

A hotbed of biodiversity? A natural history of the Ku-ring-gai council area

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ABSTRACT

The Ku-ring-gai local government area is a veritable hot bed of biological diversity as the area is peppered with numerous habitat types that support over 800 plant, at least 170 fungi and over 690 fauna species. The area plays an important part in Australia's cultural and natural history. It supplied much of the timber for early development of old Sydney Town from its tall forests and the first record of one of our most iconic bird species, the Kookaburra, by Governor Phillip's expedition party in April 1788. Ku-ring-gai's significant biodiversity stems from its diverse habitats and geological landscapes ranging from estuarine mangrove mudflats to steep sided sandstone gullies and ridges swathed in heath, open forest and riparian scrub to shale capped ridge tops with tall open forest. The area gets one of the highest levels of rainfall in northern Sydney which helps support open forest dominated by blue gums, blackbutts, turpentines and ironbarks on the richer clay soils. Today council reserves and the tree lined suburbs provide important bio-linkages or corridors between three national parks and smaller reserves within and around the lower north shore. Ku-ring-gai reserves and biodiversity are the legacy of visionary people, geography, planning and chance.

Key words: Morpho-species, biodiversity, habitats, plant communities, invertebrates

Introduction

If variety is the spice of life then biodiversity is the quintessential flavour!

The Ku-ring-gai Council area, though relatively small, is a diverse melting pot of habitats and species (see Tables 1 and 2). The area supports at least 26 plant communities and numerous habitat types that support over 800 plant, at least 170 fungi and over 690 fauna species including invertebrates and fish. This paper presents an overview of species and habitats in the Ku-ring-gai Council Local Government Area (LGA).

The geographic and geologic setting

Ku-ring-gai is located on the Hornsby Plateau between Hornsby and Chatswood approximately 14 km north of Sydney (see Figure 1). Most development is restricted to four main shale-capped ridges which are roughly followed by the Pacific Highway, characterised by a series of sandstone scarps and benches dominated by low Mona Vale Road, Fox Valley Road and Bobbin Head Road. The gently sloping ridge-top clay soils of the Wianamatta Shales drop away into steep sided gullies characterised by a series of sandstone scarps and beaches of the Hawkesbury formations. The LGA receives one of the highest rain fall totals in Sydney averaging around 1400mm per annum* which helps support the tall forest for which the area is famous. Ku-ring-gai LGA covers 84 km² with about 1,100 ha of Council bushland reserves many of which are contiguous with about 1,800 ha of National Parks including Ku-ring-gai Chase, Garigal Lane Cove and Dalrymple-Hay Nature Reserve.

Historical setting

The LGA was first officially recorded by European settlers on 15th April 1788 by Governor Phillip only about 11 weeks after the landing of the First Fleet. The area was occupied by the local Kuring-gai (Guring-gai) language group people after which the council area and national park were named. On this trip, starting near Bungaroo, was when the Kookaburra was first described being a "brown Kingfisher" (O'Reilly, 1950). When first settled the area was known variously as Hunters Hill and Lane Cove and was officially named as Ku-ring-gai around 1906 with the formation of the first Council.

Sydney's first botanist, George Caley, on an expedition in 1805 reported "some places were rather stony, but in general I have not seen so good forest land in the country" (STEP, 2007). He was referring to the area around St Ives to Thornleigh. The large stands of tall timber (blackbutt, blue gum, ironbark, mahogany and stringy bark) attracted the first settlers and timber getters from 1814 (Ku-ring-gai Historical Society, 1973). One tree was found to have a girth of 33 feet (about 10m). Several saw mills were established and timber was carried by bullock wagons to be loaded on punts at Fiddens Warf on Lane Cove River. The loggers were largely transient and moved on when most of the good timber was felled some time around the 1870s 1814 (Ku-ring-gai Historical Society, 1973).

The next phase of settlement was when orchards and market gardens were established on the rich clays soils, after logging had cleared trees, as early as 1826. These too declined after a number of good years of plentiful

*Climate data Bureau of meteorology - mean 1961 to 1990 for Kissing Point Road Turramurra NSW.

