An Assessment of the Fauna Habitat along Kedron Brook

Report to Wildlife Preservation Society of Queensland

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1 Project brief and aims

The Kedron Brook Fauna Habitat Study was commissioned by the Wildlife Preservation Society of Queensland to assess the current status of wildlife habitat along Kedron Brook and, in particular, review the role of Bushcare Groups and other projects in provision of fauna habitat along Kedron Brook.

The study focuses on localities associated with current and past Bushcare activities. The locations of Bushcare sites along Kedron Brook are shown in Figure 1.

2 Methodology

The study was undertaken by

- Field assessment of the potential wildlife habitat
- Identification of fauna known to occur along Kedron Brook from lists recorded in other studies
- Listing fauna observed in Bushcare areas by Bushcare groups
- Application of current ecological theory to the Kedron Brook Study area.

Each of the Bushcare sites was assessed (usually with the Bushcare site coordinator) to determine

- Current characteristics of the site that may provide habitat for wildlife.
- Fauna at the site as evident from direct observation or tracks, scratches, scats, burrows and nests.

This report describes the potential and existing fauna habitat along Kedron Brook. Information is based on site inspections and discussion with Bushcare site coordinators. Fauna habitat is described in terms of the components of a particular ecosystem that are used by fauna. A natural ecosystem is vegetation associated with a particular combination of geology, landform and soil (Sattler & Williams 1999). Modified ecosystems in this study are associated with a particular management regime. Natural and modified ecosystems remnant along the Kedron Brook are identified and delineated in Figure 1.

“Fauna Groups” are identified in this report as species that have similar lifestyle or habitat requirements. The components of the ecosystems used by different fauna groups are described. It was beyond the scope of the project to give detail on each species thus the general habitat requirements and use of existing habitat by species groups is discussed. This report provides an overview of the habitats, their connectivity and sustainability within the Kedron Brook catchment.

The abundance and quality of habitat for fauna occurring in the study area was reported. Some limiting factors were identified; these are of a general nature, as systematic observation over several seasons is required to determine the patterns of use of habitat by wildlife.

Significant fauna habitat in terms of its rarity, threats or potential is identified. Threats to fauna are described with a brief discussion of mechanisms to mitigate or avoid threats.

An overview of methods for carrying out fauna observations and habitat assessment are provided. These are aimed at providing Bushcare groups with some general guidelines with which to undertake consistent site assessment.

Finally, the experience of Bushcare groups are summarised and some of the different approaches discussed. Outcomes and updates on past projects are provided including a report on the effectiveness of past and current planting and habitat provision projects. A brief review of Bushcare project sites describes the current status of the locality in which the Bushcare site(s) are located with regard to;

Remnant natural vegetation
Current fauna habitat
Habitat enhancement
Project recommendations

Recommendations for further habitat rehabilitation along Kedron Brook are provided.

This report also provides an annotated bibliography and lists sources of information that may be used by Bushcare groups to access information on different species, habitats and assist in the identification of fauna.

The report will be circulated to Bushcare groups working along Kedron Brook. It will hopefully raise an awareness of the potential for habitat restoration along Kedron Brook and provide a useful resource for fauna management. The report will provide a platform on which Bushcare groups can build a network of action, which will over time, lead to the preservation and enhancement of the limited habitat still available to fauna in a highly developed landscape.

2.1 Study circumstances

The study was undertaken over an eight-week period from September 2001 to November 2001. It commenced prior to the onset of substantial rain, the previous summer had not produced high rainfall and there had been no falls in the previous eight months. Much of the vegetation was moisture stressed, and weeds were less conspicuous due to their susceptibility to low moisture. Ephemeral pools within Kedron Brook were dry; flow was present only in the lower sections. Frogs were inactive at this time; hence, assessment of their habitat was limited.

Good rainfall early in November provided opportunities to review the status of frog habitats and observe changes in flow in Kedron Brook. Several frog breeding sites were observed but not all Bushcare sites were re-visited.

Birds occupying habitat in the mountains move to the food rich resources of urban gardens to seek food at this time of year. Their presence may mask the actual numbers of species relying solely on the resources of the Kedron Brook catchment.

Time constraints on the project prevented the inspection of several Bushcare sites. General recommendations are applicable to these sites. It is anticipated site inspections and data collection may be undertaken at a later date and reported to relevant Bushcare groups.

The study is not a comprehensive survey but was confined to a one-off habitat assessment of sites. This report is not a "*fait accompli*" but rather a collection of observations, ideas and knowledge on which to build a sound understanding of wildlife along Kedron Brook.

3 Study Area

Kedron Brook lies to the north of the Brisbane CBD. It rises in the D'Aguilar Ranges east of Brisbane where there are two main tributaries, Kedron Brook and Cedar Creek. The uppermost sections of Kedron Brook are ephemeral gullies draining the southern slopes of the Samford State Forest section of Brisbane Forest Park.

Cedar Creek drains the northern slopes of Mt Nebo including Bellbird Grove and Camp Mountain Reserve, it joins Kedron Brook at Ferny Grove to the west of the Keperra Golf Course. From here, the stream meanders with an almost permanent flow through the well-established urban areas of Arana Hills, Mitchelton, Everton Park and Grange. Low hills on either side of Kedron Brook confine the meanders on the coastal plain.

Sandy Creek joins Kedron Brook at Grinstead Park (Alderley). This tributary drains bushland in the Enoggera Military Camp then flows through urban and industrial land before entering Kedron Brook. Although Kedron Brook has been channelised through the Lutwyche, Wooloowin and Toombul reaches, extensive areas of open parkland or bush are associated with the floodway. Downstream from Toombul the channel is under a tidal influence. The original channel has been modified and re-routed to the north to drain the site of the current Brisbane Airport. Kedron Brook enters Moreton Bay on the southern boundary of the Boondall wetlands.

3.1 Background – geology and ecology

Most of upper catchment lies on the Neranleigh-Fernvale geological formation, ancient metamorphic rocks producing poor soil. Granitic intrusions in the catchment occur in the vicinity of Settlement Road (Quarry). Volcanic rocks in the form of Brisbane tuff occur in the Grange Forest Park and Lutwyche reaches of Kedron Brook. They are not well exposed in the vicinity of Kedron Brook (Windsor Quarry, Sparkes Hill) although small outcrops form the channel bed in the Lutwyche reach (Near Crushers Football Club). Tingalpa Formation and Ipswich coal measures comprise the geology in the vicinity of Kalinga and Wooloowin sections of the Kedron Brook. Beyond Toombul, river sands and gravel and coastal sediments comprise the substrate. In these areas there is potential for acid sulphate soils to form.

The complex geology and landforms would have been reflected in diverse ecosystems and associated biota associated with the Kedron Brook prior to European settlement.

Poor soils in the upper catchment would have supported open forests and woodlands dominated by eucalypts. The understorey would have had a mix of shrubs and grasses, probably with a high number of species adapted to poor soils like the heath plants still represented at Downfall Creek. Soils derived from volcanic rocks are usually better quality soils with more nutrients available to plants. In these areas, the forests may have been denser, perhaps with an understorey of rainforest shrubs and herbs. Dry vine forest probably occurred in gullies and riparian forests in sheltered sections of Kedron Brook. As the Brook meanders through the coal measures (Kalinga) the vegetation would have once again changed – an open eucalypt forest would have occurred on slopes with poor and shallow soils.

On the floodplain the substrate is enriched by periodic flooding, landform characteristics determine the vegetation. Paperbark forests, billabongs, swamps with reeds and flowing channels would have been present in different combinations along the original channel of Kedron Brook. The transition from freshwater to saline habitat would have been gradual with some swamps near Kedron Brook inundated by the sea only occasionally and others more regularly. These conditions could change following floods that can alter the channel and surrounding floodplain.

