



DRAFT

**Fauna Rehabilitation Plan
Middle Harbour Catchment Area
2003**

Fauna Rehabilitation Plan for Middle Harbour Catchment 2003

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Section 1- Introduction

1.1 Overview

The biodiversity of Australian native fauna has experienced a great loss since European settlement and North Sydney has been no exception. Indeed, Australia has the worst mammal extinction rate in the world over the last 200 years (NPWS Nature & Conservation, 2001). Prior to European settlement, North Sydney would have been home to around 21 species of mammals and many species of birds, frogs and reptiles. A fraction of this variety still survives today. In order to ensure the survival of these species into the future, management plans need to be implemented to protect native fauna habitat, populations and reduce the threats to native fauna.

North Sydney's landscape contains poor sandy soil that discouraged farming in the early days of settlement. Once covered in woodland, heath, open forest and tidal flats at the mouths of creeks, the opening of the Harbour Bridge in 1932 encouraged urban growth and the 1960's saw the start of high-rise and Central Business District growth (Benson & Howell, 1995). The high shale-topped ridges once supported a Blue Gum High Forest, of more than 30m in height. This forest has since been completely cleared. The sandstone foreshores, are more exposed than the harbour shores of Port Jackson Catchment, and are the only remnants of bushland left in Middle Harbour Catchment. This catchment supports a woodland and open forest community with fauna populations specific to this community. Tidal flats and water courses once present in Brightmore Reserve, Primrose Park and Tunks Park would have once supported an important variety of aquatic bird life and marine life. In the past these ecosystems were filled in with household and industrial rubbish to create playing fields.

Remnant bushland throughout Middle Harbour Catchment provides important habitat for the survival of remnant species of mammals, birds, frogs, reptiles and invertebrates. Effective fauna management requires knowledge of what species are present in the North Sydney area. This report has been compiled using results from findings and recommendations of a Fauna Survey of Middle Harbour Bushland Reserves in March - May 2002 by Biosphere Environmental Consultants (see **Section 3**), the Fauna of North Sydney Database (see **Section 3**), The Continuing Bird Survey Interim Report by Ekerlogic Consulting Services (see **Section 3**), and other first-hand observations from Council staff.

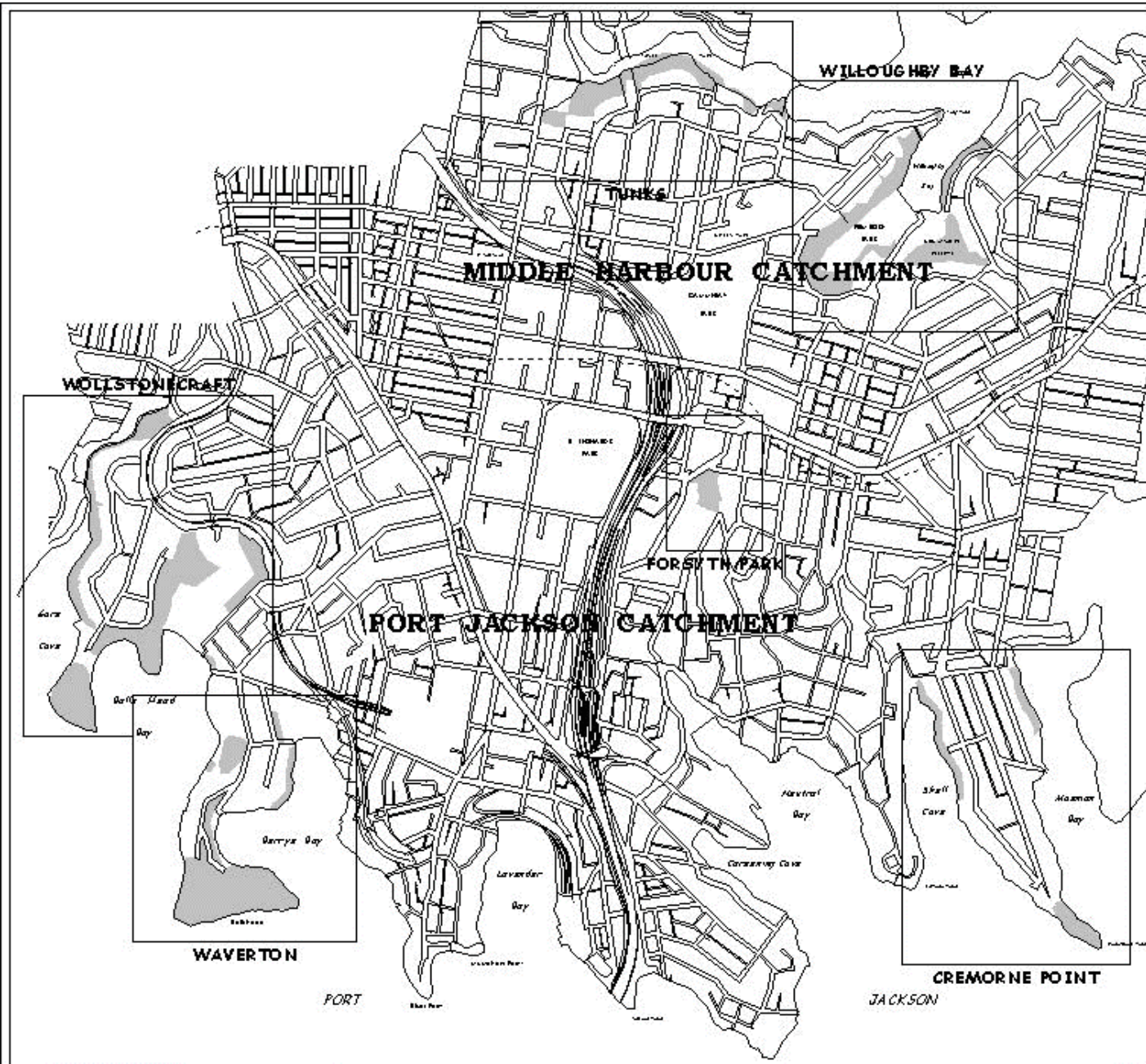
Biodiversity loss is largely a result of human impact. Significant vegetation clearing, followed by a range of impacts on isolated remnants of bushland, has placed immense pressure on surviving biota. In particular, native fauna suffers from a decline in quantity and quality of habitat (food and shelter), predation from domestic and feral animals and consequently increasing competition from other persisting aggressive species.

This report aims to address the impacts placed on native fauna. Recommendations have been made to reduce the pressures placed on native fauna, and management guidelines have been developed to ensure habitat is rehabilitated and protected. Management issues addressed in this report include: bush regeneration practices; community education; feral and feral animal control; creation of green corridors, detailed for each reserve; fire management; provision of

fresh water sources; definition of formal walking tracks; lighting; installation of nesting boxes; and installation of traffic calming devices.

The focus of these management plans is terrestrial vertebrate fauna and some aquatic avian fauna. The majority of aquatic and invertebrate fauna are not specifically dealt with in this report. However, management practices for native fauna addressed in this report will have positive impacts for aquatic and invertebrate fauna. The Fauna Rehabilitation Plan for Middle Harbour Catchment is designed to be used in conjunction with the Bushland Rehabilitation Plans for Middle Harbour Catchment (2001).

1.2 Location of Bushland reserves in Middle Harbour Catchment - refer to Map 1



REMNANT BUSHLAND
AREAS IN EACH
SUB-CATCHMENT

LEGEND

-  BUSHLAND
-  MAJOR CATCHMENT BOUNDARY



SCALE 1:15000

1.3 Aim Statement

- Protect and enhance habitat for all local native fauna biodiversity. This includes: migratory, visitor and residential native fauna in North Sydney's Middle Harbour Catchment.
- Implement management strategies that will help ensure the survival of native fauna in North Sydney's Middle Harbour Catchment into the future.
- Implement sustainable management practices that will maximise biodiversity in North Sydney's Middle Harbour Catchment.
- Create and protect critical habitat used by species that is of local significance in North Sydney's Middle Harbour Catchment.
- Reach a comparable solution to the differing needs of reserve use and native fauna.

1.4 Conservation Status of Native Fauna in Middle Harbour Catchment

1.4.1 Overview

Findings from the Fauna Survey (White, 2002) revealed that the diversity of fauna in the bushland reserves in Middle Harbour Catchment was neither diverse nor abundant. Many species that would have once been present in the past are absent from the reserves. The native animals that still persist in the bushland reserves do so despite a range of impacts on them and their habits.

The reserves in Middle Harbour Catchment are quite different from one another in topography and size. Tunks Park, Primrose Park and Brightmore Reserve contain large areas of reclaimed land. Where once mangrove and mud flat areas were, the land has been reclaimed and levelled at least one meter above the high water mark (White, 2002). Mortlock Reserve and Wonga Road, are not associated with reclaimed land but occupy narrow, steep sandstone valleys that overlook Middle Harbour.

Certain groups of animals are able to utilize the urban environment better than others and particular groups of animals are notably absent or greatly depleted. The two most poorly represented groups include:

1. Native terrestrial mammals, that appear to be eliminated from all reserves. No native rodents or terrestrial marsupials (such as the Brown Antechinus *Antechinus stuartii* recorded in the Gore Cove Track, Port Jackson Catchment) were recorded in the Fauna Survey (2002).
2. Frog species are also poorly represented. It Frog habitat however, is naturally low in the hillside woodland areas remnant in Middle Harbour Catchment. Generally, species that are more robust, gregarious and less specialised are able to still persist in Middle Harbours remnant bushland and urban environment.

More bird species are present in the reserves than any other animal form. However, bird diversity has been greatly modified by urban development and the limitation of the size of bushland areas. The same bird species are present in most of the reserves. In general, the medium-sized native birds that are strongly territorial and have a wide range of food types are well represented in the reserves. The smaller, insectivorous and more specialised bird species (in dietary and/or habitat requirements) are absent from most reserves (White, 2002; Ekert, 2002). Findings from Ekert (2002) recorded woodland birds as being the most abundant guild of birds, two times more abundant than the next highest guild, forest birds. The poorly represented guilds included the freshwater, coastal and ground seed eating birds, while the least represented are the introduced and marine species.

Some species have benefited from urbanisation, notably edge dwelling species that are able to utilize the urban environment. Some bird species are able to hunt insects from ovals and large lawn areas (eg. Willie Wagtails and Welcome Swallows). Some bird species have increased in population size due to availability of large quantities of nectar produced from ornamental flowers, such as Robyn Gordon Grevilleas (eg. Noisy Miners and Rainbow Lorikeets). Species that scavenge (Magpies, Currawongs, Silver Gulls and Australian Ravens) have adapted to food that the urban environment provides. Birds that feed on berries produced from exotic or weed trees/shrubs and native trees/shrubs dominating degraded bushland (eg. Currawongs) have also flourished in the urban environment. Some introduced species have also adapted well (eg. the Rock Dove – known previously as the Feral Pigeon, Indian Mynah, Red Fox, and Honey Bees). Exotic birds and mammals have been recorded by the Fauna Survey (2002) and Ekert (2002) and are frequently seen in each reserve. Species include the Domestic Cat, House Mouse, Black Rat and the Red Fox. Both the Red Fox and Domestic Cat were recorded during the spotlight surveys in the evening at Tunks Park and Primrose Park (White, 2002).

Despite the lack of diversity of fauna, some species are notable and significant. The insectivorous Large Bent-wing Bat, a species listed as Vulnerable on Schedule 2 under the *NSW Threatened Species Conservation Act 1995*, was first detected near Balls Head Reserve, Waverton in 1999. The Fauna Survey detected what appears to be a roost site in Brightmore Reserve, Cremorne. The bats were also recorded in neighbouring sites in Primrose Park and Wonga Road Reserve. The roosting site at Brightmore Reserve requires protection under the *NSW Threatened Species Conservation Act 1995*. A second species of insectivorous micro-bat, Gould's Wattle Bat, first recorded in the Fauna Survey of Port Jackson Catchment (White, 2001) in Smoothery Park, Wollstonecraft, was also recorded in Tunks Park, Cammeray. Grey-headed Flying-foxes were recorded feeding on Paper Bark trees or flying over each reserve. This species is also classified as a Vulnerable Species on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*.

Large numbers of Ringtail Possums and fewer numbers of Brushtail Possums were also detected in all reserves. Only one species of snake, the Golden Crown Snake (harmless to humans) was only recorded in one reserve in the Fauna Survey (2002), Primrose Park. The Common Tree Snake and Red-bellied Black Snake have been recorded in the Middle Harbour area in the Fauna of North Sydney Database. Eastern Water Dragons are frequently sighted basking in the sun along the creek lines in Tunks Park and Primrose Park.

Significant bird species have been frequently recorded throughout the area: Eastern Whipbird (Primrose Park), Eastern Yellow Robin (most reserves), Crimson Rosella (most reserves), Silvereeye (all reserves), Tawny Frogmouth (most reserves) and Superb Blue Fairy-wren persisting in most reserves. No owls were recorded in the Fauna Survey (2002), however, the Southern Boobook and Powerful Owl have been recorded in Middle Harbour Catchment in the Fauna of North Sydney Database. The Powerful Owl is listed as a Vulnerable Species on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*. Migratory birds such as the Channel-billed Cuckoo and common Koel have also been recorded on this database.

Middle Harbour provides important habitat along its shore for water birds. Birds of prey, such as the White-bellied Sea Eagle, Peregrine Falcon, Brown Goshawk, Crested Hawk and Black Kite have also been recorded in the area in the database. The Fauna Survey (2002) recorded sea birds for each reserve, such as the White-faced Heron, Little Black Cormorant, Little Pied Cormorant, Darter, Australian White Ibis and the Silver Gull. Pelicans are also frequently seen in Long Bay at Tunks Park. Primrose Park, Brightmore Reserve and Tunks Park still retain a creekline, albeit polluted and altered of its natural state. The creek line vegetation surrounding this, particularly in Primrose Parks provides habitat for birds such as the Sacred Kingfisher (migrant) and Azure Kingfisher (visitor) and Dollarbird (migrant).

The Fauna Survey (White, 2002), recorded Primrose Park to contain the highest biodiversity in the Middle Harbour Catchment (See Table 1.1), containing significantly more fauna, this was followed by Tunks Park. Tunks Park is significantly the largest reserve in North Sydney, however Primrose Park represents several different vegetation community types including dry and mesic woodland, despite heavily weed infested areas. This bushland is relatively narrow and degraded in places. Despite these disadvantages, the key factor to this reserve's high diversity of fauna that is important to note, is that it contains a wide variety of habitat through different vegetation communities and is connected to Brightmore Reserve, Wonga Road Bushland.

