Dog	U		SU	2
Canidae	*Vulpes vulpes*	Fox	U		R	1
Felidae	*Felis catus*	Cat	U		SU	1
Leporidae	*Oryctolagus cuniculus*	Rabbit	U		R	1
Leporidae	*Lepus capensis*	Brown hare	U		SU	2
Cervidae	*Cervus timorensis*	Rusa deer	U		R	1

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