3.2 History and settlement

Past land-use along Kedron Brook has undergone a sequence of changes that are similar to other parts of the Brisbane area. The rich resources in South-eastern Queensland enabled a many aboriginal tribal groups to establish semi-permanent camps in the area. The local undumbi people were custodians of the land; they harvested food and no doubt influenced the numbers of different species in the area through plant and animal harvesting, and modifying the environment either by fire or by planting.

The fact that the lower reaches of Kedron Brook were one of the first sites of free settlement is testimony to the rich resources and attractive nature of Kedron Brook to the new settlers. As settlement expanded in Brisbane, settlers sought the best land for harvesting timber and establishing productive market gardens. This land was also that favoured by wildlife and undoubtedly had the highest biodiversity.

Brisbane boomed in the 1880's, but reticulated water supplies were limited at the time. With seasonal rainfall, it was important to have a reliable water source; Kedron Brook provided that. Farming, urban and industrial development spread in a more or less haphazard manner to the west along the reaches of Kedron Brook. Transport corridors and proximity to water linked development. Intensive use and limited sanitation had led to pollution of Kedron Brook by the early 1900's.

By the 1930's, much of the Brisbane landscape had been modified by timber harvesting, agricultural pursuits and urban settlement. The pristine creeks had lost a lot of their vegetation, and water quality was declining. During this phase of Brisbane's history, many of the creek systems were considered convenient drains for the disposal of wastewater – from industry and domestic sources. Development of many innovative chemicals, and a lack of understanding of their toxicological consequences, led to damage to the waterways. There are tales of the creek waters

around Brisbane foaming with bubbles at the time of introduction of detergents – which unlike the soaps previously used, did not break down in the natural environment.

Development in the 1960's and 1970's led to siltation of the creek. Land unsuited to housing was filled – used as refuse dumps. Sites were located in the past at Grinstead Park, Wolverhampton Street, Hickey Park, Emerson Park, Upper Kedron, Teralba Park and at the Nudgee Tip site.

The 1974 flood and subsequent mitigation had a further dramatic effect on Kedron Brook. Habitat was lost, flow patterns changed, variation in depth and bank characteristics of the channel were altered in middle sections of Kedron Brook. New ecosystems were created by channelisation.

Airport development in 1980 led to the modification of the tidal reaches of Kedron Brook with the formation of Schultz canal. Prior to development for the airport, the coastal plain had supported many ecosystems including freshwater swamps, paperbark forests, coastal scrubs, mangroves and saltmarsh. Most had been severely degraded by time of the airport re-development.

The developed (mostly urbanised) land through which Kedron Brook flows is described in this report as an urban landscape. In addition to the areas of urban settlement, the urban landscape includes roadways, some industrial land, shopping complexes, schools, sports fields, parklands and undeveloped (abandoned) land. From these developed areas stormwater carries pollutants and fertilizers into the stream system. This on-going degradation causes a decline in the water quality. This in-turn results in a loss of diversity of aquatic flora and fauna.

3.3 Current situation

Urban development in the upper catchment is contributing to the loss of natural ecosystems and habitat in the Kedron Brook catchment. It is also one of the greatest potential sources for sediment and nutrient discharge into Kedron Brook. Urban developed and related activities are more regulated and undertaken with greater environmental awareness than ever before. Despite this, the development will have an irreversible impact on local biodiversity.

In 2001, Kedron Brook has taken on yet another role. A network of parkland, bush and land not able to be "developed" due to flooding or other restrictions have become an important community resource. The areas are important for recreation but also provide relicts of habitat for wildlife still surviving in the human modified landscape. For in the 21st century the visual, recreational and habitat quality of the remnant open areas along Kedron Brook have the potential to at last improve.

4 Ecosystems along Kedron Brook

The natural ecosystems along Kedron Brook were not well documented at the time of settlement. The following descriptions are based on scant historical records, observation of remnant vegetation and knowledge of ecosystems usually associated with the landforms occurring along Kedron Brook.

Much of the vegetation along Kedron Brook functions in a natural way in that plants disperse to sites, establish and grow with little human intervention. Unfortunately, many of the plants in vegetation near Kedron Brook are not native to the local area. Where remnant natural vegetation occurs, it is in small patches which differ from the original more extensive areas by having lower species diversity, having edges which differ in canopy structure and function, and are physically isolated from other similar areas of habitat.

When ecosystems or remnant vegetation patches are linked the component plant and animal populations have greater chance of breeding, facilitating genetic mixing and therefore long-term survival. Linkages also assist in re-colonisation of disturbed or destroyed habitat.

Kedron Brook, the associated streamside vegetation, and the surrounding floodplain provide a continuous linkage of aquatic habitat across the landscape. This link contains some form of wildlife habitat for most of its length. Streamside vegetation and floodplains habitats vary in form and composition along the length of Kedron Brook and therefore provide different types of habitat and effectiveness of linkages for different fauna.

4.1 Distribution of remnant ecosystems

Map based on aerial photographs – use the headings below as units Shown in Figure 1
Broad ecosystems defined and may contain several ecosystems.
Narrow stream vegetation too narrow a unit to be adequately mapped. Type indicated within mapped units covering the channel.

4.2 Remnant ecosystems along Kedron Brook

The following descriptions provide an overview of vegetation types (ecosystems) readily identifiable along Kedron Brook All types can intergrade with one another and can vary in composition, structure and naturalness. More detailed vegetation types may be identified with detailed field observation. Remnants along Kedron Brook often have some vegetation components (i.e. understorey, canopy, herbaceous species) altered or removed.

4.2.1 Riparian forest

Riparian forest may have a sparse or a more dense (closed) forest canopy. Sparse riparian canopies contain trees such as ti-tree and paperbarks, the understorey has a variety of grasses, sedges and matrush (*Lomandra* spp.). The canopy may be

continuous and connected across the steam but doesn't provide a dense shade to the stream bed.

A close riparian canopy tends to shade the stream channel. Along middle and upper reaches of Kedron Brook, *Waterhousia floribunda* is a common native species contributing to these canopies. Occasionally *Casuarina torulosa* and paperbarks (*Melaleuca quinquenervia*) are present. In the past, this vegetation would have contained a diversity of native trees. Currently camphor laurel (*Cinnamomum camphora*) and exotic celtis (*Celtis sinensis*) contribute to the tree canopy. The understorey is variable yet sparse; ferns, grasses and herbs would have been common in natural areas but in the remnants Lomandra and introduced grasses dominate the understorey.

4.2.2 Eucalyptus open forests and woodlands

Several remnants of eucalypt open forests and woodland occur close to Kedron Brook. Once this vegetation would have been common on the low hills surrounding the stream. It is likely that all remnant forest in the area has been cleared or modified to some degree in the past. Some of the larger remnants are located within Grange Forest Park and in Sparkes Hill Reservoir. The forest types vary subtly with aspect and soil type. A mix of tree species, usually eucalypts (species of the genera *Eucalyptus*, *Corymbia* and *Angophora*) are present in a relatively open forest canopy. The understorey includes dense shrubs in places but is grassy in most locations. *Themeda triandra* probably dominated the understorey in these forests prior to European settlement. Native and introduced grasses and herbaceous weeds dominate now.