The Continuing Bird Survey Interim Report (Ekert, 2002) found that both Tunks Park and Primrose Park contained the highest number of bird species throughout North Sydney (see Table 1.2). These two reserves are also the largest reserves in North Sydney and Middle Harbour Catchment. By virtue of their relatively large size this may support a greater area of suitable habitat for bird species and therefore a diversity of bird species (Ekert, 2002). In contrast, Wonga Road Bushland, a narrow strip of bushland, bordered by Wonga Road and open lawn area, recorded the lowest number of bird species. These factors may contribute to the area not being able to support a high diversity of bird species.

A comprehensive list of all fauna species present in the North Sydney area, and their status can be found in **Section 3 – Appendix D Fauna of North Sydney Database**.

Table 1.1 Number of Animal Species Recorded in the Fauna Survey of Middle Harbour Bushland reserves (White, 2002)

| Fauna Group | Tunks Park | Mortlock Reserve | Primrose Park | Brightmore Reserve | Wonga Road Reserve |
|---------------------|------------|------------------|---------------|--------------------|--------------------|
| Terrestrial Mammals | 6(4) | 3(2) | 5(3) | 5(3) | 3(1) |
| Bats | 2 | 1 | 3 | 3 | 2 |
| Birds | 31(6) | 24(5) | 35(6) | 26(6) | 20(5) |
| Reptiles | 6 | 3 | 7 | 3 | 2 |
| Frogs | 2 | 1 | 2 | 1 | 1 |

NB. The number in brackets refers to the number of exotic species found.

Table 1.2 Reserves and Number of Bird Species Recorded in the Continuing Bird Survey Interim Report (Ekert, 2002)

| Bushland Reserve Location | Number of Species |
|---------------------------|-------------------|
| Primrose Park | 26 |
| Tunks Park | 26 |
| Balls Head | 16 |
| Smoothey Park /Gore Cove | 16 |
| Oyster Cove | 14 |
| Cremorne Point | 11 |
| Forsyth Park | 10 |
| Berry Island | 9 |
| Mortlock Reserve | 8 |
| Brightmore Reserve | 7 |
| Wonga Road | 4 |
| Grand Total | 43 |

1.4.2 The Importance of Native Fauna

A broad diversity of fauna is an important component for healthy ecosystem functioning. Different fauna species provide a range of ecosystem services, from pollination of plants, seed dispersal and subsequent promotion of plant diversity to litter decomposition and nutrient recycling. Invertebrates also play an important role in pollinating, dispersing seed and cycling organic matter. They also regulate pest outbreaks through predation (Buchanan, 1996).

The greater the diversity of vegetation and number of vegetation communities, the greater the habitat potential to support a diverse range of birds, mammals, insects and microfauna, and the less chance of outbreaks of disease and pests (Buchanan, 1996). The more diverse the vegetation and fauna habitat, the more self-regulatory and healthy the ecosystem will be. Forests provide essential life supporting services by providing erosion and salinity control,

sediment control for creeks and rivers, oxygen and pollution filters, medicines and textiles, as well as providing recreational, aesthetic and spiritual value. Native fauna is essential in creating and sustaining a healthy forest.

It can also be argued that individuals as well as society have an ethical obligation, as well as a legal obligation to conserve the natural environment and our natural heritage through preservation of biodiversity.

1.4.3 Relevant Legislation

1. NSW National Parks Wildlife Act, 1974

All native fauna are protected under the *NSW National Parks Wildlife Act, 1974*.

2. NSW Threatened Species Conservation Act, 1995

Species listed as threatened are protected under the *Threatened Species Conservation Act, 1995*. Species considered *Threatened* are classified as: vulnerable, endangered or presumed extinct. The *NSW Threatened Species Conservation Act* provides identification, conservation and recovery of threatened species and their populations and communities. It also aims to reduce the threats faced by those species.

North Sydney's Middle Harbour Catchment is known to contain one resident **Vulnerable Species** listed under the *Threatened Species Conservation Act, 1995*, and two **Vulnerable Species** visitors:

Resident

1. The Large Bent-wing Bat (*Miniopterus schreibersii*) listed as a **Vulnerable Species** on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*.

Visitors

1. The Powerful Owl (*Ninox strenua*) listed as a **Vulnerable Species** on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*.
2. The Grey-headed Flying-fox (*Pteropus poliocephalus*) listed as a **Vulnerable Species** on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*.

3. Environment Protection and Biodiversity Conservation Act, 1999

The Environment Protection and Biodiversity Conservation Act, 1999 lists currently 13 Key Threatening Processes to Australian flora and fauna. A process is defined as a Key Threatening Process if it threatens or may threaten the survival, abundance or evolutionary development of a native species or ecological community.

Up to six of these processes impact or have the potential to impact on the native flora and fauna of North Sydney and the Middle Harbour Catchment. These Key Threatening Processes are:

- Dieback caused by the root-rot fungus (*Phytophthora cinnamoni*)
- Infection of amphibians with chytrid fungus resulting in chytridiomycosis
- Land clearance
- Predation by feral Cats
- Predation by the European Red Fox (*Vulpes vulpes*)
- Psittacine Ciroviral (beak and feather) Disease affecting endangered psittacine (Parrots) species

4. Companion Animals Act, 1998

Section 14 (1) (h)

Wildlife protection areas (meaning any public place or any part of a public place set apart by the local authority for the protection of wildlife and in which the local authority has ordered that dogs are prohibited for the purposes of the protection of wildlife and in which, or near the boundaries of which, there are conspicuously exhibited by the local authority at reasonable intervals notices to the effect that dogs are prohibited in or on that public place).

Section (1) (b)

Wildlife protection areas (meaning any public place or any part of a public place set apart by the local authority for the protection of wildlife and in which the local authority ordered that cats are prohibited for the purposes of the protection of wildlife and in which, or near the boundaries of which, there are conspicuously exhibited by the local authority at reasonable intervals notices to the effect that cats are prohibited in or on that public place).

1.5 Habitat Requirements for Native Fauna

1.5.1 Overview

Important components of an ecosystem for fauna habitat are:

- Mature native hollow bearing trees
- Fallen timber (logs and branches)
- Rock crevices
- Caves
- Leaf litter (mulch)
- Permanent fresh water source
- Continuous canopy coverage
- Thick, dense middle-storey vegetation
- Understorey vegetation

1.5.2 Habitat Assessment

The bushland areas of Middle Harbour Catchment were assessed in the Fauna Survey (White, 2002) on the basis of thirteen habitat components. These components are important habitat criteria that will be addressed in Section 2 for each reserve.

1. Continuity of upper canopy
2. Presence of mid-canopy layer
3. Breadth of canopy cover
4. Density of ground cover
5. Presence and nature of shelter sites
6. Exposure to daylight
7. Exposure to wind
8. Presence of winter-flowering trees
9. Continuity of fringing vegetation along creek
10. Presence of still water sites
11. Presence of deep pools
12. Presence of seepage areas
13. Presence of flowering plants in ground cover

Table 1.3 Habitat Assessment of Middle Harbour Bushland Reserves (White, 2002)

| Component | Tunks Park | Mortlock Reserve | Primrose Park | Brightmore Reserve | Wonga Rd Reserve |
|---------------------------------|--|---|---|---|--|
| Upper Canopy | Continuous only in western section | Continuous | Continuous along western side | Continuous in south-east only | Thin and discontinuous |
| Mid-canopy | Present in western section only | Present around edges of reserve | Absent except for area near tennis courts and Willoughby Creek | Present around edges of reserve | Absent |
| Extent of Canopy Cover | Limited to western section | Upper half of reserve covered | Canopy along western and southern sides | Canopy along southern and south-eastern sides | Limited to strip alongside Wonga Road |
| Density of Ground Cover | Only dense areas in western section. | Intact in most of reserve | Ground cover reduced in most areas | Ground cover intact in south-eastern area | Ground cover sparse |
| Shelter Sites | Rock ledges, logs, hollows in western area | Hollows in higher parts, rock ledges near shoreline | Hollows in western and southern; rock ledges along Willoughby Creek | Hollows in south-eastern area | Few hollows, rock ledges |
| Exposure to Daylight | High except for western area | Reasonable protection | High except for along Willoughby Creek | High except for south-eastern area | High |
| Exposure to Wind | Western area protected | Protected from southerly winds | Some protection from southerly winds | Protected from southerly winds | Exposed to northern and westerly winds |
| Winter-flowering Trees | Absent except for small area in western section. | Absent | Few, widely spaced trees | Few trees | Absent |
| Continuity of Vegetation | Good continuity in western section | No continuity with creek vegetation | Restricted continuity with Willoughby Creek | No continuity with creek vegetation | None |
| Still Water Sites | Quarry Creek and Flat Rock Creek | None | Willoughby Creek | None | None |
| Deep Pools | None | None | None | None | None |
| Seepage Areas | Small areas in western and southern areas | Small areas near shoreline | Small areas near Willoughby Creek | Small area near stormwater canal | None |
| Flowering Ground Cover | Densest in western area, reduced elsewhere | Scattered throughout reserve | Limited to small areas along western and southern sides | Limited to small area in south-east | Limited to higher ledges |

1.5.3 Diversity

Diversity within habitats is the most important feature of nature conservation (Johnston & Don, 1990; Slater, 1994)). Most of the bushland reserves in the Middle Harbour Catchment predominately contain a single community being Hawkesbury Sandstone Open Forest/Woodland. The exception being, Brightmore Reserve and Primrose Park Bushland that contain remnant Closed Forest vegetation as indicated by Benson and Howell (1994).

Although weed species have a negative impact on bushland and degrade native habitat, some fauna species have adapted to utilising particular weed species, providing alternative and often essential habitat. For example, Lantana (*Lantana camara*) provides protective habitat for Ringtail Possums and Superb Blue Fairy-wrens; and reptiles utilise weedy ground cover.

1.5.4 Green Corridors

Narrow corridors and small remnant bushland reserves are likely to be dominated by 'edge' species. Many 'edge' bird species are large bodied which feed on the ground in surrounding areas and use corridor species for nesting and roosting (Hoye, 2000). 'Edge' bird species include: Australian Magpie, Noisy Miner, Kookaburra, Eastern Rosella and Magpie-lark (Hoye, 2000). Forest bird species include small insectivorous species that tend to not move across open spaces and are vulnerable to domination by larger more aggressive 'edge' species that are found in forest trees. Small insectivorous birds can live well in areas of shrub only (and no tall trees), despite gaps in the shrub layer (ie. not continuous).

Corridors may be effective for a particular species but completely ineffective or worse for other species (Hoye, 2000). A corridor 30m wide is dominated by the processes of the forest edge, typically dominated by the aggressive Noisy Miner with the exclusion of forest birds (Hoye, 2000). A corridor must be designed from the point of view from the fauna utilising the area.

Sharp edges and maximum contrast between clearing and bushland may cause serious losses of residual biological value due to abiotic (ie. wind) and biotic forces (ie. nest parasites, predation) (Hoye, 2000).

Small populations are at risk of: inbreeding depression, demographic uncertainty, environmental stochasticity, dysfunction of social behaviour and natural catastrophe (Wood, 1996).

1.5.5 Stormwater

Common Eastern Froglets, Striped Marsh Frogs, Water Skinks and Common Bent-wing Bats were all recorded in the Fauna Survey (White, 2002) in and around stormwater drains. Thus, indicating that that stormwater is an important fresh water source for fauna such as frogs, Water Skinks and the Bent-wing Bat. Natural fresh water sources are lacking in all reserves and stormwater outlets may be providing the only, albeit polluted, source of fresh water for native fauna that require fresh water for habitat.

Stormwater drains often contain polluted water from street run off. The 'Yellow Fish Road' project run through Council and the Environmental Protection Agency's *Living Thing* campaign aims at educating the community that 'the drain is just for rain'.

1.5.6 Creekline and Associated Closed Forest Vegetation

Creekline vegetation and mesic closed forest vegetation is important habitat for reptiles (such as the Eastern Water Dragon, Eastern Water Skink), amphibians (frogs) and birds, especially Doves and migratory birds such as Kingfishers and Dollarbirds. Rainforest mammals are locally extinct.

Streams and creeks are highly degraded in Middle Harbour Catchment due to past negligence and development decisions. Urban streams in fact have been modified by development in a way that favours exotic plants and certain native species (King & Buckney, 2000). The protection and re-establishment of creek line vegetation and associated forest communities is important to providing habitat for animals dependant on a freshwater source and associated habitat, and increasing the diversity of vegetation communities that increases species richness (Barrett *et al*, 1994).

Creekline vegetation and rainforest vegetation communities are often difficult and slow to re-establish due to the constant source of weeds and favourable conditions for weeds, erosion issues and slow growth of these species. Hence, these areas are often left until later in bush regeneration works. See **Section 2.1.8** *Creek Line and Rainforest Restoration*.

1.5.7 Habitat and Food Provided by Weed Species

Under modification and pressure native vegetation has been out-competed with exotic species. There is much evidence that supports exotic vegetation does provide habitat – food and shelter for native fauna and may now be important for survival of some populations. However, despite the habitat provided by this exotic vegetation, it ultimately does not support the diversity that native vegetation would (Ekert & Bucher, 1999; Loyn & French, 1991; Gosper, 1994). Thus, supporting that bush regeneration is essential for providing and re-creating habitat for native fauna, however care must be taken in removal of weed species that minimal habitat is removed.

An introduced plant can become important to a bird species if it provides more food or coverage at a particular place and time than the remaining native vegetation. Fruit and berries are often found in remnant bushland by weed species, such as Blackberry, Lantana, Camphor laurel and Privet and provide an important food source especially in winter (Loyn & French, 1991; Gosper, 1994). The Eastern Whipbird, a frugivore known to eat the fruit from exotic species, that does not travel far is only found in a heavily weed infested area of Lantana of Primrose Park.

One study has observed that native birds forage and perch more on native plants than exotic plants and artificial structures, while the opposite was true for exotic birds (Green, 1984). Birds of open woodland (the guild most represented in Middle Harbour Catchment) have been

observed as making more use of weeds than birds of forests, where weeds are usually less abundant (Loyn & French, 1991).

Exotic food sources alter the dynamics and dominance of populations. Studies show that Figbirds have been recorded to rely heavily on Camphor Laurel and Privet fruit as a food source during winter months when native fruit abundance is low (Gosper, 1994; Hackett, 1997). However, Figbirds are commonly found in flocks of up to 10-50 birds that enable these birds to occupy territories and exploit resources by displacing other frugivores (such as Silvereyes, native Pigeons and Doves) (Ekert & Bucher, 1999). Silvereyes have also been recorded eating the berries of Camphor laurel and Privet (Ekert & Bucher, 1999). Currawongs are discussed separately in **Section 1.6.9 Competition, Dominance and Aggressive Bird Species**.