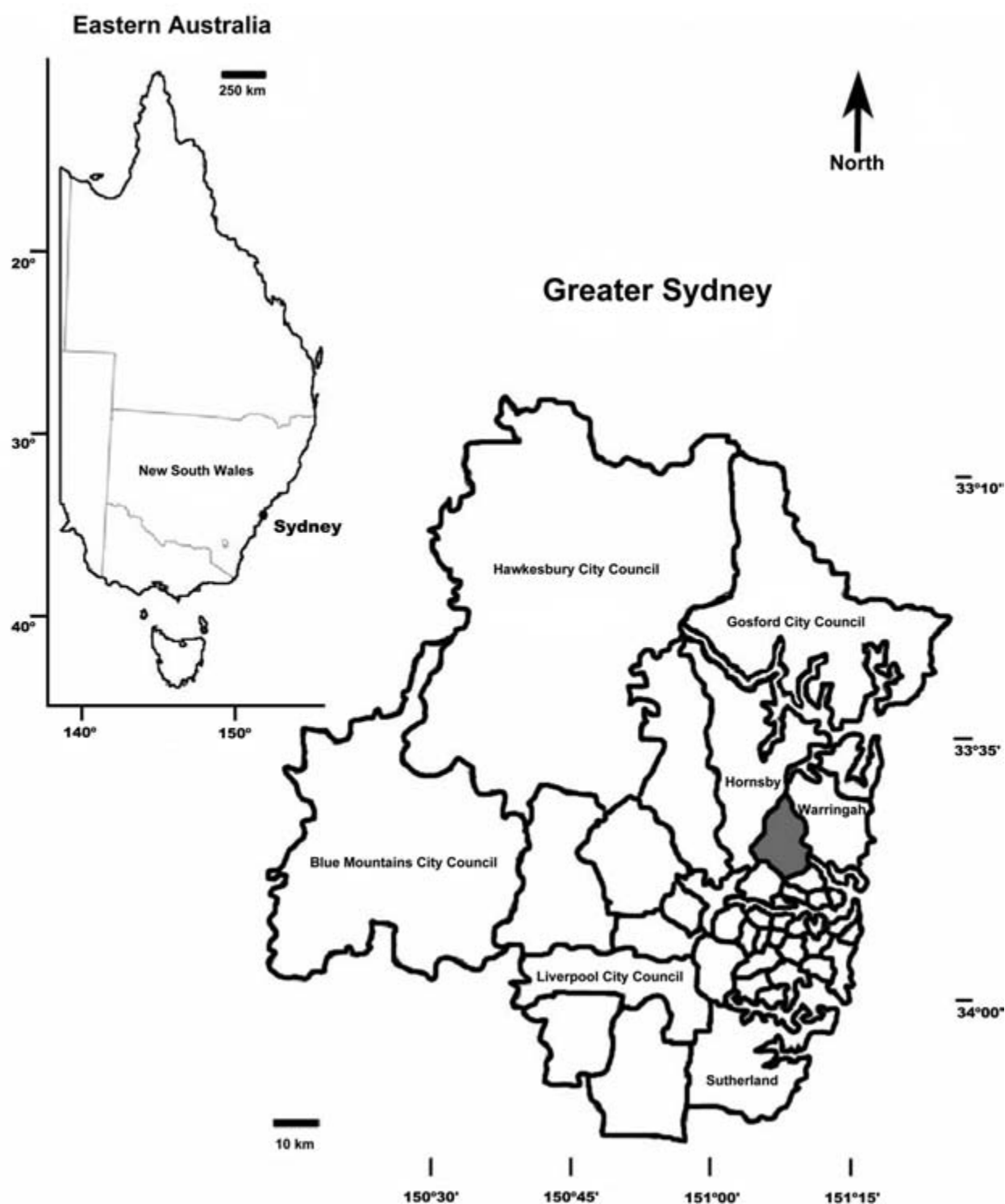


Figure 1. Location of the Ku-ring-gai Local Government Area (grey hatching)

harvests due to overuse, bushfire and the arrival of pests and diseases (The Ku-ring-gai Historical Society). Fruit orchards also attracted large numbers of flying foxes that were consequently shot in large numbers by similarly large shooting parties (O'Reilly).

After the orchardists the next development phase followed the building of the railway from Milsons Point to Hornsby around 1890 (O'Reilly). Subdivision of land into suburban blocks soon followed. By 1921, an old resident was recorded lamenting the '...loss of local

loveliness in the tall trees, orchards, ridges bedecked of waratahs and that the calls of the curlew and lyrebird were heard no more' (O'Reilly). The shire Council of the time recorded 1928 as a record year for building applications (O'Reilly, 1950). Large areas of bushland still existed into the 1930's – 1940's as recorded by Keast (1995).

The period between 1950 and 1980 was marked by a doubling in Ku-ring-gai's population from around 50,000 to 100,000 (Ku-ring-gai Historical

Society, 1996) Soaring land values encouraged many large landholders to sub-divide their properties for speculative development of Californian bungalows (Ku-ring-gai Council, May 2006). Larger properties with remnant bushland, orchards, dairies or horse paddocks gradually gave way to more houses and smaller urban blocks. However, the leafy character of Ku-ring-gai remained as development was, and still largely consists of single dwellings on urban blocks with gardens and tree-lined nature strips. Vegetation mapping carried out by Council in 2001 and 2008-2009 shows that a good proportion of this is remnant or regenerating plant communities. The remnants are mostly trees (individuals, clumps and larger stands) but understorey species also occur in places.

Following the NSW Government's Metropolitan Strategy (2005), the region is currently experiencing an increase in medium and high density development. New development is mainly along transport corridors which coincide with the level clay-capped ridges along the railway line, Pacific Highway and Mona Vale Road to St Ives. One consequence of this development is that the small remnants of Blue Gum High Forest and Sydney Turpentine Ironbark forest are diminishing and becoming more isolated.