4.2.3 Paperbark forests

Paperbark forests were perhaps one of the most widespread ecosystems on the Kedron Brook flood plain prior to development. The understorey would have contained grasses, sedges, *Lomandra* sp., ferns and herbs. Paperbark trees (*Melaleuca quinquenervia*) are scattered along the length of Kedron Brook but the oldest stands of paperbark can be seen at Keperra Golf Course and along the tributary adjacent to Australian Catholic University (ACU). Here old trees persist, but the associated understorey has been modified (in the golf course), severely weed infested (as at ACU) or managed as mown parkland (as in Kalinga and Hickey Parks). This rich habitat may have supported ground orchids and other noteworthy species prior to settlement. Weeds and invasive vines threaten unmanaged stands of paperbark forest.

4.2.4 Littoral riparian forests

Littoral forests are those that occur in areas where there is some tidal influence. Species in these locations reflect the transition from a freshwater to a saline stream system. Conspicuous in the riparian forest canopy are the Beach Hibiscus (*Hibiscus tiliaceus*), a tall tree that develops along the coastline and fringes Kedron Brook. Other trees in natural littoral forests would include beach scrub species such as Tuckeroo (*Cupaniopsis anacardioides*). The original understorey in these habitats is not known although it was probably sparse and supported matrush, ferns and sedges.

Currently weeds dominate this forest type that occurs in a small section along the lower Kalinga and Toombul reaches of Kedron Brook.

4.2.5 Mangrove ecosystems

Mangroves occur in areas under tidal influence from Toombul to Moreton Bay. The water is saline and trees are particularly adapted to these conditions. The most common mangrove in the Brisbane areas is the grey mangrove (*Avicennia marina*), other species present include the river mangrove (*Aegiceras corniculatum*) and yellow mangrove (*Ceriops tagal*). Understorey is generally absent in mangrove forests however along the terrestrial fringes areas of salt-water couch (*Sporobolus virginicus*) may occur. Mangrove ferns (*Acrostichum speciosum*) and several herbaceous species associated with salt flats (i.e. *Juncus kraussii*, *Sesuvium portulacastrum*) can also occur in these areas.

4.2.6 Grassland

Grasslands are an important habitat that develops in response to disturbance or occupies particular environments in the landscape. In the natural landscape disturbance may be a result of flood or fire. Grasses establish on abandoned sites which may be frequently disturbed by slashing or flooding.

Native grasses and grass-like plants associated with wetlands provide cover and food for wildlife, are useful in filtering stormwater, stabilize drainage lines and out compete less desirable weed species. Native grass-like plants associated with wetlands along Kedron Brook include sedges (*Cyperus* spp., *Scirpus* sp., *Lepironia articulata, Baumea articulata, Eleocharis* sp.), rushes (*Juncus usitatus*– tolerant of a range of conditions), bulrush (*Typha orientalis*) and grasses (*Phragmites australis, Paspalum distichum, Eragrostis* sp.).

Native swamp grasses (*Phragmites australis*) is a tall grass reaching 3m tall, tolerant of brackish water. It is an important component of wetlands as it provides wildlife cover, prevents erosion and useful in waterway cleansing by filtering out sediment. Remnants of *Phragmites australis* grassland are present in the Nundah area where they are in poor condition; this habitat is better represented at the airport in a complex of woodlands and wetlands.

Since settlement, exotic grasses have replaced the native grasslands. Grasslands dominated by introduced species are probably more widespread than the native grasslands would have once been. Para grass (*Bracharia mutica*) dominates large swards in the Kedron Brook channel; it is a fast-growing grass that establishes vegetatively. Para grass can be difficult to control – requires herbicide, grazing or mechanical cutting. Other grasses forming dense swathes include *Panicum* spp., *Pennisetum purpureum,* bamboo (*Bambusia* spp.) and giant reed (*Arundo donax*).

4.3 Modified and managed habitat

Despite modification, many components of the urban landscape provide resources for wildlife.

4.3.1 Parklands

There are many areas of parkland associated with the floodplain of Kedron Brook. Although the parklands contain many tall and mature trees (often eucalypts or paperbarks) most of the parks have been cleared in the past or modified by filling or extraction of sand and gravel. In these areas, the soil structure has been changed and the regenerative capacity of native plant communities therefore limited. Most parklands are maintained by mowing of the grassy understorey. Areas without a lawn understorey occur in small pockets they are often the areas rehabilitated by Bushcare groups or less accessible pockets with weedy or shrubby regeneration.

4.3.2 Channels

In the channelised sections of Kedron Brook, a distinct assemblage of plants has developed in response to the channel formation and the on-going management imposed. The sandy channel supports a range of native and exotic emergent aquatic plants. Conspicuous is the native bulrush (*Typha orientalis*) but other native species include *Lepironia articulata* and *Juncus usitatus*. Para grass (*Bracharia mutica*) is widespread along the channels and forms dense swaths in sections of Kedron Brook. Some of the notable large areas are within the channel in the vicinity of Grange Forest Park and Mitchelton reaches.

4.3.3 Abandoned land

Land near Kedron Brook cleared of native vegetation in the past for development, gravel or timber extraction may have development prohibited by flooding thus the land is abandoned. Some of these areas develop the grasslands described above. Others develop groves of native and mostly exotic trees and shrubs.

The exotic Chineese celtis (*Celtis sinensis*) and camphor laurel (*Cinnamomum camphora*) are most commonly encountered although many other introduced plants have become well established along Kedron Brook. Shrubs like lantana (*Lantana camara*) and Japanese sunflower (*Tithonia diversifolia*) form broad swathes with occasional emergent trees and few other plants. Often the abandoned land is a mix of the above species with aggressive vines readily establishing where the land is laid bare. Vines like Morning Glory (*Ipomoea cairica*) and Madera vine (*Anredera cordifolia*) have the capacity to smother all forms of shrub and tree vegetation thus reduce the diversity and structural complexity of the vegetation. Such areas of weed infested abandoned land occur in pockets along Kedron Brook with some of the most extensive examples occurring in the Mitchelton reaches.

5 Fauna habitat in Kedron Brook

The diversity of fauna that once inhabited the Kedron Brook catchment has been severely restricted by the development of the landscape since European settlement. Roads and developed land form barriers to the movement of many animals in the urban landscape. In addition, predation by domestic and feral animals is a threat to ground-dwelling fauna. Ground-dwelling fauna are poorly represented in Kedron Brook landscapes; yet encouraging certain fauna into urban areas could be detrimental if individuals are prone to road kills or predation.

The main groups of fauna associated with Kedron Brook are briefly described below. A general description of their habitat requirements, threats and occurrence is provided. Fauna observations during the project were of an opportunistic nature and comprehensive survey was not undertaken. Discussion is based on incidental observations, previous studies and relevant publications. Bushcare group co-ordinators have indicated wildlife observed in the vicinity of their sites. The results of this overview are tabulated in Appendix 1.

5.1 Invertebrates

This is a broad group too diverse to discuss in detail. Invertebrates are animals without backbones and include insects, spiders, crustaceans, worms and molluscs. Aquatic habitats are important for many invertebrate species as the water supports and protects their bodies as well as providing a medium in which to move. Invertebrates may live entirely within the water or have part of the life-cycle (i.e. larval stages) within the water. Others are drawn to water as a source of food and to drink. Invertebrates are widespread in all parts of the landscape but development has changed the balance through loss and alteration of habitat.

5.1.1 Aquatic invertebrates

Aquatic invertebrates are often a component of the lower levels of food chains, and are species on which many others depend. It is often invertebrates, feeding on algae or rotting plant material, that are the basis of foodchains in aquatic and terrestrial ecosystems.