Few if any nectivores utilise the flowers of Camphor laurel (Gosper, 1994). However, Rainbow Lorikeets have been observed relying heavily on the nectar from the introduced Coral Tree especially in winter months (Waterhouse, 1995).

Exotic plant species often provide the only source of cover for native birds to take shelter in from predators and roost and nest in (Loyn & French, 1991). Superb Blue Fairy-wrens are frequently seen only in patches of Lantana.

1.5.8 Seasonal Food Availability

Seasonal availability of fruit, seeds, nectar and insects affect the occurrence of bird species in an area (Slater, 1994), migration and breeding season for native fauna. An abundance of food is essential in breeding season. Residents often complain of possums eating their ornamental of fruit trees in spring, when possums are rearing their young. Winter is often a time of food shortage, and exotic trees such as Coral Trees, supply nectar for Rainbow Lorikeets (Waterhouse, 1995), while Camphor Laurel and Privet provide food for Currawongs, Silvereyes and Figbirds (Gosper, 1994; Hackett, 1997).

Different food trees (native and exotic) will be favoured by different fauna species. For example, in a study of Rainbow Lorikeets in southern Sydney (Waterhouse, 1995), observations were made of Rainbow Lorikeets favouring the blossoms of *Melaleuca quinquenervia* (Broad-leafed Paperbark), *Eucalyptus pilularis* (Blackbutt), *Banksia serrata* (Old Man Banksia) and the seed of *Casuarina* spp. (She Oak). However, despite bloom, they did not favour flowers on *Callistemon* spp. (Bottle Brush) or *Angphora costata* (Sydney Red Gum).

It is important that Bush Regeneration work recreates a diversity of plant species that provide food such as berries and nectar in spring, summer, autumn and winter. See **Table 1.4 Flowering and Fruiting Times of Native Trees and Shrubs**, for an overview of plants of Middle Harbour Catchment and their flowering and fruiting times. It is recommended that an array of plants that flower and fruit at different times be used in revegetation. Seasonal weather variations will also affect flowering and fruiting times.

Table 1. 4 Flowering and Fruiting Times of Native Trees and Shrubs (ref. Robinson, 1991)

| Plant | Season | | | |
|-----------------------------------|--------|---------|--------|--------|
| | Spring | Summer | Autumn | Winter |
| <i>Acacia linifolia</i> | | X | X | |
| <i>Acacia longifolia</i> | X | | | X |
| <i>Acacia terminalis</i> | | Late | | X |
| <i>Acacia ulicifolia</i> | | | X | X |
| <i>Acacia suaveolens</i> | | | X | |
| <i>Acacia binervia</i> | X | | | |
| <i>Melaleuca quinquenervia</i> | | | X | |
| <i>Polyscias sambucifolia</i> | | X | Y | |
| <i>Ozothamnus diosmifolius</i> | X | | | |
| <i>Pandorea pandorana</i> | X | | | |
| <i>Callicoma serratifolia</i> | X | | | |
| <i>Ceratopetalum apetalum</i> | | Nov | | |
| <i>Ceratopetalum gummeriferum</i> | | Nov | | |
| <i>Hibbertia dentata</i> | X | Early | | |
| <i>Elaeocarpus reticulatus</i> | X | X | Y | Y |
| <i>Platylobium formosum</i> | X | | | |
| <i>Ficus rubignosa</i> | | Feb - | Y | Y |
| <i>Rapanea variabilis</i> | X | | | |
| <i>Acmena smithii</i> | | X | Y | Y |
| <i>Angphora costata</i> | Oct - | - Jan | | |
| <i>Corymbia gummifera</i> | | Late - | X | |
| <i>Eucalyptus pilularis</i> | | Early | | |
| <i>Eucalyptus piperita</i> | | Early | | |
| <i>Eucalyptus resinifera</i> | Nov - | - Jan | | |
| <i>Eucalyptus sieberi</i> | X | - Dec | | |
| <i>Kunzea ambigua</i> | X | - Early | | |
| <i>Leptospermum trinervium</i> | X | | | |
| <i>Syncarpia glomulifera</i> | Oct | | | |
| <i>Tristaniopsis laurina</i> | | X | | |
| <i>Pittosporum undulatum</i> | X | Y | | |
| <i>Pittosporum revolutum</i> | X | Y | | |
| <i>Banksia ericifolia</i> | | | X | X |
| <i>Banksia integrifolia</i> | | X | X | Mainly |
| <i>Banksia serrata</i> | | X | | |
| <i>Banksia spinulosa</i> | | | X | X |
| <i>Grevillea linearifolia</i> | X | | | X |
| <i>Grevillea buxifolia</i> | X | | | Aug - |
| <i>Grevillea sericea</i> | X | | | July - |
| <i>Hakea dactyloides</i> | X | | | |
| <i>Hakea sericea</i> | - Sept | | | X |
| <i>Lambertia formosa</i> | X | X | X | |

| Plant | Season | | | |
|----------------------------|--------|--------|--------|--------|
| | Spring | Summer | Autumn | Winter |
| <i>Persoonia levis</i> | X | | | |
| <i>Persoonia linearis</i> | | X | X | - July |
| <i>Persoonia pinifolia</i> | | | X | |
| <i>Crowea saligna</i> | | X | X | - June |
| <i>Dodonea triquetra</i> | Y | Y | | |

KEY

X – Flowering

Y – Berry/ Fruit

1.5.9 The Importance of Different Vegetation Communities and Community Structure

Most of Sydney lies on sandstone and shale. These sedimentary rock types give rise to very different landforms and soils, each providing very different growing conditions for plants and plant communities (Benson & Howell, 2000). Different plants and plant communities (such as woodland, heath, open forest, closed forest) support different fauna populations. Certain species are characteristic of different plant communities and ‘edges’.

Middle Harbour Catchments’ remnant bushland is predominately sandstone woodland, with pockets of open forest and areas of mesic closed forest in Primrose Park and Tunks Park. Due to the size and shape of reserves, all reserves are considered as being affected by ‘edge effect’ and characteristic of edge species that include the Noisy Miner, Pied Butcherbird, Currawong and Magpie (Catterall *et al*, 1991). These birds are territorial and aggressive.

Bird species show a clear division in habitat use between woodland, open forest and closed forest (Slater, 1994). Studies have shown that tall open forest with a rainforest understorey supports the largest number of avian species because both open and closed forest species are present (Slater 1994). Woodland produces more nectar-producing plants that support nectivores; closed forests support more berry producing plants, that provide food for frugivores; and understorey vegetation supports invertebrates that supply food for insectivorous birds (Slater, 1994).

Floristic diversity is an important factor in the control of bird species diversity (Slater, 1994) and other fauna diversity. Vegetation diversity, density and structure and the types of plants in the understorey contribute to the pattern and composition of bird communities (Slater, 1994). In providing habitat for native fauna of Middle Harbour Catchment it is important to encourage the regeneration of a diversity of flora and enhancement of the different vegetation communities, as different species will favour different communities and some will favour the transition zones.

1.5.10 Middle and Understorey Vegetation

A dense shrubby understorey and middle storey is essential for many species of birds, reptiles and mammals (Wood, 1996; White, 2002; Barrett *et al*, 1994). Lack of fire and further degradation of bushland areas has resulted in loss of middle and understorey vegetation, accompanying the loss of many bird and reptile species.

A denser understorey, is reflected by richer avifauna (Slater, 1994). Many small insectivorous birds (such as the: Superb Blue Fairy-wren, Silver-eye, White-browed Scrub-wren, Robin, Thornbill, Eastern Whipbird, and Satin Bowerbird) require habitat created by the structure of dense middle and understorey vegetation for shelter, food and nesting. Many plants of a closed understorey produce fruits for frugivore birds (Slater, 1994).

Ringtail Possums make their dreys (nest) in thick shrubby midstorey vegetation.

Reptiles, such as snakes, lizards and skinks require a ground cover of native grasses, sedges, logs, rocks and leaf litter for shelter and habitat.

1.5.11 Importance of Remnant Bushland Reserves and Habitat Provided by the Urban Environment

Remnant areas of bushland are important for the survival of native fauna. Despite pressures placed on populations associated with remnant areas, survey results (White, 2002; Ekert, 2002; Fauna of North Sydney Database 2003) confirm a variety of bird, mammal, reptile and amphibian species that continue to survive in Middle Harbour Catchment. Brightmore Reserve is also home to the roosting site of the Common Bent-wing Bat, a Vulnerable Species on Schedule 2 of the *NSW Threatened Species Conservation Act, 1995*. Protection and enhancement of bushland habitat will ensure the survival and growth in population and diversity of native fauna.

Different areas of the urban environment and the interface with bushland are also important and utilised by native fauna able to adapt to the urban environment. Such areas include spaces that provide nesting sites and easy access to food and flying insects: ovals and large lawn areas (Magpies, Willie Wagtails, Welcome Swallows); tall trees next to clearings (the migratory Dollarbird), ornamental flowers and gardens (Noisy Miners, Rainbow Lorikeets); roof cavities (Brush-tail and Ringtail Possums); street lighting (Tawny Frogmouth Owls); gardens (skinks, lizards, butterflies). These components of the urban environment and land use adjoining bushland should be enhanced for continuing to support and provide habitat for native fauna.

Dead trees provide vantage points for many bird species who like to perch at the top and search for food below, for example: Dollarbirds and Raptors. Fallen limbs and dead branches also give rise to the creation of hollows used as nests and for breeding by bird and mammal species. Rocks, caves, disused buildings and stormwater drains provide roosting sites for owls and micro-bats.

The aim of understanding native fauna populations remaining in Middle Harbour Catchment is to maintain local species richness (Barrett *et al*, 1996).

1.5.12 Interaction between Ants and Plants

Ants help ecosystem functioning by carrying out seed dispersal. Some plant species encourage ants, by enticing them with oil-rich food attached to their seed, to help them disperse their seed. Ants of particular species carry the seed back to their nest, where they eat the food body and discard the rest of the seed, either underground or in the 'rubbish heap' outside. Plants with ant attracting food bodies on their seeds occur most commonly in woodland and heath on sandstone, as found in Middle Harbour Catchment. These plants include pes and wattles such as: *Zieria* spp., *Grevillea* spp., *Hibbertia* spp. and *Lomandra* spp. Fire is then often required to stimulate germination of the soil-stored seed (Benson & Howell, 2000).

1.5.13 Specific Habitat Requirements for Significant Species

BIRDS

Small Insectivorous Birds

Eg. White-browed Scrub-wren *Sericornis frontalis*
Superb Blue Fairy-wren *Malurus cyaneus*

- Require shelter from dense middle and understorey of shrubs, grasses and ground covers (Bakewell, 2001) to provide protection from aggressive larger birds.
- Make nests in the shrub layer.
- Eat insects that are attracted to insect attracting shrubs (Ondinea, 1997) (see **Section 3 Wildlife Habitat Plants of North Sydney**).

Kingfishers FAMILY ALCEDINIDAE

Laughing Kookaburra *Dacelo novaeguineae*

- Sedentary birds that occupy the same territory year after year.
- Live in woodlands and open forest.
- Diet consists of: lizards, snakes, insects, rodents and the odd small bird (Reader's Digest, 1993).
- Nest in a large cavity, either a tree hollow or branch, or a termite mound. Have been known to nest in possum boxes also.

Sacred Kingfisher (Winter) *Todiramphus sactus*

- Some, not all will migrate after breeding season in winter to islands north of Australia
- Excavate a nesting hollow using their beak and claw.
- Feed on small reptiles, crickets, grass hoppers, beetles, larvae and when near water fish and crustaceans.
- Perch on small, bare, fairly low branches (Readers Digest, 1993)

Chowchillas, Quail-thrushes and Allies FAMILY ORTHONYCHIDAE

Eastern Whipbird *Psophodes olivaceus*

- Occupy habitat in wet gully forests of coastal eastern Australia.
- The male and female whipbird together make the antiphonally whipcrack call, this signals territory and the callers position.
- Each partner forages up to 30 metres apart in dense forest underbrush.
- Establish permanent territories of about 5 – 10 hectares.
- Feed actively on the litter of the forest floor (Readers Digest, 1993).

Parrots FAMILY PSITTACIDAE

All require tree hollows for nesting.

Rainbow Lorikeet *Trichoglossus haematodus*

- Harvest nectar and pollen and associated insects and fruit on the occasion (Reader's Digest, 1993) from flowers such as *Eucalypt*, *Angophora*, *Grevillea*, *Melaleuca*, *Callistemon* and *Banksia* blossoms.
- Gregarious birds that flock in groups of two to fifty and roost in groups up to several hundred (Reader's Digest, 1993).

Australian King Parrot *Alisterus scapularis*

- King parrots feed on seed, berries, fruits, nuts, nectar, blossoms and leaf buds, from *Eucalypt*, *Acacia* trees and rainforest trees.
- Common in heavily timbered and rainforest areas.
- Require creeklines as water source.
- Require hollows in trees to nest. May utilize appropriate nesting boxes.

Crimson Rosella *Platycercus elagans*

- Live along the edges of tall timbered Eucalypt forests and woodlands.
- Essentially eat seed and fruit of *Eucalypt*, *Casuarina*, native shrubs, grasses and weed species (Reader's Digest, 1993).

Yellow-tailed Black Cockatoo *Calyptorhynchus funereus*

- Fly up and down the coast and between ranges in search of food.
- Feed on seeds of introduced Conifer trees and *Banksia*, *Hakea*, Pine trees and wood-boring larvae in *Eucalypt* and *Acacia* trees (Reader's Digest, 1993).
- Nest in hollows high above the ground (Reader's Digest, 1993).

Doves FAMILY COLUMBIDAE

Peaceful Dove *Geopelia placida*

- Relative to the Diamond Dove (*Geopelia cuneata*) and Bar-shouldered Dove (*Geopelia humeralis*) that often co-exist together.
- Nomadic birds
- Eat seeds from a wide variety of grasses, herbs and shrubs from areas on road sides, dusty places and burnt areas.
- Habitat found in well-grassed woodland with water source nearby (Readers Digest, 1993).

White-headed Pigeon *Columba leucomela*

- Nomads that live of rainforest vegetation in the lower stories.
- Eat the berries of native laurels as well as Camphor Laurel, when native rainforest vegetation is lacking.
- Among the wariest and most secretive of rainforest birds.

Crested Pigeon *Geophaps lophotes*

- Originally inhabited west of the Great Dividing Range
- Able to utilize lightly wooded areas and grasslands lacking dense vegetation.
- Ground-feeders and seed-feeders (Readers Digest, 1993).

Water Birds

White-faced Heron *Ardea novaehollandiae*

- Generalist feeders and habitat requirements
- Forage in intertidal mud flats, rock pools and residential lawns
- Prey is varied, mostly crustaceans, squid, fish, insects, amphibians, worms, spiders and snails (Readers Digest, 1993).