The current reserve system of natural areas across Ku-ring-gai is a consequence of many factors. For example visionary plans created one of Australia's earliest national parks, Ku-ring-gai Chase which was gazetted on 14th December 1894. This was due to the efforts of Eccleston du Faur an early resident of Turramurra. At first refused by the state government the area of 35,000 acres (partly within our boundaries) was of such natural beauty that du Faur persisted and took the NSW Governor to visit the area. He was so impressed he added his voice to the call to preserve the area. Topography itself has also contributed with many bushland reserves occurring in steep-sided gullies (containing creeks and riparian vegetation) which are unsuitable for development. Other bushland sites have been donated by residents such as Wombin reserve in Lindfield, which contains Sydney Turpentine Ironbark Forest. This reserve was gifted to Council in 1968 by resident E.J. Price as " ..a reserve or sanctuary for Australian native fauna and flora". Other reserves have been purchased by Council such as Browns Forest, adjoining Dalrymple-Hay Nature Reserve, in St Ives. This land was purchased by Council for £1150 in October 1934, of which £350 came from donations (STEP, 2007). By chance this land was still available for purchase and uncleared as it was on sale for development purposes at the time. The site was purchased by after persuasion by the Dalrymple-Hay Forest Preservation Committee. The committee, formed earlier, by the Mayor of the time, Creswell O'Reilly included notable local resident Mrs Annie Wyatt who later founded the National Trust, Australia (STEP, 2007). Recently, with much lobbying and assistance from local environment group, the Blue Gum

High Forest Group, Council purchased the last available residential block off Rosedale road containing a good remnant of endangered Blue Gum High Forest. The land, purchased with donations, a Federal Government grant and Council funds, was added to the contiguous reserves of Brown Forest and Dalrymple-Hat nature Reserve in 2007. The combined parcels make up the largest high quality remnant of Blue Gum High Forest in reserves anywhere.

One of our largest and most pristine bushland reserves is the Ku-ring-gai Wildflower Gardens. This contains a small remnant of Duffys Forest ecological Community and various sandstone vegetation associations from ridge-top wet and dry heath, riparian forest to sandstone gully forest. This reserve is crown land in the care and control of Council which was gazetted for the '...promotion and study and preservation of native flora and fauna' (Ku-ring-gai Council, 1996). The reserve was gazetted by the State Government with assistance and lobbying from the local branch of the Society for Growing Australian Plants (now the Australian Plant Society).

Ku-ring-gai Council has a long history in bushland management for conservation purposes as well as the more traditional recreational open space uses. In 1978 Council formed the Bushland Management Working Party, made up of ecological experts, residents and staff to advise Council on all aspect of bushland management. Council commissioned a bushland vegetation study and Bushland Management Survey (Buchanan, 1983). The study was done to assist Council in its management in bushland and weeds. During 1984 Ku-ring-gai Council adopted its new Plan of management for Bushland Areas which was the first of its kind for a Local Government area in Sydney. The same year Council formed one of the first department sections dedicated to bushland management. This was a break away from most local Councils where bushland fell under the care of engineering or open space (parks) departments. With the gazettal of SEPP No. 19, Council prepared its Bushland in Urban Areas Plan of management in 1989 which identified open space bushland (Council and private lands) and a series of management strategies. Another significant milestone was the signing of the Voluntary Conservation agreement with the NSW Minister of the Environment for the Ku-ring-gai Flying-fox Reserve in 1991. This was the first such agreement involving Local Government in NSW (Ku-ring-gai Council, 1996). Council is about to sign a second conservation agreement for the Browns Forest reserve to make its management consistent with Dalrymple-Hay Nature Reserve. Another important community supported program is Bushcare which was started by Ku-ring-gai Council in 1989, well before the national program funded by the Natural Heritage Trust which took on the same name. This program, with over 700 volunteer members, has been an integral part in managing our bushland reserves by works on the ground and support for the program and conservation of bushland by the volunteers.