Invertebrate animals vary in their sensitivity to physical and chemical changes in the aquatic environment. The abundance of species may vary seasonally or be a result of an overall decline in water quality. Bio-monitoring is a method by which the aquatic fauna of a stream are identified and the quality of the water is designated on the basis of the most sensitive species persisting in the waterway.

The biodiversity of aquatic organisms declines with declining water quality. The quality of water in Kedron Brook is reported as being in fair condition. The lower water quality was recorded in the Ferny Grove reaches and improved as the stream through the Mitchelton reaches (BCC, 2001). There has only been limited systematic measurement of water quality along Kedron Brook.

Aquatic invertebrates of interest that may be encountered in Kedron Brook are outlined below.

- Two species of water spider may occur in Kedron Brook.
- The Giant water bug is the largest of its type in Australia and may occur in Kedron Brook.
- Digger wasp holes were observed at Osborne Road and Sparkes Hill on bare soil areas not far from Kedron Brook.
- Flowing streams and associated vegetation are key habitat for many of the dragon and damselflies that spend the nymph stages of their lifecycle in the water.

Freshwater crustaceans (shrimps, prawns) occur in Kedron Brook, the highest diversity is expected in the upper catchment where there is less pollution. Sediment entering the waterway threatens crustaceans in upper reaches of Kedron Brook. Crustaceans are filter feeders and live in running water or larger pools; they may be associated with emergent or submerged vegetation.

Coastal crustaceans are losing their habitat due to clearing and are very sensitive to disturbance and pollution. The swamp crayfish is reportedly one of the worlds smallest and inhabits paperbark forests in South-eastern Queensland. It is possibly extinct in Brisbane but because of its cryptic nature may persist unnoticed.

Termites of the genus *Nasutitermes* construct arboreal nests in dead trees or on dead limbs; they build soil galleries (trails) running up the trees and feed on dead wood. Kingfishers and lizards use the arboreal nests as temporary residences. Several of these were located along Kedron Brook and at two locations were being used as nesting sites by Kookaburras.

5.1.2 Butterflies

Butterflies can be readily recognised and there is considerable knowledge of the biology and resource requirements for many species. By providing particular for butterflies, they can be encouraged to an area and increase in numbers.

Butterflies require suitable larval food plants, food for adults (flower nectar and other plant juices) and water for adults. Butterflies can be specific in the types of plants required to lay eggs on. The plant must provide food for the larvae when they hatch and protection during pupation. Larval food plants may be quite different from the plants required by an adult butterfly that feeds on nectar and sap. Different butterflies have different requirements. There are many listings of food plants for butterflies (see Reference section). Generally a diversity of flowering native tree, shrub, grass, vine and herb plants will increase the diversity of butterflies able to use an area

Some butterflies have become rare in South-east Queensland due to loss of habitat. Butterflies are able to utilise both the Kedron Brook environs and nearby urban gardens. In urban gardens pesticides applied to fruit trees and garden plants will harm butterflies or their larva.

Native shrubby and herbaceous plants used by butterflies that have been replaced by exotic flower gardens and weeds. Generalist butterflies can use these plants but the resources available to more specialised native species are limited.

5.2 Fish

Many of the small fish in Kedron Brook are introduced. The Gambusia or Mosquito fish was observed in all reaches of Kedron Brook and was released many years ago. Aquarium fish (guppies, platys and swordtails) are common in the middle reaches of Kedron Brook. Notwithstanding this, native Gudgeons, Crimson – spotted rainbow fish, Olive perchlet and Pacific blue eyes have been reported from Kedron Brook (BCC website).

Larger species of native fish are common along permanent flowing parts of Kedron Brook. Silver perch swim in small schools close to the surface; they are particularly active when there is some flow in Kedron Brook.

In spring the male jewfish or eel-tailed catfish builds nests in the sandy shallows by swimming round in circles to form a circular depression. Once the female has laid her eggs, the male guards the nest for up to 3 weeks. On hatching, juveniles hide in aquatic vegetation.

Other species observed include eels. The larger fish probably survive in Kedron Brook because they are too large to be bothered by the aquarium species. To date Kedron Brook appears free of carp and other larger exotic species that could jeopardize the survival of the larger native fish.

Fish most likely to survive in Kedron Brook are those able to utilise a number of habitats, adapt to change and tolerate the fluctuating pollution and nutrient levels.

5.3 Amphibians

A decline in frog populations around the world was noted in the 1970's, in some cases habitat loss has caused decline, in other areas the reasons for it are less well known (Robinson 1993).

Frogs are considered here according to the habitat they frequent; tree frogs, marsh or sedge frogs, and burrowing frogs all occur in the vicinity of Kedron Brook. The utilisation of breeding areas by the different groups is not distinct, different species (from different groups) will use the same breeding pond or habitat.

In addition, frogs tend to be opportunistic – they breed when there is sufficient water and it is of a temperature that stimulates their calling and therefore mating. Permanent ponds are not necessarily required, species will utilise pools of standing water on playing fields, in parkland and in intermittent drains.

Breeding is successful in these locations if there is sufficient time for the tadpoles to develop before the water body dries up. This is then a balance between providing adequate (warm) water temperatures to facilitate rapid frog development and protection of the waterbody from predators that would make a quick meal of emerging froglets.

General requirements for frogs to breed

- Off-stream habitat
- Appropriate water temperature and duration of intermittent ponds
- Vegetative protection for emergent froglets and metamorphs
- Nearby habitat or linkages to habitat suited to adults of species (various)

Frogs can breed in unlikely locations; many species will breed in inconspicuous areas unnoticed by human visitors.

Breeding within the main stream of Kedron Brook is probably limited by the presence of exotic fish that aggressively nibble on tadpoles, and competition with cane toad tadpoles. Observations prior to the onset of the first good rainfall for the season indicate cane toads tend to "jump the gun" on native frogs. Cane toads are a tough and adaptable species that breed earlier in the season, often in response to light rainfall which did not stimulate mating calls in native species. Toad tadpoles are able to use concreted drains and other modified structures in which to breed and develop. All Bushcare groups reported cane toads in the vicinity of their activities. Frog distribution was less well known.

Frogs disperse to new habitats during wet conditions when they may be washed in floodwaters downstream or migrate across land. The latter is most likely during a "good" wet season when frogs will move to other areas if they hear others calling vigorously. Urban areas provide suitable habitats for frogs; garden vegetation, standing water and debris to shelter under. Roads are a hazard to movement, particularly busy ones. There appears a tendency for drivers to target toads on the road and hopefully miss the more agile native frogs.

Successful frog breeding has occurred in Grinstead Park where two different areas of habitat are managed to facilitate successful breeding and frog development. One is an area of grassland that is filled to form an ephemeral pool following good rain. The second is a drainage channel in which water is retained by the construction of a low earth wall. The latter area has taller and denser vegetation and steep-sided banks. Green tree frogs, Graceful tree frogs and the Ornate burrowing frog were recorded from the grassy soak in 1996.

The Brisbane Frog Society (BFS) undertook a detailed survey of frogs in Grinstead Park in 1998. Results of the assessment are shown in Table1. The Laughing tree frog (*Litoria tyleri*) is reported from the headwaters of Kedron Brook (Upper Kedron area) (BCC website). Recent urban development in this area may threaten this species. A Stoney creek frog (*Litoria lesueri*) was observed in the worm farm at Ferny Grove High School (M.Lowson *pers. comm.*)

Table 1 Frogs numbers recorded from Grinstead Park in Summer 1998

Frog species	Grassy soak	Drain
Ornate burrowing frog	10	100
Green tree frog	10	10
Graceful tree frog	15	200
Eastern sedge frog		3000
Bleating tree frog	5-6	40
Striped marsh frog	5-6	500
Tusk frog		20
Cane toad		5-6

Frog tadpoles were observed in a grassy soak at Alderley Grove and potential breeding sites in grassy soaks occur in many locations along Kedron Brook including Zion Hill area, Australian Catholic University, playing fields and grassy drains in the Mitchelton reaches, and any other grassy areas which retain water for a period and have some dense grassy or shrubby vegetation in the vicinity.