Little Pied Cormorant *Phalacrocorax melanoleucos*

- Mix with the Little Black Cormorant.
- Visit almost any body of water that is plentiful in food.
- Feed predominately on crustaceans and some fish.

- Breeds in colonies in spring and summer in a nest in trees lining rivers, swamps and ephemeral swamps (Readers Digest, 1993).

Little Black Cormorant *Phalacrocorax sulcirostris*

- Mix with the Great and Little Pied Cormorant.
- Frequent coastal estuaries and quite marine inlets.
- Feed on a greater variety of prey than the Little Pied Cormorant, mainly fish.
- Breeds mainly in Spring – Autumn depending on food supply, in a nest in a tree or bush often in the same tree as the Little Pied Cormorant and Darter (Readers Digest, 1993).

Australian Pelican *Pelecanus conspicillatus*

- Dive for fish in shallow water and also feed on crustaceans.
- Breed on lakes or swamps, fresh or briny (Readers Digest, 1993).

Darter *Anhinga melanogaster*

- Frequent smooth fresh or salty riverine waters and lakes inland from the coast for feeding.
- Feed on insects, fish and tortoise.
- Breeds mainly in spring and summer (although can be any month of the year), in a nest in a tree above the water (Readers Digest, 1993).

Owls FAMILY STRIGIDAE

Barn Owl *Tyto alba*

- Nomadic birds.
- Feed primarily on the House Mouse (Reader's Digest, 1993).
- Live in open wooded country.
- Roost in the day in tree hollows, thickly foliated trees, caves, rock crevices, buildings and wells (Reader's Digest, 1993).

Powerful Owl *Ninox strenua*

- Keep large permanent territories (Reader's Digest, 1993). Population density is kept naturally low (Greenyer, 1999).
- Roost by day in tall forest trees.
- Preys on birds and medium sized arboreal mammals, especially the Ringtail possum (Reader's Digest, 1993).

Nocturnal Birds

White-throated Nightjar *Camprimulgus mystacalis*

- Live in Eucalypt forests and camouflage themselves on the ground during the day in dry dense leaf litter with few plants growing close to the ground (Reader's Digest, 1993).
- Hunt during the night for nocturnal insects, such as moths and flying beetles (Reader's Digest, 1993).
- Local birds that breed in the same few hectares year after year (Reader's Digest, 1993).

Tawny Frogmouth *Podargus strigoides*

- Sedentary birds living in the same area year after year.
- Hunt during the evening for nocturnal insects, spiders and myriapods (centipedes, millipedes).
- Nest on a horizontal fork of a tree 3-15 metres above the ground (Reader's Digest, 1993).

Migratory and Nomadic Birds

Common Koel (Winter) *Eudynamys scolopacea*

- Migrate from Indonesia arriving in September to October (Reader's Digest, 1993).
- Live in dense pockets of *Eucalypt* trees and rainforest.
- Parasitises other species' nests and lay their eggs in species that have similar sized eggs, such as: Red Wattlebirds, Figbirds and Magpie-larks (Reader's Digest, 1993).

Channel-billed Cuckoo (Summer) *Scythrops novaehollandiae*

- Migrates south from Papua-Asia in August-October to breed.
- Parasitises other species' nests to lay their eggs in, including the Magpie-lark, Magpie, Currawong and Raven (Reader's Digest, 1993). These birds then raise the chick as their own.
- Eat fruits and berries, particularly figs. Occasionally eat eggs, chicks and insects.

Dollarbird (Spring) *Eurystomus orientalis*

- Migrates from New Guinea to Australia in Spring to breed.
- Nest in hollows in tall trees.
- Perch on top-most bare branches of tall trees beside clearings.
- Eat insects on the wing (Reader's Digest 1993).

Spotted Pardalote (Winter) *Pardalotus punctatus*

- Feeds on lerps, manna and insects on the foliage of Eucalypt trees
- Migrate in winter months for warmer areas. Return to breed.

- Nest in terrestrial burrows excavated in low banks or walls, often on the banks of creeks.
- Forages from the ground through to the mid and canopy levels. Not restricted to mature forests, as they do not nest in hollows (Readers Digest 1993).

Silvereye (Summer) *Zosterops lateralis*

- Require shelter and foraging habitat from the shrubbery vegetation layer in varying types of forest.
- Migrate and disperse after breeding in summer from Tasmania and southern Victoria.
- Glean over leaves and twigs for insects – beetles, bugs, wasps, flies and aphids; visit flowering plants for nectar and seeds; and pick at fruit.
- Generally feed in small flocks (Readers Digest, 1993).

MAMMALS

Require:

- Tree hollows,
- Connecting canopy coverage,
- Dense native middle and understorey vegetation.

Brown Antechinus *Antechinus stuartii*

- Thick ground cover and abundant logs (Braithwaite, 1995).
- Live in forests or scrub with dense ground cover, sleeping during the day in burrows under rocks or logs (Ondinea, 1997).
- Feed at night on stems, bark, leaves, pollen, flowers, fruits, seed and fungi, as well as earthworms, insects and their larvae (Ondinea, 1997).

Ringtail Possum *Pseudecheirus peregrinus*

- Live in a variety of forest and woodland habitats, often in suburban gardens.
- Make nests (drey) of leaves, twigs, ferns in dense middle-storey shrubs (such as Lantana and *Kunzea*), or on a branch or tree hollow. Will commonly utilize Possum boxes, and occasionally live in roofs.
- Diet consists predominately of *Eucalypt* leaves (McKay & Ong, 1995; White, *pers.com.*) but will also make use of introduced plant species; flowers and fruits.

Brushtail Possum *Trichosurus vulpecular*

- Live in variety of forest and woodland habitats, frequently in the suburban garden.
- Nest in tree hollows and roofs, but also in a fallen log, rock cavity or a hollowed termite mound (Strahan, 1995).
- Found to feed mainly outside of bushland reserves, rather in gardens (White, *pers.com.*).

- Feed predominately on leaves, succulent shoots, flowers, fruit, buds, bark of native and cultivated shrubs and trees. Very occasionally may eat meat in the wild (How & Kerle, 1995; Ondinea, 1997)

Insectivorous Micro-bats

Eg. Gould's Wattle Bat *Chalinolobus gouldii*

Large Bent-wing Bat *Miniopterus schreibersii*

- Use echo-location to locate insects near the tops of trees (Bakewell, 2001).
- Diet consists of insects, primarily moths (Hoye, 2000).
- Roost in tree hollows, under bark, in caves, stormwater culverts, buildings, roofs, old mines (Hoye, 2000; Ondinea, 1997).
- Found in forested areas where small insects can be foraged above tree canopy (Dwyer, 1995).

Grey-headed Flying-fox *Pteropus poliocephalus*

- Common in rainforest and wet Eucalypt forest with a relatively dense canopy.
- Commute daily to foraging areas, usually within 15 kilometres of the day roost, a few individuals may travel up to 50 kilometres in an evening.
- Roost in gullies, usually close to water and in vegetation with a dense canopy (Tidemann, 1995).
- Feed nocturnally on rainforest fruits (Figs and Palms) and nectar and pollen from *Eucalypts*, *Turpentine*, *Leptospermum*, *Banksia* and *Callistemon*, and are probably important pollinators of these trees (Ondinea, 1997; Tidemann, 1995). Found in the several sites in the Fauna Survey (Biosphere 2002) to be feeding on Paper Bark *Meleleuca* trees.
- Responsible for the seed dispersal of many rainforest and other *Eucalypt*, *Angophora*, *Leptospermum* and *Banksia* trees (Tidemann, 1995).

AMPHIBIANS

Frogs

- Require moist understorey and ground cover near clean water.
- Live around logs, rocks and bark for shelter.
- Eat insects, snails, worms, spiders, small lizards and other frogs.

Eg. Brown Striped Marsh Frog *Limnodynastes peronii*

Common Eastern Froglet *Crinia signifera*

- Live in most freshwater environments including: fish ponds, ornamental ponds, sheltering under logs, rocks or leaf litter during the day (Ondinea, 1997).

REPTILES

- Thick understorey of grasses, mulch, logs, rocks, leaf litter and shrubs to provide protection from predators.
- Large bare rocks and logs for basking in the sun.

Eastern Water Dragon *Physignathus lesueuri*

- Live near fresh water, such as: creeks, rivers, foreshores, fish ponds, ornamental ponds and swimming pools. Often use overhanging branches (Ondinea, 1997).
- Eat small reptiles, frogs, insects, flowers, fruit, snails, worms, small mammals and some vegetation (Ondinea, 1997).

Geckoes

Eg. Southern Leaf-tail Gecko *Phyllurus platurus*

- Shelter beneath small rocks, in rock crevices, in caves and under logs. Also found in garages.
- Nocturnal reptiles.
- Eat insects and other invertebrates.

Skinks

| | |
|--------------------------------|--------------------------------|
| Eg. <u>Eastern Water Skink</u> | <i>Eulamprus quoyii</i> |
| <u>Grass Skink</u> | <i>Lampropholis guichenoti</i> |
| <u>Delicate Skink</u> | <i>Lampropholis delicata</i> |
| <u>Weasel Skink</u> | <i>Saproscincus mustelina</i> |

- Live in and around tree trunks, rocks, logs, ground litter, low cover near basking sites, concrete paths, fences and walls (Ondinea, 1997).
- Eat small insects.

Eastern Blue-tongued Lizard *Tiliqua scinoides*

- Live in rock crevices, hollows, animal burrows, under fallen timber, in drain-pipes, under concrete and in old brick and stonework (Ondinea, 1997).
- Eat snails, insects, fruit, flowers and carrion.

Golden-crowned Snake *Cacophis squamulosus*

- A secretive, nocturnal snake that shelters during the day under stones, logs and leaf-litter.
- Venomous, although not dangerous to humans.
- Abundant in sandstone areas in the south.
- Feeds mainly on small skinks (Cogger, 1996).

Common Tree Snake *Dendrelaphis punctulata*

- Live in trees or shrubs, and forage on the ground for food.
- Diet consists of: frogs and birds, and some reptiles and small mammals.
- Shelter in tree hollows, under rocks, in crevices and caves, or even in houses (Cogger, 1996).

FISH AND AQUATIC FAUNA

- Require clear, unpolluted water. Some species are more sensitive to pollutants than others. Macro-invertebrates can be used as indicators for testing water pollution levels.
- Habitat requirements include: rocks, logs, and aquatic vegetation, bank vegetation (including mangroves), intertidal areas (such as mudflats), pools, riffles and backwaters, and bank stability to provide shelter, shade, foraging and breeding site (Ondinea, 1997).
- Food requirements include: aquatic and terrestrial insects, crustaceans, molluscs, plankton, algae and other aquatic plants, fish (Ondinea, 1997).

INSECTS AND OTHER INVERTEBRATES

- Appropriate habitat and host species to complete entire life cycle.
- Invertebrates rapidly respond to environmental change.
- Ecologically important for the functioning of an ecosystem.
- Useful as bio-indicators to monitor the health and/or pollution/disturbance of an ecosystem (Pik, 2000).
- Invertebrates have been found to favour native plants with resting stages (egg masses and pupae), lerps and scales occurring more frequently on native than exotic plants (Green *et al* 1989).

1.6 Threatening Processes

1.6.1 Overview

Threatening Processes to native fauna include:

- Lack of bushland area
- Habitat loss and destruction
- Isolation of bushland reserves
- Loss of ground cover
- Lack of middle-storey vegetation
- Disruption of canopy
- Predation from feral animals, namely the Red Fox
- Lack of hollows and competition for nesting hollows
- Dominance and aggressive bird species, such as: Currawongs, Noisy Miners
- Predation by domestic animals, especially the cat
- Disturbance from dogs and their scent
- Threats from other introduced fauna species
- Street and house lighting
- Disturbance from noise, movement and pedestrian traffic
- Weed invasion
- Insecticides, poisons (ie pesticides accumulating in the food chain) including rat poison, Pollution
- Diseases in populations

1.6.2 Lack of Bushland Area

The small amounts of bushland area means that only a small percentage of habitat remaining can only support a corresponding small percentage of species and their populations. The remaining bushland areas suffer from edge effect, weed invasion, loss of native vegetation and other associated impacts. Small bushland areas often can only support faunal species that are generalist feeders and generalists in habitat requirement.

1.6.3 Habitat Loss and Destruction

The loss of habitat is the overall riding factor in loss of native fauna diversity. Habitat destruction is continuing through cleaning up of dead branches, removal of bush rock, lawn mowing and poor bush regeneration practices eg. over-clearing. Land clearing is listed as a key threatening process under the *Environment Protection and Biodiversity Conservation Act 1999*. Dead wood and dead trees provide important habitat for native fauna. Dead wood and branches provide habitat for lizards, frogs, ground mammals and invertebrate fauna. Fungi, bacteria and invertebrate organisms breakdown the dead wood, recycling the nutrients back into the soil and ecosystem. Bush rock also provides important habitat for lizards and snakes.

Removal of Exotic Trees and Bush Regeneration Works

Introduced plants often become substitute habitat for native fauna, providing food, transport routes and shelter for birds, mammals and reptiles (see **Section 1.5.5 Habitat and Food Provided by Weeds**). Removal and over clearing of these tree and shrub weed species causes further loss in habitat and places fauna risk from exposure and lack of shelter, loss of safe transportation routes and loss of food.

Coral Trees provide a reliable supply of food for Rainbow Lorikeets; Privet and Camphor Laurel provide fruit for frugivore birds. Date Palms provide nesting sites for Ringtail Possums and Rainbow Lorikeets; Lantana provides critical habitat and shelter for the Superb Blue Fairy-wren and Eastern Whipbird (in Primrose Park), and *Pittosporum undulatum* provides a sheltered Middle Storey.

Dieback

Dieback of *Eucalypt* spp. and *Angophora Costata* trees can be caused by several factors relating to an altered and unhealthy ecosystem. Angophora dieback was first observed occurring at Cremorne Point, Port Jackson Catchment. In September 2001 funding was obtained from Coastcare to research the disease and involve the community in restoration of the community in the 'Protection and Rehabilitation of the Sydney Red Gums at Cremorne Point'. The dieback was positively identified as being caused by the soil pathogen *Phytophthora cinnamomi*. Dieback, presumably also due to *Phytophthora*, is also occurring in areas in Primrose Park.

Phytophthora cinnamomi has recently been declared by the NSW National Parks and Wildlife Service as a Key Threatening Process. Research is being undertaken by The Royal Botanic Gardens into the disease and ways to stop the spread of the pathogen and mitigate its threat. It appears that stormwater is a key factor in the presence of the pathogen.