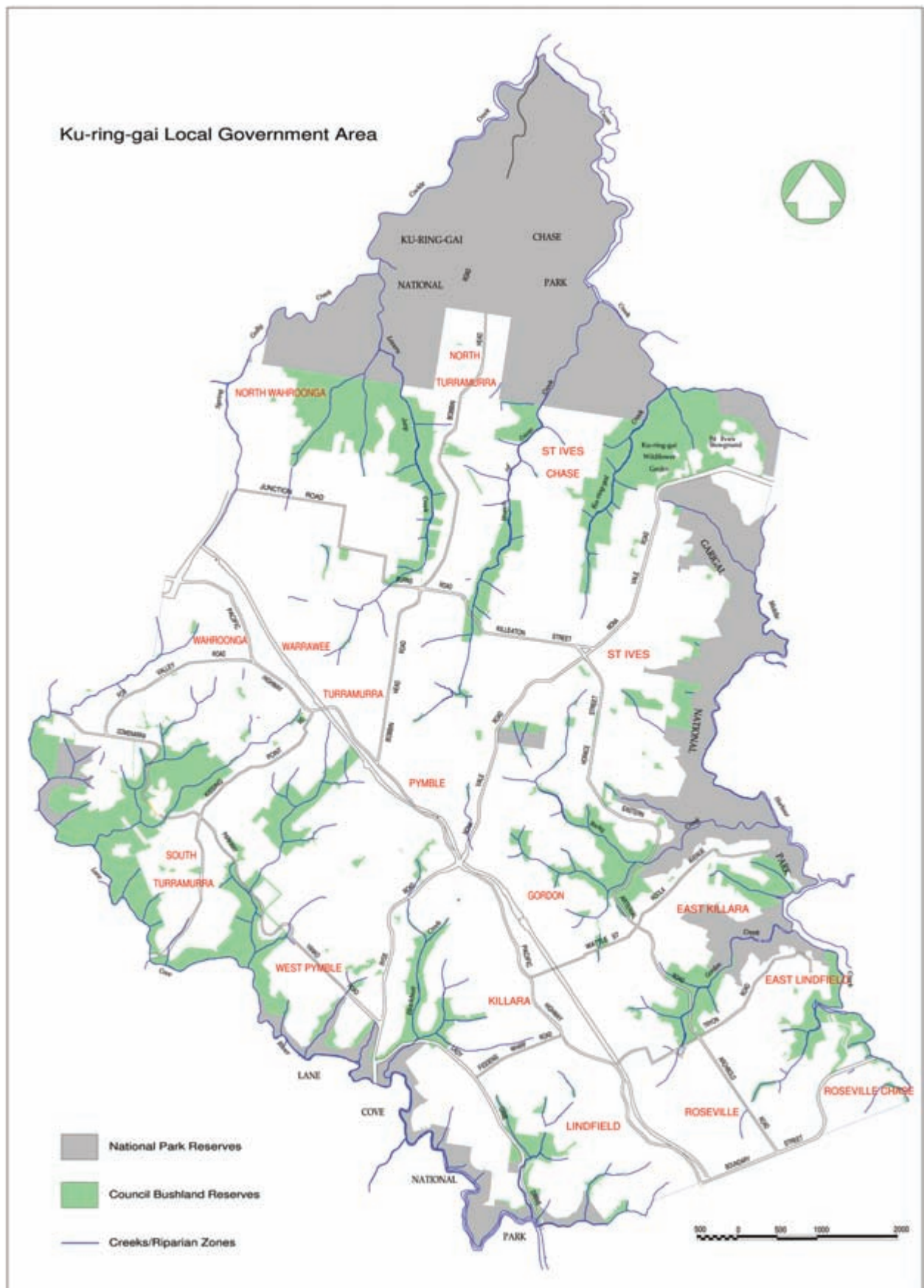


Figure 2. Council and national park reserves of the Ku-ring-gai LGA.

Habitats and diversity

The relatively high species diversity in the LGA is likely due to the diverse range of habitats, microhabitats and ecotones. (See Tables 1 and 2 and Appendix). The greater the diversity of habitats and microhabitats the greater the diversity of species can be supported.

Species Diversity Summary - Vertebrates and the *other 99 %

Table 1. Summary of biodiversity in Ku-ring-gai

Species and ecosystem diversity	Numbers of species or associations
Flora species	843
Fauna species	693 (including invertebrates)
Mammals	47
Reptiles	45
Amphibians	26
Birds	218
Fish	28
Invertebrates	329**
Fungi species	171
Vegetation associations	26
Threatened Species	
Flora species	15
Fauna species	28
Mammals	8
Reptiles	1
Amphibians	3
Birds	15
Fish	1
Invertebrates	1 - not confirmed
Threatened Ecological Communities	
Threatened Ecological Communities (NSWTSC Act)	5 (2 of these also listed under EPBC)

* IE invertebrates. ** Mostly aquatic macro-invertebrates identified to family or morpho-species only. Approx 195 identified to species or genus level. For a full species list refer to Ku-ring-gai Council, May 2006. *Biodiversity Strategy*.

Habitat is made up of several components including structure (such as vegetation layers or topography), number of species present, type of substrate (EG. soil, water or rock) and availability of resources (such as food or nest sites). These factors are also affected by climate, aspect, exposure and average humidity to determine the specific habitat and micro-habitat types available in any area. A greater

variability of habitat elements means a greater diversity of habitats. Human impacts also influence the types and quality of habitat available from relatively unmodified natural areas to highly modified remnants and totally artificial

Ku-ring-gai contains terrestrial and aquatic habitats (see table 2). These broad habitat types can merge into others forming ecotones between terrestrial and aquatic, urban and natural and between types within each group such as forest to woodland. Within terrestrial vegetation Ku-ring-gai contains various structural types of plant associations. Based on the Specht (1981) classification system there are structural types ranging from closed forest and tall open forest to low open woodland and low heath land. Depending on aspect, topography and soil type various subtypes of vegetation can be discerned such as mesic forest and sclerophyllous woodland, wet heath and 'rainforest'. Aquatic habitats include fresh and marine or brackish water types. Vegetation in these habitats includes riparian scrub along freshwater streams and mangrove forest such as the stand near Roseville Bridge in Middle Harbour which has largely developed on sediments from urban runoff.

The composition and number of plant species can influence the diversity of habitat available as some fauna and fungi for example are dependent upon one or a group of plant species. In Ku-ring-gai six main vegetation communities are listed in our Bushland Plan of Management (2006) being - Blue Gum High Forest, Sydney Turpentine-Ironbark Forest, Duffys Forest Ecological Community, Coastal Sandstone Heath, Sydney Sandstone Gully Forest (the most common and wide-spread vegetation group), Sydney Sandstone Ridge-top Woodland (Ku-ring-gai Council, 2006).. The first three of these are specific endangered ecological communities but the last three sandstone communities can be divided into more specific sub-types or associations such as Sydney peppermint – Smooth-barked Apple Open Forest. At least 26 plant associations are recorded in Ku-ring-gai Council, 1998.