5.4 Reptiles

A high diversity of lizards occur in the Brisbane area (Wilson & Czechura 1995) yet the specific requirements of many reptiles and their actual distribution along Kedron Brook are poorly known. Some species are common and often seen (Eastern water dragon, Water skinks), others are smaller or more cryptic (prefer to hide) and therefore their distribution is unknown but they may be quite common along Kedron Brook.

Because most reptiles are ground-dwelling they are vulnerable to predation and death on roads. This problem is compounded by the tendency of species to “sun” themselves in early spring on the warm bitumen of roads. As a lot of the reptiles, particularly skinks and smaller lizards, have a relatively small home range they are able to reside in small pockets of habitat retained in the vicinity of Kedron Brook and in urban yards. For some of the smaller species the trunk of a mature eucalypt may provide an adequate home range.

Most reptile groups are expected to be more common in the outer suburbs where larger areas of suitable habitat are available. Reptiles are often ground dwelling and may burrow, shelter under rocks, stones and logs, use hollows in trees or hide under the bark of trees. Many are insect feeders and will congregate where insects are plentiful (i.e. near the stream). Larger reptiles tend to be omnivorous (native violet flowers are a favourite food of bearded dragons).

Dragons and water skinks are abundant along the length of Kedron Brook. They can often be seen resting in sunny locations on rocks or upper banks of the stream and are quick to retreat to the waters edge or cover of thick vegetation when disturbed. Keelback snakes were noticed at several locations along Kedron Brook and are therefore expected to be relatively common.

Reptiles expected to be associated with larger bushland remnants would include land snakes (Brown snake, tree snakes) and monitors. No monitors were reported by Bushcare groups or observed during field visits, however, scratches on eucalypts indicated their presence in the upper catchment in the Samford State Forest section of Brisbane Forest Park.

An absence of ground cover such as fallen timber, leaf litter and nesting hollows probably limit the distribution of reptiles in parklands. Disturbance by dogs and cats may prevent nesting. Roadways limit movement from one habitat to another in the urban landscape. Despite these conditions, skinks are plentiful in areas with a ground covering of leaf mulch or fallen timber.

Turtles are common in deeper reaches and in pools along Kedron Brook. The saw-shelled turtle was most commonly sighted although several groups reported the Brisbane long-neck turtle occurred near their areas.

5.5 Mammals

Mammals have become severely restricted in distribution in the urban landscape. Wallabies and kangaroos have disappeared from most of the area; road kills have contributed to this. Red-necked wallabies were last seen 2 years ago in the vicinity of the Ferny Hills Bushcare group site (G.Mills *pers. comm*.) in the upper reaches of Kedron Brook.

Bandicoots survive in some of the larger open forest remnants. They are evident by their diggings, shallow triangular scrapings on the soil surface. The Long-nosed bandicoot is common in the Sparkes Hill Reserve where they are active at night and shelter under lantana thicket during the day. Diggings were observed upstream in forest remnants however there was no evidence of bandicoots in the Kalinga Park forest remnant.

Echidnas possibly occur in some of the upstream remnants but were not reported by any Bushcare groups. Described as widespread in Brisbane (Caneris 2001), echidnas are vulnerable to road kills and predation by dogs.

A solitary old fox is known to inhabit the Sparkes Hill Reserve.

Larger mammals are likely to be present in the uppermost reaches of Cedar Creek (near Mt Nebo) and in the Enoggera Military Camp (upper reaches of Sandy Creek). It was beyond the scope of this project to detail species in these areas. Enticement of large mammals from these refuges into urban areas is not practical as the fauna will quickly become exposed to the predation and road-kill hazards of urban areas.

Linkages between upper catchment populations of large fauna and those within the Boondall-Airport complex are not possible. If genetic mixing of populations is found to be necessary, a manual transfer of individuals would be required. Our developed landscape does not offer possibilities of safe mammal movement along Kedron Brook at present.

5.5.1 Possums

Perhaps one of the mammal groups best adapted to urban life are the possums; the Brushtail possum is able to utilise food (fruit and ornamental species) and nesting resources (building eaves and roofs) within the urban landscape. This species is widespread and with the arboreal lifestyle can traverse the urban areas and roads (via powerlines).

The Ringtail possum is a less common species and was reported from Melrose Park Bushcare group and Colac Channel Bushcare group in the lower-mid sections of Kedron Brook. This species prefers greater connectivity of the tree canopy than the brushtail and therefore less able to adapt to the fragmented forest canopies in the urban landscape.

5.5.2 Bats

Because bats are able to traverse the urban areas, they can use food and nesting sites in the urban landscape. Three groups of bat can be identified – the fruit bats, blossom

feeding bats and insectivorous bats. The most well known are the fruit bats or flying foxes. They feed in vegetation along Kedron Brook and on garden trees in surrounding urban areas.

Flying foxes visit Brisbane in the summer months and roost in groups numbering in the thousands. There are eleven main roosting areas in Brisbane; one is situated on Sparkes Hill. There are three species that use the same daytime roost areas, the most common is the Black flying fox, but the Little red and Grey-headed flying foxes are also present.

Blossom bats feed on flowering eucalypts, paperbarks (*Melaleuca* spp.) and other trees; larger trees provide a more plentiful food resource.

Insectivorous bats are small (microbats) swift and feed at night, they are sometimes detected by a shadow around a light or by high-pitched clicking sounds. Kedron Brook is an important feeding habitat for these bats. Concentrations of insects emerging from the water are a rich food source. They feed in urban areas and are considered important in the control of many insect pests. Insectivorous bats nest in tree hollows and the reduced number of large trees in the developed environment has probably limited nesting sites available.

5.5.3 Platypus

The platypus is found in freshwater in eastern and South-eastern Australia, it is a semi-aquatic animal that feeds under water and nests in a long burrow dug into the streambank. Although common, they are vulnerable to habitat change, water pollution and degradation of streambanks and associated siltation. Platypus feed on small aquatic fauna such as insect larva, freshwater shrimps and crayfish. They are active at dusk and dawn and anytime on rainy days. They have excellent hearing and disappear at the approach of people. Mating occurs in August and the female lays eggs in a long nursing burrow and may stay within it for several months.

The platypus has specific requirements in terms of streambed structure. It is believed to be common in Brisbane although is rarely seen. There are several locations along permanently flowing reaches of the Kedron Brook with potential platypus habitat. The steep earth banks at Kalinga Park provide such habitat although the vegetation does not significantly overhang likely burrows sites. Platypus have been seen in the area and few dispute the possibility of platypus in Kedron Brook. Suitable locations for platypus may occur in the upper reaches of Kedron Brook in the vicinity of the Keperra Golf Course and in deeper pools in the Mitchelton reaches.

5.6 Birds

Of the fauna occurring along Kedron Brook, birds are probably best adapted to exploiting resources in the urban areas. They can cross roads and developed areas thus more mobile birds are favoured over low-flying birds with short flight distances.

The urban landscape appears to favour birds that roost, move or act in groups. Along Kedron Brook a diversity of species were recorded and varied with the location depending on habitat available. The following discussion considers groups of birds

based on the ecosystems and landforms that meet most of their habitat and lifestyle requirements.