Dieback of Eucalypts and loss of understorey vegetation, common in fragmented and degraded landscapes can also be associated with a greatly reduced diversity of birds (Ford *et al*, 2001).

For further information see:

Appendix L - Summerall, B. (2002) *Assessment of the cause of Angophora dieback at Cremorne Point for North Sydney Council* Royal Botanic Gardens, Sydney.

1.6.4 Habitat Fragmentation - Isolation of Bushland Reserves and Edge Effect

Isolated Remnants

North Sydney's remnant bushland areas are isolated fragmented islands in a sea of the urban environment. This poses problems for terrestrial, arboreal and some aerial species to move around beyond their home territory in search of food, mates, new territory or habitat. Isolation also limits the capacity of migratory species to use the reserves while moving across Sydney. Island pockets not only have large physical boundaries and implications but may also lead to genetic inbreeding and ultimately local extinction.

Species that are able to fly large distances may not be disadvantaged by isolated remnants, however terrestrial and short-distance flying species may be totally confined to individual reserves making them particularly vulnerable to local extinction (White, 2002).

Edge Effect

Remnant Bushland Reserves in Middle Harbour Catchment are small in size and narrow in shape, that makes these areas particularly vulnerable to a variety of impacts (White, 2002). The widest tract of bushland occurs in Tunks Park, still less than 100 metres wide and bound by residential dwelling, roads, street lights and footpaths.

All bushland areas suffer their greatest impacts along the boundaries with outside environments termed 'edge effect'. When reserves are long and thin and surrounded by urban areas, the edge effect is large and the potential for environmental damage is high. Such change includes: the change in vegetation due to change in micro-climate; invasion of weeds; exposure to predators; and the change in fauna species. Edge species that can dominate this habitat include the Noisy Miner, Pied Butcherbird, Currawong and Magpie (Catterall *et al*, 1991). These birds are territorial and aggressive and push out smaller insectivorous birds.

1.6.5 Lack of Middle Storey Vegetation and Loss of Ground Shelter

The loss of middle storey vegetation and ground cover are the most likely reason that terrestrial mammals and smaller birds have been lost from Middle Harbour Catchments' bushland reserves (White, 2002). In addition, fallen trees, logs, branches and obtrusive rocks have been taken away to make the reserve more human-friendly, further decreasing habitat potential.

Small birds, mammals and reptiles need the protection and structure of the middle storey and ground covers for habitat: shelter, protection, food and nesting sites.

Fire

One of the main reasons for loss of middle storey and understorey plants is the absence of fire (White, 2002). Fire occurs naturally on the Australian landscape and was used extensively by Aboriginal people who 'farmed' the land using fire as a tool. Native plant species (with the exception for Rainforest communities) have adapted mechanisms to survive and regenerate with fire. Indeed many species need fire to stimulate seed germination.

1.6.6 Disruption of Canopy

Without a continuous canopy, mammals such as Possums must come down to the ground to continue travelling. This leaves the animal vulnerable to predation.

1.6.7 Predation from Feral Animals – The European Red Fox *Vulpes vulpes*

Ground-dwelling native terrestrial mammals (such as the Brown Antechinus *Antechinus stuartii*) are absent within North Sydney's Middle Harbour Catchment reserves. With this absence, the introduced Black Rat and House Mouse have expanded to become a dominant ground-dwelling terrestrial mammal. The main reason for the demise of mammals appears to be heavy predation by foxes, cats and dogs (White, 2002). Together with the lack of natural habitat and decades of public misunderstanding, these mammals have fallen into serious decline.

A Red Fox was seen in the Fauna Survey (White, 2002) during the day in Tunks Park. Foxes have been frequently sighted around North Sydney for many years. Predation by the European Red Fox is listed as Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*. No feral Cats have been seen or recorded in North Sydney, although the domestic cat was sighted in the Fauna Survey in Mortlock Reserve and Tunks Park. Feral Cats are known to exist in the neighbouring municipality of Willoughby City Council. It is possible that feral Cats may make their way into North Sydney Council's Middle Harbour Catchment via adjoining reserves into Tunks Park and Mortlock Reserve. Predation by feral Cats is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*. Dogs were observed in the Fauna Survey in all reserves, with the majority being off leads.

1.6.8 Lack of Nesting Hollows and Competition for Nesting Sites

Australian fauna have evolved with native vegetation that is susceptible to the development of hollows. Many mammal and bird species, especially parrots, rely on hollows for nesting. Different species require hollows of different size, shape and height that will depend on the maturity of the tree. Some hollows take up to 200 years to develop. Some species require hollows all year round, and others only at breeding season. There is high competition for hollows, especially in remnant bushland reserves, where hollows are in short supply as well as in the surrounding urban environment. Many of the old growth trees have been cut down for timber, or old limbs removed for public safety or to 'tidy up' the tree. Birds and mammals that require more specialised hollows have been out competed by species that require more general hollows, or are more dominant or aggressive. There is also competition with introduced animals such as the European Honey Bee and Indian Mynah.

Species surviving in Middle Harbour Catchment that require hollows for nesting include the: Rainbow Lorikeet, Crimson Rosella, Brushtail Possum, Dollarbirds (migratory), and the Southern Boobook Owl. Studies have shown that Rainbow Lorikeets have been able to compete successfully for hollows from other native and introduced species (Waterhouse, 1997). Native tree species that produce suitable hollows include: *Eucalytus pilularis* (Blackbutt), *E. Piperita* (Sydney Peppermint) and *Angophora costata* (Sydney Red Gum). Exotic trees do not readily produce hollows.

Artificial Nesting Boxes can be designed and built for an array of different bird and mammal species. Please refer to **Section 2.1.17 Nesting Boxes** for further information.

1.6.9 Competition, Dominance and Aggressive Bird Species **The Pied Currawong *Strepera graculina* and Noisy Miner *Manorina melanocephala***

The urban environment supports many bird species, some at high population densities, however, the assemblages of birds in cities are not in equilibrium (Major *et al*, 2000). Some species common in cities less than 100 years ago are now rare and new species continue to colonise (Hoskin *et al*, 1991). There are several interacting factors influencing the survival of species in the urban environment (Major *et al*, 2000):

1. Size and presence of remnant vegetation.
2. Competition with better adapted exotic species that have a longer history of human cohabitation.
3. Predation of exotic predators.
4. Structure and floristics of planted garden vegetation.
5. Supplementary feeding by humans.
6. High levels of residual pesticides.

These factors in the urban environment of North Sydney support a high population of the Pied Currawong *Strepera graculina* and Noisy Miner *Manorina melanocephala*. The Pied Currawong has long been known as a major cause for the decline of small birds and a major threat to urban bird diversity (Major *et al*, 2000; Bass, 1995). The Noisy Miner is also a major threat to urban bird diversity and to the decline of small bird species.

The Pied Currawong

The Pied Currawong is a species native to the west of the Great Dividing Range. Due to the altered environment, in recent years the Pied Currawong has made the push to the east. Being omnivorous scavengers (Readers Digest, 1993), and partially frugivore, they have benefited from the prolific abundance of exotic ornamental plants and bush weeds that produce red or black berries, such as Camphor Laurel *Cinnamomum camphora* and Privet *Ligustrum* sp. (Buchanan, 1989; Bass, 1995). The other component of these birds diet is prey from nest predation of eggs and nestlings (Major *et al*, 2000), further threatening the survival of many smaller bird species.

Currawongs are also highly territorial and able to defend their territory from other bird species, smaller and larger. Other species are harassed and chased out. Possums caught out of their nest in the day- time, are also harassed (including harassment by Noisy Miners and Sulphur-crested Cockatoos) and can be pecked to death by Currawongs.

Currawongs are also responsible for the spreading these berry producing weed species (Privet and Camphor Laurel), in turn helping to perpetuate the survival of the population (Buchanan, 1989). It has been argued that the abundance of exotic berries for the diet of these birds may in fact reduce predation on smaller native bird species (Buchanan, 1989).

Supplementary Feeding

By supplementary feeding these birds, high numbers of the population are able to be supported. Supplementary feeding of other bird species also indirectly supports their population. For example, nest predation was found to be higher in gardens where Kookaburras *Dacelo novaeguineae* were fed frequently (Major *et al*, 2000).

Vegetation Composition

Stands of large trees with little middle and understorey vegetation, such as vegetation in parks and many gardens, also constitutes prime habitat for the Pied Currawong.

The Noisy Miner

The Noisy Miner, a large Honeyeater, live in large and socially complex communes (Readers Digest, 1993). These communes are highly territorial, with six to thirty birds combined in a loose colony of up to several hundred. Miners unite as mob predators and attack snakes, goannas, and other bird species that enter their territory. They are successful in driving out most species, smaller or larger, and occasionally killing some (Readers Digest, 1993).

Vegetation Composition

Noisy Miners are woodland birds (Readers Digest, 1993), able to dominate bushland areas smaller than 10 hectares, with limited dense middle and understorey vegetation. This typifies bushland of North Sydney.

Noisy Miners also benefit from the copious amounts of nectar provided by large hybrid *Grevillea* sp., such as 'Robyn Gordon Grevillea'. These plants are popular in garden and parkland landscaping and considered to be native.

1.6.10 Predation and Disturbance by Domestic Animals

Cats and dogs are both a problem in bushland reserves.

Cats

Domestic cats were recorded in the reserves at night in the Fauna Survey and possums were found killed by cats. Cats are a particular problem to native fauna as they are able to hunt lizards, birds and mammals throughout the day and night.

Statistics from WIRES and Taronga Zoo Wildlife Clinic from 1991-2000 regarding cat attacks on native animals in the North Sydney local government area, reveal that out of all the species brought to them for care, Ringtail Possums have had the greatest number of cat attacks/fatalities. These statistics also show that Rainbow Lorikeets and Blue-tongue Lizards have been subject to large numbers of fatalities from cat attack.

In 2002 an Eastern Water Dragon was sighted dead at Primrose Park with puncture wounds to its body, most likely from a cat. The animal was not eaten.

For further information see:

Appendix J - Cat Attack and Fates of Native Animals of North Sydney from 1991-2000; Some Statistics for Ringtail Possums – 1 July 2001 to June 2002 Sydney Metropolitan Wildlife Services

Disturbance by Dogs

Dogs are also a problem in bushland reserves, as dogs roaming the bushland disturb a lot of native fauna, especially birds. The constant presence of dogs in the reserves is sufficient to cause native animals to abandon the reserves (White, 2002). Dogs also kill some mammals. Possums were found in the Port Jackson Survey (White, 2001) that had been savaged by dogs. Even if dogs do not catch and kill native animals directly, their scent that disseminates throughout reserves causes native animals to avoid these areas. Thus, foraging areas are reduced, stressing native fauna populations further (White, 2002).

1.6.11 Threats from other Introduced Fauna Species

The Black Rat *Rattus rattus*

The Black Rat, found in most bushland reserves in Middle Harbour, is omnivorous feeding on many fungi, invertebrates and reptile species. There is little evidence so far in Australia that supports the idea that the Black Rat destroys eggs and young birds. The Black Rat does not so much, displace native species, however, exploits niches not occupied by native species (Watts, 1995).

The Black Rat does spread disease (Watts, 1995). And it may act as prey for the Red Fox, thereby taking pressure off native populations.

The House Mouse *Mus musculus*

The House Mouse is found in most bushland reserves in Middle Harbour Catchment. Studies have shown that it often becomes abundant and ubiquitous about 18 months after fire at a time when native species are at a low density. These populations can remain high for three to four years, decreasing as the density of small native mammals increases (Singleton, 1995). It therefore may imply that as with the Black Rat, it moves into areas where native ground mammal species is low, such as bushland reserves in North Sydney.

The House Mouse is eaten mainly by raptors (Singleton, 1995), and therefore may also take pressure off native populations as prey for raptors and the Red Fox.

The European Honey Bee *Apis mellifera*

The European Honey Bees invades nesting hollows and nesting boxes to create hives in, thus depriving arboreal native fauna critical nesting sites.

The European Honey Bee also interferes with the natural pollination of indigenous flora. Honey Bees are unable to pollinate some plant species.

Indian Mynah *Acridotheres tristis*

The Indian Mynah, not to be confused with the native Noisy Miner *Manorina melanocephala*, is brown with a black head and yellow feet, eye-patch and bill and is a very aggressive bird. It evicts other birds from their nests, dumps out the eggs and chases native birds from their roosting areas. The mynah generally prefers urban backyards, where it displaces many Australian species and is a strong competitor for food. (WTMA, 2002). The Indian Mynah breeds in hollows competing with native birds and possums for nesting hollows (Readers Digest, 1993).

1.6.12 Street and House Lighting

Street and footpath lighting can be a problem for the nocturnal animals. For fauna such as Ringtail Possums and Owls, light pollution can force these animals out of reserves. Most nocturnal animals avoid street-lit areas, with the only exception being Tawny Frogmouths which have learned to sit above street lights and be concealed in the shadow while waiting for moths to be drawn towards the light (White, 2002).

Oval lighting will disturb nocturnal native fauna in Primrose Park due to flood-lights lighting the oval at night for football practice.

1.6.13 Disturbance from Noise, Movement and Pedestrian Traffic

Most bushland reserves in Middle Harbour Catchment have several formal and informal walking tracks through them. High pedestrian traffic through much of the reserve, lacking a 'core' conservation area will disturb native fauna.

1.6.14 Weed Invasion Negative Effect of Exotic Berry Species

Although, exotic weed species provide habitat, food and shelter for native fauna, native vegetation is of greater habitat value than weedy vegetation. It has been found that near-pure stands of Privet provides limited resource for birds, however, Privet located near native forests provided supplementary resources for many more species (Ekert & Bucher, 1999).

The presence of exotic berry vegetation, such as Privets *Ligustrum* sp. and Camphor Laurel *Cinnamomum campona*, also impacts on many species of native fauna indirectly by the presence of flocks of territorial and aggressive bird species attracted to these plants. Such aggressive bird species that utilize these plant species for food include: the Figbird *Sphecotheres viridis* and Pied Currawong *Strepera graculina*.

Ants and other Invertebrates

There is evidence that more specialist leaf litter invertebrates are affected by the infestation of weed plant species. Seed dispersing ants have been found to be less abundant in areas infested by Bitou Bush *Chysanthemoides monilifera* (French & Eardley, 1998) and other weedy areas (Pik, 2000).

1.6.15 Pollution, Poisons and Diseases

Pollution outbreaks in waterways can kill and cause illness and mutations to fish and other aquatic fauna. Toxins may bio-accumulate and cause illness and death in animals higher up in the food chain that consume these smaller affected creatures.

Insects infected by pesticides and insecticides and consumed by insect predators such as Tawny Frogmouth Owls, can build up the toxin in their fat reserves. In times of little food, fat deposit are utilised by the body and the toxin released into the blood system, causing illness and death.