Closed vegetation types occur along some sheltered creek-lines (riparian) dominated by coachwood known as riparian scrub or closed forest. Our most significant closed forest is a patch of 'rainforest' growing on a sheltered basalt diatrema at Brown's Field in South Turramurra, where cabbage palms and sassafras trees can be found. Other closed forms are mangrove forest in Middle Harbour near Roseville and wet heaths in the St Ives area.

Due to the geology of shale overlaying sandstone and the topography of flat ridges and steep-sided gullies various other sub-habitats and niches can be found. A series of benches occur in the sandstone layers below the shale-capped ridges where there are caves, rock scarps and 'perched' wetlands or soaks. Species that typically occur

Table 2. Examples of broad habitat categories in Ku-ring-gai.

Terrestrial habitats	Intermediate habitats	Aquatic Habitats
Forest	Riparian zones	Streams (freshwater)
Woodland	Mangroves	Streams tidal (brackish)
Heath	Wetlands / soaks	Estuarine (marine)
Caves, rock faces and soil	Intertidal zones	
Urban / artificial	Drains, culverts and channels	Dams, ponds, marinas

NB these categories do not necessarily coincide across the table.

in these areas include red-crowned toadlets and coral fern. Various 'urban habitats' also occur such as - parks and sporting fields, low density housing with large gardens, modified stream channels, golf course dams, culverts and buildings. There is a whole suite of species that are now considered to be 'urban fauna', including introduced and native species, and those that can only survive in pristine or relatively intact natural habitats (Smith and Smith, 2001).

Due to historical reasons most of Ku-ring-gai's bushland reserves are predominantly riparian but a number consist of sandstone ridge top reserves dominated by sclerophyllous low open forest, woodland or heath. It is these latter reserves that have the best quality remnant vegetation and water quality as there is an absence of the urban runoff, nutrients and weeds that degrade vegetation and habitats. Good examples of these are the St Ives Show Ground, the Ku-ring-gai Wildflower Gardens and Twin Creeks Reserve. The few streams in these areas are little affected by urban runoff. They consequently support the richest aquatic macro-invertebrate assemblages including sensitive taxa that do not occur in most other urban streams in the northern Sydney area (Wright et al, 2007). In fact, one stream (a branch of Cowan Creek) is of such high habitat and water quality it can be used as a reference stream for aquatic macro-invertebrate and habitat monitoring studies. This stream can serve as an example of how our natural waterways would have existed pre development (Wright et al, 2007).

The habitats that are least represented in reserves are the ridge-top clay and clay-sandstone transition communities. These provide habitat for the three threatened ecological communities of Blue Gum High Forest (BGHF), Sydney Turpentine Ironbark Forest (STIF) and Duffys Forest Ecological Community. Human activities such as forestry, agricultural and development pressures on these level fertile plateaux have been most intense since early settlement.

Recent studies have shown that Blue Gum High Forest in particular, though highly fragmented, is important fauna habitat. Studies on macro-invertebrates (Taylor et al 2006) and microbats (Basham, 2005) have shown these remnants have relatively high species richness and species abundance. The richness and abundance for these taxa are partly explained by the high biomass and moisture of the vegetation for both bats and invertebrates. Large mean trunk diameter and (vertical) structural diversity is also important for bats. Sheldon Forest, which contains remnants of BGHF and STIF that grades into Sydney Sandstone Gully Forest (SSGF), scored particularly well for microbat bat diversity and abundance. Similarly, the Dalrymple-Hay / Browns Forest reserve scored well as bat and invertebrate habitat. This reserve contains one of the largest intact remnants of Blue Gum High Forest. It is probably the most ecologically intact stand of BGHF and is therefore very important for conservation of this endangered community. It is also important for its value as fauna habitat.

The highest diversity of reptiles is found amongst the ridge top heath and woodland habitats probably due to the abundance of sandstone rocks, crevices and outcrops and high solar exposure. The greatest bird diversity has been found in the gully reserves with structurally and floristically diverse habitats grading from open sclerophyll forest to tall mesic forest and closed riparian scrub (Smith et al 2001).

The importance of Ku-ring-gai Council's diverse habitats and their connectivity to surrounding national parks has been highlighted by a recent study by the Department of Environment and Climate Change (DECC). The 'Rapid Fauna Habitat Assessment of the Sydney Metropolitan Catchment Management Authority Area' (2008) study, commissioned by the Sydney Catchment Management Authority, assesses the regional importance of vegetation remnants as habitat. Two connected vegetation complexes were ranked 6th (Middle Harbour) and 17th (Lane Cove Valley) out of the 50 remnants surveyed for their habitat value. The minimum size assessed was 50 hectares and a number of higher ranked reserves were much larger than those traversing parts of Ku-ring-gai. The study further indicated the high value of the local habits.