5.6.1 Waterbirds

Ducks, waders and species associated with in littoral zone are included in this group. The mouth of Kedron Brook and the adjacent Boondall and Moreton Bay wetlands are internationally significant breeding grounds. Migratory birds such as whimbrels and sharp-tailed sandpipers gather in large numbers on the margins of Moreton Bay to feed. Few of these migratory species venture upstream along Kedron Brook.

Birds that congregate in small groups or have solitary behaviour (i.e. White faced heron, Little egret, Royal spoonbill) feed within sections of Kedron Brook. Both remnant natural sections of the stream and channelised sections are useful as wildlife habitat.

5.6.2 Stream margin species

Species commonly encountered along the channel include the White-faced heron, Pacific black duck, Dusky moorhen and egrets that hide and feed in the channel, and streamside vegetation.

Insectivorous birds are attracted to the insects emerging from the water. They nest in the reeds or grasses growing next to Kedron Brook. Cisticolas and warblers occupy Bulrush (*Typha orientalis*) or Para grass dominated areas along the channelised sections.

On the drier margins of the streamside vegetation; finches, wrens and quail inhabit dense swards of grass. Birds were observed in grassland adjacent to Grange Forest Park and in overhanging lantana thickets in the upper catchment.

5.6.3 Forest birds

This group includes the species that live in forest areas, many are able to use the open parkland and urban gardens to feed and nest.

A number of forest birds prefer dense cover and would have once taken refuge in the understorey of dense forest or shrubby thickets. Clearing of understorey for the formation of parkland, paths and roads has reduced the cover available to these species; they are now less common in the landscape due to a lack of habitat. Silvereyes are an example of forest birds that are still relatively common in the gardens and in thick vegetation remnants along Kedron Brook.

Species of forest birds that have declined in the urban landscape are Bush stone curlew, finches, some honeyeaters, robins, flycatchers and babblers. Many have lost the type of habitat or food resources they prefer. For others, fragmentation of the once more extensive forest areas to small patches has reduced the available home ranges they would have once defended as large family groups.

Two pairs of whipbirds were reported form the GFP-Sparkes Hill sections of Kedron Brook in the 1980's. Now only one or two male whip birds live in thickets of vegetation in the Grange Forest Park forest remnants. The only other whipbirds were reported from the uppermost parts of the catchment in Brisbane Forest Park. This

indicates how the isolation of forest fragments in the urban landscape can prevent re-colonisation by species.

5.6.4 Hollow nesters

Parrots, lorikeets and rosellas find plenty of food resources in the urban gardens and public parklands but the number of tree hollows available for nesting possibly limits numbers. Different sized and shaped hollows are required for different species. A list of birds recorded from the local areas and utilising nesting hollows is given in Table 2. Bees, bats, possums, tree snakes, skinks and lizards also use the hollows.

Clearing of the landscape has reduced the number of tree hollows available to wildlife. Nesting boxes have been place in many parklands and near Bushcare sites to provide additional hollows. This has had mixed success but a thorough and systematic assessment of available hollows and their use by native and introduced wildlife is required.

Introduced Indian mynahs have been observed to evict native birds to take up hollows provided in nesting boxes.

Table 2 Hollow nesting birds recorded from Kedron Brook

Eastern rosella
Galah
Pale-headed rosella
Rainbow lorikeet
Scaly breasted lorikeet
Sulphur crested cockatoo
Dollarbird
Rainbow bee-eater
Indian myna

Kookaburras may nest in tree hollows; at Sparkes Hill and at the ACU Bushcare sites they were observed to be nesting in the arboreal termite nests. As the termites feed on dead wood the presence of standing dead timber becomes an important ingredient for the provision of kookaburra and kingfisher nesting resources in the urban landscape.

5.6.5 Raptors and owls

The freshwater habitat and many associated reptiles and fish occurring along Kedron Brook provide a rich food resource for raptors and owls. Mudflats and grassland at the mouth of Kedron Brook is the only known breeding and roosting location for grass owls in south-eastern Queensland. The grass owls have been observed in the middle (channelised) sections of Kedron Brook. Little is known of this bird and protection of existing habitat it is known to frequent is paramount.

Frogmouths roost in forest remnants and are occasionally recorded from urban gardens. Sea eagles, whistling kites, osprey, brown falcons and the Nanking kestrel have all been recorded patrolling Kedron Brook from far above.

Extensive undeveloped land around Brisbane Airport and Boondall Wetlands has been identified as significant nesting and roosting areas for raptors (Hayes *et al.* 1996).

6 Habitat along Kedron brook

This section is based on reports from Bushcare groups on fauna associated with their areas. Lists compiled by the respondent groups Appendix 1 were used to build a picture of fauna occurrence and distribution along Kedron Brook. Wildlife habitat indicators were identified at each Bushcare sites visited.

Resources available to fauna change in response to season and habitat contraction. The availability of a resource to particular wildlife is determined by its ability to access resources within the surrounding urban areas. An important consideration is the ability of an animal to move through the developed landscape.

6.1 Habitat links

Kedron Brook is a wildlife corridor linked along its length by the flow in the stream and by the streamside vegetation. Although this habitat changes along the length of Kedron Brook, it does form a continuous link across the landscape and functions to provide a corridor for much of the wildlife associated with Kedron Brook. Habitat links vary with species, and are usually perceived quite differently from humans. Fauna groups with limited distribution along Kedron Brook are

- ground-dwelling animals,
- those requiring a large home range and
- those vulnerable while moving within the urban landscape.

As a consequence, wallabies, kangaroos, monitor lizards and possibly echidna do not occur along Kedron Brook. Ground-dwelling birds such as quail are confined to remnant bush adjacent to the Kedron Brook.

A continuous riparian forest cover does not exist along Kedron Brook; it was probably not continuous even before European settlement. Forest birds that prefer to remain hidden are limited in their distribution in urban and parkland areas due to the wide spread clearing of understorey vegetation.

Facilitating animal movement is important to allow for recolonising of unoccupied areas and to allow genetic mixing of populations. Many animals disperse at different times of the year and require different types of continuity to move through the landscape. For forest birds preferring open forests Clumps and scattered trees every several hundred meters are sufficient. For ground-dwelling birds or cryptic species' a dense cover of vegetation is required, the continuity of such vegetation will be an important determinant of wildlife movement. Frogs dispersing during wet seasons require shelter and moist habitats fairly close together to hide and rest during the day.

Ground-dwelling fauna should not be encouraged out to the margins of bushland or into areas with many busy roads where species are vulnerable to predation or road kills.

Wildlife to encourage includes

- birds currently with limited resources,
- birds declining in the urban landscape,
- reptiles with home ranges covering small areas (i.e. smaller species),
- species that remain closely aligned to the stream channel.

6.2 Significant habitats

Several types of fauna habitat have been identified as significant within Kedron Brook because they

- Are habitat currently limiting in the environment.
- Have potential for Bushcare groups to achieve aims in habitat creation
- Support species which will use the habitat and are already in the area
- Have been successfully restored in other locations and/or Kedron Brook.
- There is community interest in pursuing projects of this nature.

The nature and location of significant habitats along Kedron Brook are discussed below. Bushcare activities that improve wildlife habitat condition or increase the amount of habitat available are recommended.

6.2.1 Streamside habitats

This is one of the fundamental habitats associated with flowing streams. As long as the Kedron Brook is functioning naturally, some streamside habitat will develop. This habitat includes emergent aquatic and terrestrial plants. The area is exposed to periodic flooding which is a natural process. As the water rises in the stream organic material that has accumulated on the soil surface adjacent to the stream is washed into the aquatic system and is a forms food resource on which many aquatic invertebrates (filter feeders) depend. Streamside vegetation can be washed away and bare areas exposed by flood. Sedimentation of the channel produces new areas on which vegetation can develop. Unfortunately, weeds quickly colonise these areas along Kedron Brook.