Disease such as *Psittacine Beak and Feather Disease* is high in the parrot population, especially in the local Rainbow Lorikeet population. *Psittacine Beak and Feather Disease* is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999* to endangered Psittacine (Parrot) species. Rainbow Lorikeets are not endangered species, however the disease occurs in high proportions in Sydney. This disease leads to a lowered immune system and loss of flight feathers that can lead to death through easy predation or illness. It is thought that the disease is spreading due to two main causes:

1. In nesting hollows that are not being rested due to constant occupancy. This is related to the lack of nesting hollows and change in food availability causing species such as Rainbow Lorikeet populations to breed in winter and spring; and
2. Through feeding stations where people feed birds, and sometimes a highly inappropriate diet. The feeding of food such as sugar, bread and honey can also lead to susceptibility to disease.

Other diseases are known to occur in populations of the Australian King Parrot population and Frogs. Infection of amphibians with *Chytrid* fungus resulting in *Chytridiomycosis* is listed as a Key Threatening Process under the *Environment Protection and Biodiversity Conservation Act 1999*. Currently, both these diseases have not been recorded in either populations occurring in North Sydney.

1.6.16 Drought

Drought affects bushland areas and the fauna that rely on that habitat. Food becomes scarce and water sources dry up. In the drought of 2002, possums were seen scavenging from unlikely food sources and Blue-tongue lizards were seen dehydrated. Studies have shown that drought affects most bird guilds, with the exception of those that feed on the ground, on the bark or in the air. This indicates that invertebrate species that live in the leaf litter, under the bark or in the air are more immune to drought due to their ability to find protection. The guild most affected by drought, are the berry eaters (Slater, 1994).

1.6.17 Specific Threats to Significant Native Fauna

BIRDS

Insectivorous Birds

- Loss of habitat, particularly dense middle-storey vegetation.
- Change in ecosystem, with a greater number of trees in the urban environment that encourage edge dwelling species and lack of shrubs that favour small insectivorous birds.
- Predatory attack from cats and foxes.
- Predatory attack of eggs and aggressive dominance from territorial birds such as Currawongs.
- Change of fire regime affecting loss of flora species, availability and timing of insect attracting plants.

Parrots

- Lack of hollows. Out competition of parrots that only require nesting hollows at nesting season with parrots that remain in nesting hollows all year round.
- Lack of large old growth hollows.
- Competition for hollows from introduced species such as the Honey Bee and Indian Mynah.
- High incidence of disease within populations of parrots eg. *Pscitticean* Beak and Feather Disease, which affects Lorikeets and Cockatoos.

Kookaburras, Tawny Frogmouths

- Loss of suitable trees for nesting, roosting, and perching while waiting for prey.
- Insects killed by pesticides, then eaten by Kookaburras and Tawny Frogmouths which absorb the pesticide chemicals and are stored in their fat. When food is in short supply, their fat storage is used and high concentrations of poison may be absorbed in their blood, which results in reproductive losses or death (NPWS, 2001).

Owls and Nocturnal Birds

- Loss of habitat. Require large areas of bushland (White, *pers.com*). Reserves are often too small and isolated to support breeding pairs (Greenyer, 1999).
- Lack of prey; fauna species loss affects species higher up in the food chain.
- Predation from cats, foxes, snakes and dogs.
- Competition with foxes and cats for food, such as Ringtail Possums and other small mammals (Greenyer, 1999).
- Loss of old trees with hollows (Greenyer, 1999).
- The main cause of premature mortality is due to road fatalities (Wilbrow, 1999 *pers.com*.; Debus & Chafer, 1994). High mortality also due to: electrocution, fungal infections, poisoning and predation (Greenyer, 1999).
- Disturbances from noise and presence of humans near nest sites deter Powerful Owls from mating (Greenyer, 1999).

MAMMALS

Insectivorous Bats

- The Large Bent-wing Bat is preyed upon by owls, pythons, feral cats, and occasionally the fox (Dwyer, 1995).
- Frequent disturbance of roosts used for hibernation increases winter mortality.
- Dependence upon relatively few nursery caves, threatens the survival of widespread populations if these sites are disturbed (Dwyer, 1995).
- Gould's Wattle Bat is preyed upon by owls, the feral cat and the Pied Butcherbird and Currawong (Dixon, 1995).

Grey-headed Flying-fox

- Disturbance of roosting sites, particularly during the last few weeks of pregnancy, can lead to females spontaneously aborting (Tidemann, 1995).
- Electrocution on power-lines (NPWS, 2001).
- Persecution due to poor understanding of diseases they may carry (NPWS, 2001).

Possums

- A discontinuous canopy leads to individuals needing to descend to the ground more frequently and are thus more exposed to terrestrial predators.
- A large impact on populations of possums and other marsupials is due to predatory attack from the introduced cat, both feral and domestic, fox and occasionally dogs (Smith, 1995; How & Kerle, 1995).
- Possums crossing roads are subjected to the potential of being run over by cars.
- Lack of hollows for nesting.
- Lack of middle-storey for shelter and nesting.
- Possums are territorial. Possums trapped and relocated greater than 50 metres from site of capture, are taken outside of their territory. The stress of entrapment and relocation, particularly in the day, leads to a very high incidence of mortality.

- Resident frustration and subsequent action with possums living in their roofs, and damaging their garden plants.
- Possums killed either accidentally or on purpose with rat poison.

Brown Antechinus

- Vulnerability to introduced predatory attack from cats, foxes and dogs (Braithwaite, 1995).
- Mistaken as the introduced house mouse or rat and subsequently killed.
- Species vulnerability due to specific mating habit.
- Loss of habitat through the clearing of native vegetation.

REPTILES AND AMPHIBIANS

Frogs

- Susceptibility to pollution. Increased pollution levels in the air and water.
- Lack of permanent fresh water supply.
- Alteration of drainage patterns and stormwater runoff (White & Pyke, 1996).
- Fungal pathogen (Berger & Speare, 1998).
- Water quality, pollution and sedimentation.
- Herbicides, pesticides and fertilizers.
- Predation by feral animals such as foxes and cats (Daly 1995 & 1996).
- Road mortality where populations are already small due to other threats (Daly, 1996).
- Predation by exotic fish, which eat frog eggs and tadpoles, particularly the Plague Minnow (*Gambusia holbrooki*) (Morgan & Buttemer, 1996).
- Loss of suitable breeding habitat through alteration by infilling and destruction of wetlands (Morgan & Buttemer, 1996; Clancy, 1996).
- Susceptibility to increasing levels of ultra-violet light (damage to the ozone layer).

Snakes

- Loss of habitat and ground cover vegetation.
- Removal of bush rock.
- Indiscriminate killing of snakes through fear or dislike. Many harmless snakes and legless lizards are killed unnecessarily in this way (NPWS, 2001).

Lizards and Skinks

- Predatory attack from cats, foxes and dogs.
- Mortality from cars (especially roaming male Blue-tongue Lizards) and lawn mowers.
- Poisoning from pesticides and eating snails that have been poisoned with an insecticide.

1.7 Method

1.7.1 Fauna Surveys

The Fauna Rehabilitation Plan for Middle Harbour Catchment has been compiled using results from the Fauna Survey conducted by the Biosphere Environmental Consultants in March – May 2002. Carried out over six days and six nights, the survey gave a brief overview of the presence/status of wildlife in North Sydney. The aims of the survey were to catalogue the mammals, reptiles, birds and frogs that occur in each reserve; identify threatened or endangered species or species of local significance; to assess the extent of habitat for native fauna; and to recommend methods that might improve the habitat value of the reserves for native fauna.

A constantly updated database of the Fauna of North Sydney (see **Section 3**) compiling sighting records from Council's Wildlife Watch Program, Bushland Management Team, Contractors and past sightings and studies were also used to supplement findings from the survey. Wildlife Watch is a community based education program whereby interested local residents record fauna seen in their local area. The program provides valuable information for sightings of wildlife in North Sydney, however the information provided is by community volunteers and may not be entirely definitive.

In July 2002 North Sydney Council employed Ekerlogic Consulting Services to carry out an ongoing bird survey over the next five years. The summery findings of the interim report for the first six months were also used for information for the Fauna Rehabilitation Plan for Middle Harbour Catchment.

1.7.2 Limitations of the Study and Continuing Surveys

Limitations of the study include the rapid assessment of fauna for the Fauna Survey. It is unlikely that all species of fauna present in North Sydney's Middle Harbour Catchment could have been recorded in this survey that occurred over six days and nights. Some species are seasonal and migratory and would not have been recorded if they were not present in the time frame of this study. However, to supplement findings of this report, other studies and the Fauna of North Sydney Database were used. Despite the possibility that not all species are accounted for, management guidelines in this plan will benefit all native fauna species.

The Ekerlogic Consulting Services Continuing Bird Survey has been instigated to provide an indication of the dynamics of the bird populations living in the bushland of North Sydney. It is proposed that the results from the survey will be used as an ecological indicator to ascertain the effectiveness of bushland rehabilitation activities in conserving and promoting native fauna habitat.

Section 2 - Fauna Rehabilitation Management Plans

2.1 Management Strategies for the North Sydney Local Government Area

The following management strategies are applicable across the whole local government area, and are geared towards promoting the sustainable management of local wildlife. More specific on-ground strategies have been created for each bushland reserve within the Middle Harbour Catchment, and can be found in the latter part of **Section 2** of this report.

2.1.1 Implementation of the Bushland Rehabilitation Plan for Middle Harbour Catchment

It is recommended that the Council continue to implement the Bushland Rehabilitation Plan for Middle Harbour Catchment, which is guided by environmental legislation set out in the *Local Government Amendment Act 1998* and the North Sydney Council Plan of Management Plan, adopted in 1995.

2.1.2 Fauna Conservation Areas

At present remnant bushland in North Sydney is classified and protected under the *North Sydney Local Environmental Plan 2001* (LEP) as a 'Bushland Zone', managed under the Bushland Plan of Management adopted by Council under the *Local Government Act, 1993*.

The LEP specifies that:

Bushland Zone

1. Objectives of the zone

The particular objectives of this zone are to:

- (a) protect and preserve bushland so as to provide representation of the natural state and to enable existing animal and plant communities to survive in the long term, and
- (b) allow, where appropriate, for low impact recreational opportunities which will protect the values of bushland, and
- (c) protect and preserve bushland for its natural, cultural, historical, scientific, educational, archaeological, geological, recreational, scenic and visual values in accordance with the Bushland Plan of Management adopted by the Council under the *Local Government Act 1993*.

2. Development which may be carried out in this zone

Any development in accordance with the plan of management adopted under Division 2 of Part 2 of Chapter 6 of the *Local Government Act 1993* and for the time being applicable to the subject land. Development for the purpose of:

bushfire hazard reduction; bushland regeneration and management; community notice signs; drainage; landscaping; remediation; vehicular access for emergency and maintenance vehicles; vehicle access to another permissible use within the zone; visitor facilities.

For further information see:

'North Sydney Council Bushland Plan of Management, adopted in 1995'. Available through North Sydney Council.

Some sections of urban bushland may require additional protection to specifically protect native fauna. The zoning of 'Wildlife Conservation Areas' is able to be instigated by Local Government under the *Companion Animals Act, 1998* and includes the implementation of appropriate regulations for the reserve chosen by Council. An example of such zoning could include: the exclusion of domestic animals, restriction of the placement of walking tracks and public entry, may be fenced and gated, have no internal night lights, or may only be open to the public at certain times of the day, as recommended by White (2002).

Bushland areas identified by White (2002) in order of priority for dog exclusion zones are:

1. Wonga Road Reserve and Mortlock Reserve
2. The higher (southern) side of Brightmore Reserve
3. Willoughby Gully in Primrose Park Bushland
4. The higher (southern) bushland areas of Tunks Park Bushland

Wildlife Protection Zones should be given to reserves that are high in biodiversity with the greatest conservation potential and low recreational usage. Wildlife Conservation Areas could initially be targeted in areas that include critical habitat for threatened and vulnerable species, such as Brightmore Reserve, and then on success of these areas be extended to include other fauna rich areas or areas where specific fauna habitats have been recreated.

Alternatively, for ease of public compliance, Wildlife Protection Zones could be instated in specific areas of reserve that are not currently under high use by the public or with the absence of walking tracks. For example, Tunks Park bushland has large tracts of area inaccessible to the public. This section could be made a Wildlife Protection Zone and signs erected.

Wildlife Protection Zones needs to result in the heightened protection of native fauna. A Plan of Management should be developed for each 'Wildlife Conservation Zone' in order to maximise the usefulness of the area (White, 2002).

For further information see:

Section 1.4.3 – Relevant Legislation: *Companion Animals Act, 1998*

2.1.3 Protection of Critical Habitat

The *NSW Threatened Species Conservation Act 1995* requires that critical habitats of endangered, threatened or vulnerable species be protected.

One area of critical habitat that requires protection is the roost site for Large Bent-wing Bat (*Miniopterus schreibersii*) in Brightmore Reserve.

Management of Threatened Species and Critical Habitat

The Large Bent-wing Bat (Miniopterus schreibersii)

Critical habitat of the Large Bent-wing Bat includes roosting sites. This roost site needs to be recorded and protected and ensured that the is not publicly revealed. Protection of the roosting site can be achieved by covering the stormwater opening with a wide mesh cover that will not prevent bats from flying in and out, however will stop feral animals (and people) from disturbing the bats. The location of the site should not be generally available to the public, though should be known to Council's Bushland Management team (White, 2002).

Management issues for the colony of Large Bent-wing Bats discovered roosting in Waverton in 1999 are discussed in a report compiled for Council by Glenn Hoye (2000).

A NSW National Parks and Wildlife Service Recovery Plan for the Large Bent-wing Bat is available by contacting NSW National Parks and Wildlife Service.

For further information see:

Fauna and Flora Assessment Waverton Peninsula (2000) Glen Hoye. Available through North Sydney Council Open Space and Environmental Services Division.

The Grey-headed Flying-fox (Pteropus poliocephalus)

A NPWS Recovery Plan for the Grey-headed Flying-fox will be prepared by 2006.

Management guidelines set out under the *Threatened Species Conservation Act, 1995*, for the Grey-headed Flying-fox that are applicable for Council are as follows:

- Continuing synchronous annual counts to track population trends and monitor success of management actions.
- Conducting education programs to increase awareness about Grey-headed Flying-foxes and dispel misconceptions.
- Identification and protection of key foraging areas to ensure foraging resources are available throughout the year.

North Sydney provides foraging areas for the Grey-headed Flying-fox, however there are no roosting sites located in North Sydney.