Diversity and relative abundance

Least frequently recorded species

A total of 392 fauna species were recorded only twenty times or less including those species in table 3. The lack of abundance for these species is likely due to lack of observations as many are cryptic, hard to identify, live in inaccessible habitats or are just unappealing to most people. Species such as the rock ringlet butterfly are easily confused with other butterflies and are inconspicuous. Even though they are common they are probably grossly under reported. Micro-bats are little studied, emerge only at night and cannot generally be identified by observation. Some species, such as *Mormopterus species 2* (Southern Free-tail bat), have only recently been described and are only discernable in the field by specialists using ultrasonic call detection and analysis. The first record of this species in the Ku-ring-gai LGA was 2005 in a study specifically on microbats (Basham, 2005). . Other species are rare or may be rare visitors to the area such as the Double-banded Plover which may just be a vagrant. Other fauna, such as the Spotted Tailed Quoll and Platypus (both sighted twice in the last 10 years), are only recorded as individuals occasionally. These species are uncommon and generally difficult to observe

The most diverse and abundant fauna are the most overlooked and least frequently observed. They are the invertebrates including the worms, insects, spiders, snails and their myriad kin. This group has been dubbed the other 99% referring to their relative abundance and diversity on the planet. Even the more obvious and appealing invertebrates such as 'pretty' butterflies or iridescent Christmas beetles are rarely recorded even though common. This may be because people do think it is not important to record invertebrates or that they are too far from us on the 'evolutionary tree' and therefore too dissimilar or that they don't have the 'cute and cuddly' factor. Similarly many public databases do not have provisions for recording invertebrates with many invertebrate species not known or described to the species level so are simply not recorded. This is true of the Ku-ring-gai LGA but many species or at least families have been recorded. So far about 329 taxa have been recorded. These are mostly aquatic macro-invertebrates identified to family or morpho-species level with approximately 195 identified to species or genus level. However, this is probably only a small percentage of the species diversity occurring here. For example sitting beside a small golf course dam in Gordon you

can easily observe 4 or 5 species of dragonflies or damselflies along with various species of spiders, water striders, moths and water beetles within the space of a few minutes. And this is not a particularly diverse area. Other habitats, such as heath or tall open forest harbour many more species. Local taxa such as ants are more diverse than others and are being used as surrogates to estimate overall diversity. A study currently underway by Chris Ives of Macquarie University in Ku-ring-gai so far has identified 72 morpho-species of ants at just 18 sites within 100m metres of riparian systems (refer also to Ives et al 2005, Ives et al 2007).

There are likely to be thousands of insect and other invertebrate species in Ku-ring-gai as studies have been very limited so far. Researchers such as Harry Recher, at Edith Cowan University and Jonathan Majer at Curtin University found nearly 2000 species occurred in the canopies of just four species Western Australian eucalypts. More invertebrate species were also found on the bark. Most of these were not known species but identified as morpho-species awaiting now identification.

Most frequently recorded species

Most fauna species observed in Ku-ring-gai were recorded more than once! Ten of the most frequently observed fauna are listed in Table 4. The statistical *mode* for fauna, (*IE the value that has the highest frequency*) for number of species sightings is five and the average number of sightings per species is 25.93. Fauna such as the Grey-Headed Flying Fox and Powerful Owl are frequently recorded even though they are threatened species. This is likely because they are large,

obvious and easily identified species. The flying foxes have a maternal colony in Gordon that typically houses around 20,000 to 40,000 bats in the breeding season. In rare seasons the colony may increase to over 70,000 bats as occurred in February 2009. Bat numbers swelled in our colony (and the other Sydney camps) as they moved in to take advantage of a mass flowering of Bloodwoods in the Hawkesbury area. The Ku-ring-gai Bat Conservation Society estimated that 25% of the entire Australian population of Grey-headed Flying Foxes moved into the Sydney region at this time. As for the Powerful Owls there are probably only a few pairs in the LGA but they have large ranges and often leave an impression on many householders with their loud calls and their habit of dropping half eaten possums in back yards. These, and other obvious fauna, like Kookaburras and Rainbow Lorikeets are probably over represented because they are easily recognised iconic species that frequent backyards and high rise balconies. For example ringtail possums 249 sightings were recorded with a total of 459 individual animals mostly near in gardens and on powerlines.

Many of these abundant species are now recognised as 'urban fauna' that have adapted and prospered in human landscapes (Smith and Smith, 2001). However, there are a large number of more sensitive 'bushland species' surviving in local reserves such as White-throated Treecreepers, Yellow Faced Honeyeaters, Red-crowned Toadlets, Bush Rats (*Rattus fuscipes*) and the Brown Antechinus. This is likely due to the size and connectivity of many local reserves with adjacent national parks and that they have good habitat diversity. Other fauna, such as Swamp Wallabies, Long-

Table 3. Ten of the least abundant or least frequently sighted species

No of sightings	Sum Individuals	Scientific Name	Common name
1	1	<i>Charadrius bicinctus</i>	Double-banded Plover
1	1	<i>Chasmagnathus haswellianus</i>	Crab
1	1	<i>Chthamalus antennatus</i>	Barnacle
1	1	<i>Chthonicola sagittatus</i>	Speckled Warbler
1	1	<i>Cristiceps aurantiacus</i>	Golden Weedfish
1	1	<i>Junonia Villida ssp. calybe</i>	Meadow Argus Butterfly
1	1	<i>Euastacus spinifer</i>	Freshwater Crayfish
1	1	<i>Galaxias maculatus</i>	Common Jollytail
1	1	<i>Hypocysta euphemia</i>	Rock Ringlet Butterfly
1	1	<i>Mormopterus sp.2</i>	Southern freetail Bat