Where trees form the streamside vegetation, they provide stability to the stream bank and partially or totally shade the channel. The shelter provides a cool area in which aquatic species may escape excessively warm waters and hide from predators. Kingfishers and bee-eaters perch on branches to seek out prey.

Herbaceous and shrubby plants that occupy the streamside habitat grow quickly in the nutrient rich environment, most recover quickly from floods. Emergent aquatic plants (i.e. Bulrush and reeds) provide important areas in which emergent insects, frogs, reptiles and birds may shelter and nest.

Threats to streamside habitat are

- Excessive erosion and bank slippage – a natural process of stream function but in settled areas can cause problems for surrounding developments and lead to excessive sedimentation of parts of the channel.

- Clearing existing habitat – this tends to occur during the maintenance and management of the waterway such as removal of excess sediment and during

weed control. Access to the stream, channel stabilisation work and bridging also will lead to clearing of streamside habitat.

- Simplification of structure due to the widespread dominance of one or two plant species. Bulrushes and Para grass currently dominate most of the streamside vegetation along Kedron Brook at the expense of a greater diversity of native aquatic grasses, sedges, rushes and herbs.

- Replacement of native streamside plants with exotic species. This has already occurred along most of Kedron Brook where weeds dominate the herbaceous layer and invasive species like Singapore daisy have taken hold.

How can Bushcare groups enhance this habitat?

Work within the channel is limited by constraints imposed to prevent flooding and associated damage to surrounding areas. There are limits to the amount and extent of planting that may be undertaken in the channel.

It must be remembered that the channel will flood at some time and the impact of this on any work within the channel is variable. Planted vegetation may be washed away, covered with sediment or killed by immersion. Tree planting within the channel can have a destabilising effect and high losses may occur. Bottlebrush (*Callistemon* spp.) and *Waterhousia floribunda* have been observed to regenerate within the streamside vegetation. Protection of these naturally regenerating individuals may be a better focus for in-stream activity.

Bushcare groups can be most effective in streamside areas by selectively weeding areas to facilitate the growth of native plants that have established themselves. This may involve the removal of smothering vines and dense grasses in their vicinity. Care needs to be taken not to expose large areas to flood damage by clearing all the vegetated cover.

Areas in which this type of work may be effective are

- Where native vegetation is predominant
- Associated with individuals of regenerating native canopy trees (i.e. Waterhousia, bottlebrush and paperbark).

6.2.2 Frog habitats

Habitat providing breeding sites for frogs in the pre-settlement landscape was probably extensive in terms of both on-stream breeding ponds and off-stream breeding sites (temporary pools or marshy areas). Since settlement, the landscape has been smoothed, depressions filled, and the habitat for frog breeding greatly modified. Notwithstanding this, many of the frogs have found breeding niches within the developed landscape using pot plant dishes, drains and puddles on playing fields for breeding. Generally we know little of the size or distribution of frog populations associated with Kedron Brook.

The Cane toad is an ongoing competitor and threat to frog species. Removal of toad spawn is probably one of the most effective mechanisms for toad control. Spawn is best located in mornings after toads have been calling or following rain (even light

showers). It floats on the water or is partially submerged as long clear jelly strands in which black eggs are embedded. None of the native frogs lay eggs in these distinctive strands.

Frogs need off-stream habitat for breeding to avoid introduced fish and toads. Many areas on the floodplain and surrounding parkland offer potential frog breeding sites. Identification of existing breeding sites is important as frogs can breed in the most unlikely and opportunistic places. This may vary from season to season depending on the rainfall.

Existing frog habitat needs to be identified and located before modification to create new sites. If frogs are already breeding in an area, supplementing of their habitat may be more useful than creating a new habitat which may attract cane toads to the area.

The formation of ponded drains and protection of grassy areas that become inundated have been successful in allowing frogs to breed in Grinstead Park. The success of frog breeding in any area will be dependant to a certain extent on the prevailing weather conditions and the duration of the standing water if fed from rainfall. “Topping-up” of temporary pools may assist tadpole survival however the following cautions are issued;

- Chemicals in treated water may have toxic consequences for some frogs
- Adding cool tap water to a sun-warmed pool will lower the water temperate and therefore reduce the rate of metamorphosis.

A breeding pond is only part of the frog habitat requirements. Frogs feed on insects thus conditions suited to insects are required. Insects can congregate on insect harbouring plants, associated with composting plant material, and adjacent to water. Young frogs (and adults) need shelter during the day in cool, moist locations where they will be safe from predators. Emergent aquatic vegetation, dense reeds and grasses and trees with thick foliage can provide these. They need to be close to the feeding and breeding ponds. Ground dwelling frogs such as Tusk frogs require cover such as logs and stones beside the stream or pond. Burrowing frogs require a sandy substrate in which they can burrow. Tree frogs need rocks or overhanging tree branches from which they call.

Striped marsh frogs are common in the urban landscape, they are tolerant of polluted water and permanent standing water seems to favour this species (BFS 1998).

<u>How can Bushcare groups enhance this habitat?</u>

Before embarking on frog restoration it is important to know what is there and whether it is working as breeding habitat. This may take several summers with good rainfall to determine whether frogs are using the site.

New breeding locations need to consider the requirements for frogs –

- Clean water,
- Appropriate temperature and duration ,
- Appropriate vegetated shelter in the vicinity,
- Free from toads

Planting of dense tussock vegetation such as native grasses and *Lomandra* spp. is effective in excluding cane toads. Remove adult toads from frog habitat and freeze to humanely kill them. Toad spawn should be removed from water and left to dry in sun.

6.2.3 Butterfly habitat

Butterflies require a diversity of resources

- Larval food plants
- Sheltered pupae location
- Adult food sources of nectar, sap and fruit.

Butterflies can have an important role in the pollination of plants and defoliation by caterpillars can change the micro-environment surrounding host plants. Butterflies recorded from Kedron Brook were often widespread but rarely occur in large numbers.

How can Bushcare groups enhance this habitat?

Bushcare groups can increase the diversity of natural habitat in their local area. This may be by rehabilitation new areas with trees, shrubs and understorey or enhancing the shrub and ground layer herb components of existing forest or planted areas. Specific butterflies can be attracted by suppling suitable host plants, these may be trees, shrubs or herbs. Flowering shrubs and herbs are important food sources for adult butterflies.

6.2.4 Nesting Hollows

Old trees are becoming a limited resource in the landscape; they are being removed or dying at a much greater rate than they are being replaced. At the current rate of loss, there will be few living old trees in the urban landscape in 20 years time. Eucalypts are considered to take up to several hundred years to form hollows. It is more likely hollows form at different ages in different tree species and this will vary with the habitat. Standing dead trees as well as living trees provide hollows.

Different sized and shaped hollows are required for the many species of birds, reptiles and mammals that use hollows. Important characteristics include the height above the ground, the size of the orifice, the size of the cavity and the shelter provided. In South-eastern Queensland about 70 species have been identified as using hollows, these include 12 bat species, 39 birds, seven species of possum and glider, and 12 reptiles (Hayes *et al*. 1996).

Invertebrates such as borers that are the larvae of beetles or moths, often initiate hollows. The wood around borer activity decays and hollow formation begins. Cockatoos or kookaburras may enlarge the hollows. A survey by Hayes *et al*. 1996 found that hollows were common along Kedron Brook but their numbers have diminished very significantly compared to those available in the pre-settlement landscape.