Synonymous with the NPWS Recovery Plan, it is recommended that the Wildlife Watch Program continue to help monitor the sightings of the Grey-headed Flying-fox. Residents involved in the program should be notified that recording sightings of this species is important. The information provided from these sightings can then be forwarded to the NPWS for their monitoring program.

Grey-headed Flying-foxes are frequently electrocuted on overhead electricity wires. Specific areas of electric wires have been identified in North Sydney (in consultation with a representative from the Ku-ring-gai Bat Conservation Society) as having frequent Flying-fox fatalities. These wires have been prioritised for 'Aerial Bundled Cabling'. Aerial Bundled Cabling combines all wires into one sheathed cable, which prevents electrocution. It is recommended that North Sydney Council continue to bundle in high priority areas on an annual basis.

Educational talks by the Ku-ring-gai Bat Conservation Society have been provided to the public through the Bushcare Adventures Program in 2001. Educational activities and talks by the Ku-ring-gai Bat Conservation Society and other environmental educators for children and adults on the Grey-headed Flying-fox can continue to form part of the Bushcare Adventures educational activities.

2.1.4 Replacement of Lost Shelter Sites

Rocks, Logs and Branches

In addition to replacing middle and understorey vegetation, fallen trees, logs, branches and bush rocks should be left in place (away from public pathways and access) and replaced for habitat and nutrient recycling within the ecosystem. Lizards, frogs, snakes, terrestrial native mammals and invertebrates will utilize the habitat provided by logs, branches and rocks. Fungi and other micro-organisms will breakdown dead wood recycling the nutrients back into the system. In turn, fungi provides a food source for some native fauna.

Rocks and logs can be used in 'landscaping' bushland sites. Educational signs could be erected in sites highlighting that the removal of bush rock and dead wood is prohibited and that it provides important habitat.

Dead Trees

Where public safety is considered, dead trees and branches should be left on site to naturally break down. Dead trees that need removal for public safety should be only lopped back to a stag. These stags are generally safe for many years to come and provide habitat to native fauna. Advice on the option of lopping back only to a stag can be sought from the professional Arborist. Many species of birds use dead trees and vantage points to observe prey. Possums can also utilize the dead tree as a safe transport route off the ground. Micro-organisms and fungi will eventually create hollows (if not already present) in the trees which provides nesting sites for possums, parrots and other bird species.

2.1.5 Buffer Planting

Bushland reserves can be shielded from the impacts of the surrounding urban environment by a wall of resilient and bushy native plants. These plants need to be chosen for being able to tolerate greater physical damage and exposure and fast growth, whilst creating a buffer between the natural bushland and urban interface (White, 2002). A bushy buffer zone will help prevent the spread of weeds along the edges and provide protection for native fauna from cats, dogs and disturbance by people.

A buffer zone may naturally occur through regeneration, or edges can be revegetated with species such as: *Acacia* spp., *Grevillea* spp., *Banksia* spp., *Lomandra longifolia*, *Dodonea triquetra*, *Monotoca* sp., *Kunzea ambigua* and *Hakea* spp. Edges of reserves should be targeted as a priority in regeneration works to create this buffer zone.

2.1.6 Tree Plan

A Tree Plan is required for each reserve. In the plan, the number and age classes of native trees are recorded as well as the location of exotic trees. The plan should be aimed at successively eliminating the exotic trees and replacing them with native trees (generated from seed collected within the reserve). If tree species are absent from the reserve that should be replanted these should be derived from seed stock taken from the nearest source area.

Although the aim of the plan is to replace exotic trees with native trees and to replace senescent native trees with replacements trees, some caution is advised before actions are implemented. Some exotic trees may be used by native fauna as habitat trees in the absence of a suitable native tree being present. When it is clear that exotic trees are being used as habitat, the replacement tree should be well established before the exotic tree is removed. In this way habitat is always present for native fauna (White, 2002).

2.1.7 Creekline and Rainforest Restoration

Natural rainforest and creekline vegetation (mesophilic) naturally occurs in successional stages, from the pioneer plants to the large mature trees. Regeneration of such areas takes many years to reach maturity (Greening Australia 1998).

Clump Planting Method

When revegetating such areas, the first few stages can proceed more rapidly by planting a combination of fast growing light demanding trees and slower growing trees that will live a long time once mature. Robert Kooyman of NSW State Forests has developed a method based on years of trials, known as the Clump Planting method (Greening Australia, 1998). Trees are planted 1.5 metres apart in 'clumps'. Each clump has a tall fast growing tree surrounded by slower growing species. Rapid growth of this central tree draws on the other trees and shrubs up to the light creating a canopy within an estimated 2-3 year period.

Creekline Restoration

Creek and stormwater drainage lines can be reconstructed using large sandstone rocks. Effective design and engineering of a natural creekline will help prevent erosion, as well as provide habitat and aid natural bushland aesthetics. Within this construction, ponds can be made that will provide habit for frogs and a still fresh water source for birds and lizards. Water loving species such as sedges and rushes should be planted through out the creek line to filter water and provide habitat for fogs and other animals. Dense stands of small trees can be planted above the water flow level (Greening Australia, 1998). Some weeds may need to be retained in the short term to help prevent erosion.

2.1.8 Tree Preservation Order

North Sydney Council's Tree Preservation Order (TPO) needs to assess habitat value of trees on private property when evaluating permission for removal and pruning. During the evaluation process, an assessment should be made on the presence and/or potential of existing nesting hollows, nests and dreys. An assessment should also be made on the food resources the tree provides to local fauna. TPO guidelines for the pruning of larger branches should require a collar to be left (of at least 30cm) to allow a hollow to develop over time.

It is also recommended that the Significant Tree Register should be reviewed and amended where appropriate to include specimens of high ecological and habitat value. Such specimens would include mature indigenous trees, especially with hollows and those forming connective canopy.

A poster listing indigenous plant species for North Sydney titled 'Live Local Plant Local' has been compiled for gardens and gardeners. The list provides information on each species' growing condition requirement and height at maturity. This list is provided with Tree Preservation Order permits to encourage and educate residents about planting local species in private gardens.

For further information please refer to:

Appendix N - North Sydney Council Tree Preservation Order

2.1.9 Green Corridors and Linkages

The creation of 'green corridors' and linkages will enable fauna to move between bushland areas. These corridors should be as large and as wide as possible so as to minimise 'edge effects' and enable usage for a wide range of species. Narrow corridors may not provide adequate protection for extremely edge-sensitive bird species (Bakewell, 2001). Maps of possible green corridor creations will be outlined in Map 2 for each reserve in Section 2. 3.

Corridors, where possible, should mimic vegetation communities and structure of the bush to include:

1. Canopy trees
2. Middle-storey

3. Understorey
4. Ground covers

There are three ways that corridors can be created:

1. Plantings in Council Parkland areas without interfering with recreational space and/or views.
2. Sympathetic street tree planting/street tree landscaping.
3. 'Native Havens – Flora for Fauna in Your Garden' programs for residents adjoining bushland or linking bushland reserves.

A strategy for the creation and design of green corridors for North Sydney has been formulated and will form part of the Council's Biodiversity Strategy.

1. Parkland Vegetation

Planting of indigenous species in Parklands could provide habitat for fauna and linkages to remnant bushland areas. Planting could take place around existing mature parkland trees to create a shrubby understorey, as well as on lawn areas that are not utilised for recreational purposes.

In areas where views are to be retained or a population of small insectivorous birds are known to exist, it is recommended that islands of shrub vegetation are created. The exclusion of larger canopy trees in this area means that habitat for larger, more aggressive bird species has been omitted. Therefore, smaller birds can persist without the threat of competition from larger birds, such as Australian Magpies or Pied Currawongs.

Remnant vegetation, rubble and weeds found on the side of roads and surrounding old industrial sites, provide important habitat for small birds, possums and reptiles. For example, Lantana can provide important habitat for Scrub Wrens, while rubble provides shelter for lizards; therefore, the habitat value of these particular sites, needs to be carefully considered before removal or a 'tidy up' of these sites occurs. If removal is to take place, alternative habitat needs to be arranged prior to the event.

2. Street Tree Landscaping

Street Tree Landscaping involves the planting of understorey shrubs and ground covers around the bases of existing street trees. This type of landscaping has the potential to provide habitat for wildlife such as travel routes, shelter, food or nesting sites. Although many indigenous trees may not be appropriate for street tree planting due to their size, structure, root system and/or vulnerability to the streetscape, native trees do provide more habitat and food for fauna compared to their exotic counterparts. On consultation with the Tree Preservation Officer, a list of both indigenous and native species that would be appropriate for street tree landscaping has been compiled and listed below.

NB. * Indicates native species that are not currently found in North Sydney, or are not indigenous to North Sydney, but native to the Sydney region.

Indicates native genera with the potential usage of hybrid species or species not indigenous to the region, selected as appropriate for streetscaping.

Grasses and Ground Covers

| | |
|-------------------------------|------------------------|
| <i>Lomandra longifolia</i> | Mat Rush |
| <i>Geranium homeanum</i> | Native Geranium |
| <i>Dichelachne crinita</i> | Longhaired Plume Grass |
| <i>Dichleachne micrantha</i> | Shorthair Plume Grass |
| <i>Themeda australis</i> | Kangaroo Grass |
| <i>Echinopgan caespitosus</i> | Hedgehog Grass |
| <i>Viola hederaceae</i> | Native violet |

Shrubs

| | |
|-------------------------------|------------------------|
| <i>Grevillea linearifolia</i> | White Spider Flower |
| # <i>Banksia sp.</i> | Banksia |
| <i>Acacia implexa</i> | Hickory |
| # <i>Acacia sp.</i> | Wattle |
| # <i>Callistemon sp.</i> | Bottle Brush |
| <i>Eriostemon myoporides</i> | Long-leaved Wax Flower |

Trees

| | |
|------------------------------------|------------------------|
| <i>Melaleuca armillaris</i> | Braclet Honey Myrtle |
| <i>Eleocarpus reticularis</i> | Blueberry Ash |
| <i>Banksia serrata</i> | Old Man Banksia |
| <i>Banksia integrifolia</i> | Coastal Banksia |
| <i>Acemna smithii</i> | Lillypilly |
| <i>Leptospermum polygalifolium</i> | Lemon-scented Tea-tree |
| * <i>Synoum glandulosum</i> | Scentless Rosewood |
| <i>Phebalium dentatum</i> | |
| <i>Callicoma serratifolia</i> | Black Wattle |
| * <i>Cupaniopsis anacardioides</i> | Tuckeroo |
| <i>Livistona australis</i> | Cabbage-tree Palm |
| * <i>Diploglottis australis</i> | Native Tamarind |
| <i>Tristaniopsis laurina</i> | Water Gum |
| * <i>Backhousia citriadora</i> | Lemon Myrtle |

Fruiting exotics that have been planted in the streetscape or in parkland areas should be reduced as they provide an abundant, year round supply of food for aggressive bird species such as the Currawong.

2.1.10 Fire Management

Ecological burning is an essential tool used to maintain bushland resilience, biodiversity and habitat conservation. Whilst fire is needed to create healthy bushland and thus habitat, it is essential that current habitat is also preserved during this process.

Small broad-scale burning is the most beneficial type of burning, however should be used only in reserves large enough to provide alternative habitat areas. As a general rule broad-scale burning should not be larger than 10% of the total area of the reserve, and should be proportional to the shape of the reserve. Burning should be undertaken strategically and in a mosaic fashion, with areas adjacent to one another not being burnt until regeneration has reached a height of around 1.5 metres. If broad-scale burning is not appropriate for an area, then pile burning should be used.

An entire reserve should be burnt over a period of ten years, excluding areas inappropriate for burning (i.e. indigenous closed forest, degraded sites or young revegetated sites). Repeated burning of an area should not take place more frequently than seven years or less frequently than fifteen years. Too frequent burning of bushland, encourages fire-dependent and fire-tolerant species. Coupled with the loss of other species, this leads to an altered ecosystem with vegetation susceptible to fire ie. more flammable. Likewise, with too infrequent burning, mesophilic vegetation will dominate the bushland with the loss of sclerophyll species and an overall loss of species diversity.

Burning should not coincide with the nesting season of birds that are known to make their nests near the ground or in the shrub layer. A table highlighting nesting seasons of birds found in each reserve from the Fauna Survey and the Fauna of North Sydney Database is provided for each reserve in **Section 2.3**. Birds that are not included in the table are those that nest: above 6m; on creek banks; in tree hollows; in cave and rock ledges; and in rainforests (which should not be burnt).

Before burning piles of debris, piles should be disturbed to encourage lizards and other reptiles that may be living in the piles to move on.

2.1.11 Fresh Water Sources

There is a lack of fresh water in most of the reserves. Fresh water is crucial in providing habitat for frogs as well as drinking and bathing water for lizards and birds. Artificial frog ponds could be created in appropriate and sheltered areas in reserves. Bird-baths can also be constructed for each reserve.

For further information, see:

Appendix H - *Frog Facts No.2: Keeping Frogs in Your Garden*

Appendix I - *How to Build a Bird Bath*

2.1.12 Walking Tracks

Tracks and pathways create an 'edge effect' in a reserve, whereby the bushland intersected with pathways experiences a change in microclimate, is susceptible to weed invasion and other pressures associated with an altered ecosystem.

A central 'core' area is needed for conservation, which provides an area that is undisturbed and suffers minimally from edge effect. Tracks should be redirected around the outside of the reserves, and tracks running through the middle of reserves should be closed. Where there are too many tracks, especially informal ones, these should be closed and discouraged and a few formal walking tracks constructed or highlighted.

2.1.13 Community Education

Community education is essential for promoting an understanding/appreciation of wildlife issues in North Sydney. Lack of knowledge/understanding is often the cause of negative human impact on native wildlife.

Community awareness programs highlighting the presence of wildlife populations can be achieved through educational signage placed along bushland walking tracks. Educational signage should educate passers-by about the fauna that inhabit the reserve, to be mindful of their presence and how they can utilize the reserve without negatively impacting on wildlife.

Wildlife education needs to reach the wider community. This may be achieved through education of the threats to wildlife that is caused by human impact through articles in local newspapers, displays in the Stanton Library and in rates notices. The selling of indigenous plants locally, possibly through local nurseries, would also be useful in encouraging residents to plant native species in their garden.

The Bushcare Community Education Program

Council has several community awareness publications that need to reach further into the community. 'How to Attract Native Birds to your Garden – without Artificially Feeding' is a publication addressing the negative effects of feeding native birds and if one chooses to feed native birds, how to provide a healthy natural diet and which birds not to encourage. 'Living with Possums' is a community educational booklet addressing the issues of illegally trapping and relocating possums, possums in roofs, and possums eating ornamental plants.