Table 4. Ten of the most abundant or most frequently sighted species

No of Sightings	Sum Individuals	Scientific Name	Common name
89	552	<i>Limnodynastes peronii</i>	Brown-striped Marsh Frog
221	671	<i>Eolophus roseicapilla</i>	Galah
321	726	<i>Gymnorhina tibicen</i>	Australian Magpie
145	801	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo
118	1056	<i>Lampropholis guichenoti</i>	Garden Skink
469	1100	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
372	1113	<i>Platycercus elegans</i>	Crimson Rosella
48	1518	<i>unassessed ICE I – Elmidae Family</i>	Riffle Water Beetle
422	4793	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet
161	79760	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox

nosed Bandicoots and Brush Turkeys have become more frequently observed over the last 6 years. This is in part due to regional urban fox control programs that Ku-ring-gai and other Councils and the National Parks and Wildlife Service (DECC) have been undertaking since 2000 (Mason and Olsen 2000). Brush Turkey numbers have been increasing in many areas of NSW including some where fox baiting is not occurring. One theory is that they are finally recovering their population numbers and previous range after being extensively harvested for food during the Great Depression of the 1930's (Pers com Geoff Ross, Wildlife Management Officer, NSW National Parks and Wildlife Service)

Some mechanisms for protecting biodiversity

There are many mechanisms available to protect what is left, and to perhaps enhance it in places. The current planning legislation in NSW calls for all Councils to create a new standard LEP (Local Environmental Plan). The new LEP template though it simplifies the mechanisms available can be a vehicle for conservation as well as development. The standard template includes environmental protection zones or *E zones* for conservation purposes, for example the E2 or Environmental Conservation zone. Local clauses and map overlays can be added to an LEP to include provisions for protection of biodiversity. The NSW Department of Planning and the Local Government and Shires Association can provide advice on overlay maps and local clauses for conservation areas that can be included in Local Environmental Plans. More detailed provisions can be added to the Development Control Plan (DCP) associated with the Local Environmental Plan.

Other ways Councils can help protect biodiversity is to sign conservation agreements with the NSW Department of Environment and Climate Change for reserves or encourage private land owners to do so for private lands. Purchasing lands with biodiversity value may be an option as Ku-ring-gai Council has done for its Flying-fox Reserve. Gaining community support is very important whether it is for purchasing land or protecting reserves under voluntary conservation agreements. Community groups and residents can lobby and influence State and

Federal members of parliament in ways Councils are unable to. Simpler ways to protect and enhance local is to form Bushcare groups, carry out bush regeneration and hold tree planting days using local indigenous plants. A study near Northam Western Australia, showed that planting trees already found in the area (indigenous trees) is much better for encouraging wildlife than planting similar, non-indigenous, trees from even short distances away (Recher 2001).

Policy and management plans are essential the daily and long-term protection of local biodiversity in Council owned or managed reserves. Councils are required under the Local Government Act to have plans of management in place for all their lands and many Councils including Ku-ring-gai have them specifically for bushland reserves. Biodiversity strategies are useful tools to set goals and help maintain biodiversity on public and Councils lands. To make these documents more effective Ku-ring-gai has linked these directly to its (general) Management Plan so that goals become key performance indicators rather than just 'vision statements' or ideals.

Conclusions

Binning and Young (1999) and Paul Adam (2004) assert the view that Local Government has an essential and important role in biodiversity conservation. The Ku-ring-gai area has a faunal fecundity and diversity which makes it significant amongst the diminishing natural areas of the Sydney metropolitan landscape. Its faunal richness is due to its habitat variety, connectivity to larger reserves and its place in the surrounding urban and natural landscapes. As the 'quintessential flavour to the spice of life' the biological diversity of the Ku-ring-gai and surrounding local government areas, is an important and essential ingredient in our recipe for future conservation of species in our region.

Ku-ring-gai's surviving biodiversity and habitats are partly the legacy of visionary people, geography, planning and chance. The maintenance of local biodiversity in Ku-ring-gai, and other Local Government areas, will not persist by chance alone but by planning for the future and with the help of visionaries and the local community.

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APPENDIX I – Photographs habitats and fauna

Appendix I contains photographs of some common and rare fauna species recorded in the Ku-ring-gai Council area.



Some Habitats of the Ku-ring-gai Council area

Mesic Tall Open Forest (Blue Gum High Forest) St Ives

Over 30,000 records - the data has been collected from several sources including the NSW Wildlife Atlas DECC), the Australian Museum's specimen collection, the Royal Botanic Gardens, our own Wildlife Watch records and other sources such as consultant reports and studies.

•Available via the Internet at www.kmc.nsw.gov.au

APPENDIX I



Sydney Sandstone Gully Forest, Lindfield. Note the sandstone outcrops with fissures



Wet heath and woodland, Ku-ring-gai Wildflower garden, St Ives



Freshwater Creek Ku-ring-gai Wildflower garden, St Ives



Mangroves on tidal estuarine inlet Middle Harbour, Roseville Chase

APPENDIX I



Riparian scrub Sheldon Forest
Turramurra



Fauna: The other 99% - invertebrates of the Ku-ring-gai Council area

Black Jezebel Butterfly – only one record but may be common



Swordgrass Brown Butterfly (*Tisiphone abeona*) Common in sandstone flora with saw sedges (*Gahnia* spp) that its larvae feed on



One of a number of Ringlet butterflies common in the area but easily overlooked confused with other species

APPENDIX I



A Geometrid Moth (*Epidesmia* sp) on kidney weed (*Dichondra repens*). Common around tall moist forest and adjoining suburban lawns but not reported in Council databases except for this observation



Meridolum middenense – a land snail often found in moist leaf litter in open sclerophyll forest. It is easily confused with other native land snails



Bulldog ant (*Myrmecia* sp.) - one of several species common in bushland reserves



Lipotriches australica - one of many species of native bee that occur around Sydney, buzz pollinating a *Dianella* flower

APPENDIX I



The tiny social native bee *Trigona carbonaria* is common but rarely noticed or recorded. An efficient pollinator it can often be found in suburban gardens and vegetable patches when air temperature is over 18°C.



An unidentified hoverfly living up to its name. A very common group (the *Syrphidae*) that has a preference for the daisy family flowers and seems to prefer yellow. Their larvae are useful predators of aphids



Freshwater shrimp (*Paratya australiensis*) – seasonally quite abundant in many freshwater streams but unseen as it is transparent, small – noticed only when caught through dip-netting.



Dragonfly (unidentified) one of two common red species in the area around sunny creeks and golf course dams

APPENDIX I



Australian Emerald dragonfly *Hemicordulia australiae* common in the area shows its iridescent colours in direct sunlight



Red and blue damselfly (unidentified), probably uncommon, one of 5 Odonata family observed around a single golf course dam on one warm morning



Web of life – a blue damselfly (*Ischnura* sp possibly) ensnared by an unidentified species of spider at the same golf course dam



Freshwater yabbies a small species rarely recorded or observed but not rare

APPENDIX I



The fiddler beetle not rare but rarely recorded. Much of its life is spent as a larvae feeding on decaying wood. The adults emerge in summer and feed on flowers.



Fauna – vertebrates of the Ku-ring-gai Council area

Grey-headed Flying-Foxes in their camp in Gordon. A threatened but very noticeable species due to its size, habits and vocalisations. Regularly recorded by residents and counted by the KBCS



Bentwing Bats (*Miniopterus schreibersii*) using a road culvert to roost. The dark patch in the upper right corner is a water spider.



Echidna found near Council Chambers Pacific Highway Gordon. An easily identified but unobtrusive species observed occasionally in urban bushland and backyards.

APPENDIX I



Ringtail possum - probably the most frequently recorded native mammal in the area as it lives in urban areas and is easily observed feeding in gardens or as it gambols across roofs. This one was photographed by our tree maintenance crew in the fronds of a palm.



The common eastern froglet (*Crinia sinifera*) is a small and cryptic but easily identified by its inordinately loud call. A common and frequently recorded species.



Dwarf Green Tree Frog (*Litoria fallax*) is cryptic but easily observed with a distinctive call so is frequently recorded. This is our most commonly reported tree frog.



The Red-crowned toadlet a cryptic fossorial species with a quiet non-distinctive call. It is recorded much less than other species in the area. It depends upon clean soaks and minor rivulets to make its nest in wet vegetation only in sandstone areas.



Common and frequently recorded the inquisitive eastern water skink frequents various habitats including riparian areas and backyards



Rare and rarely recorded the Heath Monitor (*Varanus rosenbergii*) is probably often confused with the more common Lace Monitor (*Varanus varius*)



The diamond python (*Morelia spilotes*) is relatively common, easily identified and observed due to its size so is frequently recorded



The most frequently recorded venomous snake species. Obvious and usually easy to identify accurately the red bellied black snake is often seen sunbathing on bush tracks and sometimes in backyards. Other common local venomous snakes are more cryptic and harder to tell apart at a glance such as - swamp snakes and whip snakes

APPENDIX I



The yellow faced honeyeater is relatively common in bushland reserves but is not frequently recorded. It is small and cryptic but has a loud and distinctive call



The rare but frequently recorded Powerful Owl often leaves an impression on residents due to its large size, penetrating stare, booming call and habit of leaving half-eaten possums in back yards.



Glossy Black Cockatoo is a quiet unobtrusive species but easily observed as it happily cracks open Casuarina 'cones' for seeds. It is rare and generally recorded in pairs or small groups up to 5 birds.

APPENDIX I



Glass perchlet and southern blue eye are both common species rarely recorded. Locally they are found in brackish estuaries and fresh water streams such as Middle harbour.



The flat headed Gudgeon is cryptic and rarely recorded but probably relatively common in freshwater streams in the area.

All photos David Wilks except ringtail possum photo – Ku-ring-gai Council and echidna – Alison Walker