In 2003, Council produced an educational kit to be distributed to all cat and dog owners in North Sydney. 'Enviro-pet: A North Sydney Guide to Pets and Native Fauna' addresses the issues of cats and the threat to native fauna, encouraging residents to keep cats indoors; and the effect of dogs to native fauna and dog faeces, educating why dogs must be on a lead in all bushland areas and why owners must pick up after their dog.

The 'Native Havens – Flora for Fauna in Your Garden' program is offered to all residents in North Sydney. This program provides assistance and indigenous plants for residents to create a native habitat garden.

Other community education programs are currently run through North Sydney Council's Bushcare program, include: Wildlife Habitat Gardens workshop, Wildlife Observation Field Trips to Barren Grounds Bird Observatory and Calga Springs Sanctuary and other provision of educational material/displays. The community volunteer wildlife Program is another way to educate residents by getting them involved in wildlife observation. The Bushcare Adventures Program provides interactive educational activities for children and adults in the school holidays. This Program provides important education about local wildlife and bushland issues and should continue as part of the Bushcare Program.

For further information see:

North Sydney Council Open Space and Environmental Services Division, Bushland Department for community awareness publications and the Bushcare programs offered.

Or, online at: www.northsydney.nsw.gov.au/what's on/Bushcare Activates

2.1.14 Feral Animal Control

The Red Fox *Vulpes vulpes*

Fox control programs are required by the NPWS and are in progress. Foxes may never be completely eradicated from bushland reserves but their numbers can be culled (White, 2001). Den fumigation and a baiting program both need to be utilized. By making den fumigation the focus of the fox control program, this will ensure the culling of juvenile foxes, thus reducing the next generation of foxes. Vagrant foxes will still be present and these can be culled through a baiting program in reserves that are a distance of 150m from residential dwellings at Balls Head Reserve, Waverton and Berry Island Reserve, Wollstonecraft.

For further information

Appendix K - Summary of Fox Control Program 2002

Feral Cats *Felis catus*

Cat traps can also be placed in reserves to trap any feral cats that may be present. Cat traps may also trap domestic cats found in reserves. Feral cats can generally be distinguished from domestic cats by their larger size and more aggressive behaviour. If there is uncertainty as to whether a cat is feral or domestic, the cat should be taken to a veterinary clinic for identification. Feral cats will need to be taken to a veterinary clinic to be euthanased. If the cats' owners can be identified from a tag on their cat's collar or microchip, the cat should be released to their owner and the owner notified that their cat was caught in bushland.

Rabbits

Escaped domestic rabbits are not regularly sighted in Middle Harbour bushland.

A Rabbit Trap can be placed for such occurrences and taken to the local veterinary clinic and euthanased, or returned to the owner (if there is one). It is unlikely that rabbits in small numbers pose much threat to native fauna and flora in Middle Harbour. It is likely that their presence would take the pressure off native populations as prey for foxes and cats.

European Honey Bee *Apis mellifera*

Bees that invade nesting boxes, should be removed. Boxes can be taken away by Apiarists and the hive and Honey Bees used.

Bees that invade hollows, if safely accessible can be destroyed with smoke or flame. Use of an insecticide is not preferable. An Apiarist can be employed for assistance.

Indian Mynah *Achridotheres tristis*

A research team from the Australian National University has been trialing a method to remove Indian Mynahs in the 'Australian National University Minimising Myna Project'. Decoy birds and food are used to attract Indian Mynahs into a trap through special valves in the base designed to fit Indian Mynahs and Starlings *Sturnus vulgaris* but not other birds like the Australian Magpie *Gymnorhina tibicen*. Once the birds are trapped, they are taken away and humanely euthanased with Carbon Dioxide (CO₂) (ABC, 2002).

2.1.15 Control of Domestic Animals in Reserves

Community education regarding responsible pet ownership needs to be targeted across all areas adjoining bushland, in particular those areas where there has been declaration of a Wildlife Protection Zone. The focus of the education should be to encourage cat owners to keep their cat within residential property boundaries, particularly at night.

All bushland reserves in North Sydney require dogs to be on a lead at all times. This policy ensures that dogs are confined to the tracks and under control of their owner, which minimises disturbance to wildlife and the bushland. In 2003, this policy will be supported with educational signage stating North Sydney Councils policy that dogs be kept on leads, in all bushland reserves in North Sydney. Further, active enforcement of this policy is required by Council's Rangers. Dog bins and plastic bags need to be provided for all reserves. Dog Exercising areas are available around North Sydney to allow a space for dogs to run around freely.

In 2003 'The North Sydney Guide to Pets and Native Fauna' Community Education Kit was produced and distributed to all pet owners in North Sydney to educate residents on this issue. The aim of this education kit is to inform residents on why it is important to keep your cats indoors, all or most of the time, how to do this, why it is important and that it is legally required to keep dogs on leads in bushland areas.

For further information

Appendix J - *Cat Attack and Fates of Native Animals of North Sydney from 1991-2000; Some Statistics for Ringtail Possums – 1 July 2001 to June 2002* Sydney Metropolitan Wildlife Services

2.1.16 Lighting

Street lighting should not be aimed into the reserves. Shielding on the back of street lights should be implemented which greatly reduces the amount of light entering the reserves. Footpath lighting along bushland reserves need to be shielded so that light is directed downwards rather than radiating in all directions from an overhead light source.

Residents whose properties back onto the bush should be discouraged from having backyard spotlights pointing into reserves. A single backyard spotlight can dislocate fauna for 50m either side of the light source (White, 2002).

2.1.17 Nesting Boxes

Possum boxes are useful in providing homes particularly for Ringtail Possums, Brushtail Possums and occasionally Kookaburras. Possum boxes can be installed in all reserves with the exception of Berry Island. Possum boxes are utilized in the majority by Ringtail Possums although they are designed for Brushtail Possums.

The number of boxes will vary for each reserve depending on the size of the reserve. Please refer to individual reserve management plans in Section 2.3 for the numbers of boxes recommended. Further research and trial needs to be done to determine the most successful Parrot nesting box design. Other boxes designed for Owls, King Parrots and Kookaburras can also be specifically made, installed, monitored and evaluated. A publication from The Gould League of Victoria (1997) *The Nest Box Book: Nestboxes for Birds and Mammals*, covers a range of nest box design for species of birds, bats and possums. This publication can be referred to for specific nest box design for different species that may benefit from nesting boxes being erected in bushland reserves.

Possum boxes should be installed outside bee swarming season (generally for 6 weeks within mid-August to December) to try to avoid the possibility of European Honey Bees moving into the boxes. It will not be possible to avoid boxes being inhabited by feral animals, particularly bees and Indian Mynahs. If this occurs, the box should be removed.

Council encourages local residents to install possum boxes in their properties. Possum boxes are sold by North Sydney Council at cost price.

2.1.18 Roads and Traffic

Traffic calming devices could be installed along roads adjacent to bushland to reduce possum fatalities on roads.

Aerial pathways for possums can be constructed over roads by the Roads and Traffic Authority that have a particularly high incidence of road mortality. Roads, with few options for safe commuting overhead for possums, that have a high incidence of possum fatality, can be identified and the RTA approached for the construction of an aerial possum pathway. The RTA has constructed an aerial pathway for possums over the Wakehurst Parkway, to trial the success of pathways for possums needing to cross areas of frequent and high traffic usage.

2.1.19 Council Policy, Development Applications and Assistance Programs

Council's draft Development Control Plan Section 19 outlines guidelines for properties that share a common boundary with bushland. The guidelines are in place to ensure that works adjacent to bushland are compatible with the long-term conservation and management of remnant bushland in accordance with the Bushland Plan of Management and the principles of the State Environmental Planning Policy No. 19 – Bushland in Urban Areas (SEPP 19).

In March 2003 Council's Bushland Team met with members of Council involved with Development Applications to discuss Council's Development Application process to involve encouraging residents adjoining bushland to plant a section of their garden with indigenous native plants, so as to not adversely affect bushland. Development Applicants adjoining bushland will be provided with the 'Live Local Plant Local' poster, detailing appropriate indigenous species, planting conditions and plant details, how to create a Wildlife Habitat Garden and a list of Native Nurseries.

Council also provides a 'Native Havens – Flora for Fauna in your Garden' program free of charge to all residents in North Sydney. This program provides a professional site assessment, an information package, indigenous plants, assistance with planting, loan of tools and on-going support and advice. The program, through advertising aims to reach the community and encourage native habitat gardens.

2.1.20 Re-introduction of Native Fauna

Breeding and re-introduction programs of endangered native mammals, birds and reptiles has been trialed, successfully and unsuccessfully carried out in many parts of Australia by private and government bodies. The primary determinant factor in successful re-introduction and survival of the species is the availability of appropriate habitat and the eradication of the threat to the species – namely feral animals, in particular the Red Fox *Vulpes vulpes*. Fox baiting programs have been carried out in private sanctuaries that have re-introduced indigenous mammals, such as Earth Sanctuaries and Calga Springs Wildlife Sanctuary. An electric fence have been placed around the reserves after a total eradication of all feral predators has been carried out.

There are several other factors to consider with the re-introduction of any native fauna. These include issues of inbreeding and the animals being able to interbreed, and that the animals are still wild and able to survive in the natural environment. Populations able to inter-breed, is possible when species can travel easily between reserves ie. that they are not isolated. This can happen when the animals are mobile between large distances and able to utilize green corridors. Animals held in captivity for a great length of time, particularly over generations are difficult to release back into the wild.

Native Bees (*Trigona carbonaria*) and Blue-tongue Lizards (*Tiliqua scincoids*)

Due to the limited size and isolation of bushland reserves in North Sydney and the present of the Red Fox, the possibility of successfully re-introducing native mammals and birds is unlikely. However, the re-introduction of native bees *Trigona carbonaria* and Blue-tongue Lizards *Tiliqua scincoids* may be possible.

It is possible that these two species can also be re-introduced into bushland reserves in North Sydney's Middle Harbour Catchment. Foxes and in particular, cats and dogs will need to be eliminated from sites for Blue-tongue lizards to be released. Habitat and shelter sites would also need to be created with rocks, logs, grasses and other ground covers. Blue-tongue lizards readily utilize 'artificial' shelter sites and will eat native and introduced invertebrate species (such as the garden snail). These lizards also exhibit strong site fidelity and utilize corridors of dense vegetation (Koenig *et al* 2001). The native Bee *Trigona carbonaria* will live in artificial hives, however they need to remain cool. Sites chosen for native bee release will need to contain large tracts of flowering vegetation, such as Tunks Park.

Ku-ring-gai Council Re-introduction Program – Trials and Discoveries

In 2003, Ku-ring-gai Council's Bushcare Department in conjunction with the NSW National Parks and Wildlife Service and herpetologists, are breeding and releasing Blue-tongue lizards into suitable sites.

Ku-ring-gai Council's Bushcare Department has also been re-introducing native bees *Trigona carbonaria* back into bushland reserves. *T. carbonaria* naturally occur in Sydney and stock for releasing into Ku-ring-gai was sourced from Queensland, where genetic difference is minimal. It was discovered that the hives are susceptible to heat and that the bees can die on hot days above 40°C. The hives will now be painted with a ceramic paint called 'Supertherm' which is an insulation paint providing protection equivalent to 8 inches of fibreglass with a single coat.

Supplies can be purchased from:

'Supertherm' Available – online at www.supertherm.net

Native Bees *Trigona carbonaria* Available – online at www.uq.net.au/~zzrzabel

2.2 Statement of Management Objectives for Bush Regeneration Works

2.2.1 Policy for all Bushland Team Members and Contract Bush Regeneration Tenders

- That Tenders for Bush Regeneration must include a clause for native fauna habitat protection and enhancement specific to native fauna present on site. Tenders must meet a standard and be hired on merit for fauna habitat protection practices within bush regeneration works.
- That Bush Regeneration supervisors must be aware of native fauna habitat protection issues. These supervisors must be educated and instated on the basis that they are aware of native fauna habitat protection practices and will supervise these practices on site. All supervising staff should be given a copy of '**Native Fauna Habitat Protection Guidelines**'. This policy will need to apply to Council staff and all contracting staff.

2.2.2 Bushland Management Practices 'Native Fauna Habitat Protection Guidelines'

To be utilized in Bush Regeneration works by local Bushcare groups, contract Bush Regenerators and the Bush Regeneration Team throughout bushland in Middle Harbour Catchment.

Protect, Enhance and Recreate Middle-Storey Vegetation

The loss of middle-storey vegetation had a large impact on wildlife populations. To restore middle-storey vegetation is a foremost priority.

The middle-storey can be recreated using ecological burning, direct seeding, or planting. Poisoned exotic canopy and mid-storey trees should be left in situ until new native canopy trees have matured in height.

Creating Connective Canopy

To ensure that the canopy is still connected when removing canopy weed species, leave poisoned exotic canopy in situ until new native canopy tree has matured in height.

Buffer Planting

Buffer planting along the edge of the reserves can be done to increase habitat area. This may include plantings next to parkland or on the roadside. This will require the cooperation of other departments in the Open Space and Environmental Services Division.

Spraying of Herbicide

The spraying of herbicide should not be used next to creek lines and near water sources. Hand weeding and other methods such as blanketing out weeds should be used instead. The spraying of herbicide needs to be minimised where possible in all bush regeneration sites. Other methods should be adopted where possible.

Use of Mosaic Pattern for Weeding and Clearing (Method from Ondinea, 1997)

Begin weeding in number 1 areas and allow regeneration or revegetation to develop to a height of no less than 2m, or a density similar to the previous weed cover before commencing on number 2 areas and so forth. Choose upslope sites to begin work at and then move downslope.

Upslope

| | | | | | |
|---|---|---|---|---|---|
| 1 | 2 | 1 | 2 | 1 | 2 |
| 3 | 4 | 3 | 4 | 3 | 4 |

Downslope

Size of Bush Regeneration Site

Each site for bush regeneration should be no larger than 20m x 20m, or ? of the reserve (Ondinea, 1997).

Replacement of Ground Cover

Replace ground cover habitat components such as rocks, logs, leaf litter and native plantings. Uncover rocks from weeds and plant native ground covers around rocks to create habitat for lizards and skinks.

Removal of Exotic Vines

Cut vines back from indigenous trees, leaving the vine in the tree and remove base of vine from the soil. For non-indigenous trees, leave vines or cut back at base and remove base of vine where necessary, until the tree is removed.

When to carry out Bush Regeneration Works

'Primary' Bush Regeneration work and Ecological Management Burns (eg pile burns, broad area burns) should be done outside of breeding times of scrub birds: March, April, May and June, that are in an area to maximise the retention of the middle-storey for nesting habitat (see Table 1 in individual site management plans in **Section 2.3**).

'Maintenance' work should be carried out throughout the other months of the year.