Nesting boxes have been provided in many locations in Brisbane as an alternative to tree hollows. Rainbow lorikeets and cockatoos were observed using nesting boxes along Kedron Brook. Starlings and Indian mynah birds use nesting boxes, it is not desirable to provide resources for these introduced birds. The use of nesting boxes

needs to be reassessed and perhaps nesting box design modified to exclude the Starlings and Indian mynah.

Bat nesting boxes have been provided as part of a PhD investigation. The boxes have a very small aperture to enable the insectivorous microbats to enter. Little is known of the habitat-specific requirements of insectivorous bats.

Threats to hollow bearing trees in the landscape are

- removal for development,
- death from old age (least likely),
- dieback as part of an overall landscape dysfunction (See box below) and
- accidental death.

The latter two threats are often related.

How can Bushcare groups enhance this habitat?

Identification and protection of hollow bearing trees. Identify the trees to landholders or operators in the area as significant and susceptible to damage.

- Prevent covering by smothering weeds
- Protect from fire
- Do not prune dead limbs unless necessary.
- Explore the possibilities for hollow creation by "rough" pruning or alternatives to nesting boxes.

WHERE HAVE ALL THE TALL TREES GONE?

Removal of vast areas of ground layer plants and development by paving the ground surface has changed the balance of insects in the landscape. Some species have increased others have decreased. The changing habitats have altered the proportions of predators that feed on the insect populations. In urban areas, as in the rural land, insect-gleaning birds, which once veraciously fed on the insects on leaves and bark of large eucalypts, have largely disappeared from the landscape. Populations of leaf-attacking insects increase uncontrolled by their natural predators. Over time, continual insect attack can leave large trees stressed and susceptible to further damage.

At the same time, the proportions of ground dwelling and wood boring insects have changed. Predatory birds have reduced in numbers and the numbers of boring larvae may increase – trees are again attacked at a scale that is different from a naturally functioning system.

Eucalypts are renown for their ability to survive fire. This is true for many trees that regenerate readily from tuberous or epicornic shoots. When ancient trees are partially hollowed – by a past fire or borer damage, the existing hollows can act as chimneys and facilitate the burning of the old trees. In addition, stressed trees have less energy to resprout following fire and may die. Where borers have been active, they damage the thick outer bark that protects the bloodwood and stringybark species. The unprotected heartwood is exposed to fire damage.

A final disturbance comes from the management of the land in which the trees remain. Mowing, clearing or "tidying-up" can damage the root system. Although the large trees have an extensive root system, many of the small roots from which water and nutrients are derived are just below the soil surface. The use of herbicides within the root zone of some large trees has led to their death. Damage to this significant area can be the last straw for a stressed tree.

6.2.5 Forest bird habitat

Wildlife habitat clearing has led to the widespread decline in forest birds; this is reflected along Kedron Brook. Planting in the past has facilitated the establishment of forest trees but there has often been limited development of a shrubby layer.

Bird nests were uncommon in the Bushcare plantings; nests present were in the densest trees or in the central parts of the plantings.

Birds most suited to open forests with sparse understoreys are becoming more common in urban and rural areas. Aggressive species like the Noisy minor, Indian Mynah, Currawongs, Crows and Butcherbirds dominate the bird fauna in many urban and parkland areas. These species are widespread along Kedron Brook.

Although a number of forest birds have been recorded from Kedron Brook there is limited knowledge of the distribution, movement and population sizes of forest birds using resources associated with Kedron Brook. Lorikeets, rosellas and large honeyeaters are commonly seen in gardens and parkland. Less common are smaller honeyeaters, flycatchers, whistlers and fantails that prefer dense shrubs or a closed canopy.

How can Bushcare groups enhance this habitat?

Bushcare groups can enhance forest bird habitat by providing shrubby thickets of native plants. Flowering species provide food resources and twiggy or spiny plants offer protected nesting sites.

Some spiny/twiggy or other plants that may be used for nesting are; *Bursaria spinosa, Citriobatus pauciflorus, Clematis aristata, Maclura cochinchinensis, Microcitrus australis,* Bracken (*Pteridium esculentum*) and native shrubby peas (e.g. *Davesia* spp., *Pultenaea* spp.).

Plant understorey shrubs in clumps of three or more – a dense thicket will form more quickly. Where a planted stand has developed a dense canopy aim to create a dense buffer of native plants around the margins. This will help prevent weed invasion and maintain a sheltered, cool understorey for wildlife. Ferns and herbs can be established under the more dense canopy.

6.3 To Weed Or Not To Weed

A weed is a plant growing where it is not wanted. Different species are weeds in different locations. Engineers consider species such as bulrush that inhibit streamflow weeds but this native plant provides important habitat for stream-side fauna.

Lantana is a weed because it is not native. It provides a general cover that is otherwise lacking for ground-dwelling fauna. Small birds such as wrens and thornbills hide and nest in lantana thickets. The fruit is eaten by pigeon and other birds and can be an important resource during drought for other species. Unfortunately, the birds also disperse the seed across the landscape.

Para grass swathes adjacent to Kedron Brook provide shelter for birds, frogs and emerging stream insects. The quality of habitat may not be as good as that provided by a suite of native grasses, rushes and herbs, but it is better than no cover for the streamside fauna.

The habitat value of weeds must be recognised – in some cases, greater habitat availability is created by leaving the weeds and revegetating cleared areas. Once native substitutes have been established, offending weeds are gradually removed.

Not all weeds have positive benefits; smothering vines reduce diversity, habitat and can have limited food value to fauna due to their abundance over a short flowering period.

The presence of native plants in vegetation is always preferable to weedy vegetation.

7 Threats for fauna habitat.

7.1 Habitat and resource loss

By far one of the greatest threats to wildlife along Kedron Brook is a loss of resources through accidental or intentional development or management.

The death or removal of old trees is very significant, this leads to a loss of nesting hollows, under bark hollows and food resources (nectiferous and insectivorous).

Following rain, native frog tadpoles were observed in a pool of standing water in grassy parkland at one of the Bushcare sites. Protection of the breeding area would involve little more than exclusion of traffic (foot and vehicles), possibly topping-up of water levels, and observe of the success (in terms of emerging frogs) of the breeding pond. Unfortunately, within a week the grass was slashed and tractor wheels had muddied and churned the remaining puddles – the breeding site had been destroyed (for now).

7.2 Biodiversity loss

Loss of natural fauna biodiversity is a consequence of direct habitat loss (i.e. clearing) or may be a consequence of invasion of dominating species such as weeds and aggressive fauna.

Weed invasion is the greatest threat to the plant biodiversity benefits Bushcare groups aim to achieve.

Aggressive birds such as the introduced Indian mynah and the native Noisy minor, also crows, ibis can exclude more timid species from an area, particularly if shelter is limited. Introduced species, whether intentional or accidental, are a serious threat to the natural ecosystems along Kedron Brook. Already exotic fish have displaced many of the smaller native species. Introduction of large exotic species (i.e. Carp) poses an enormous threat to remaining native fishes.

7.3 Habitat decline

Any loss of stream quality, including natural variability, water quality and streamside vegetation will compromise wildlife along Kedron Brook.

Aquatic species are important components of lower levels of foodchains. Many species are therefore directly or indirectly affected by a reduction in aquatic faunal populations.

Main threats to water quality along Kedron Brook are

- Current urban development and associated forest clearing in Upper Kedron. Sediment control measures have been placed on waterways draining these developments.

- Pollution from developed areas. Over time, dust, vehicle emissions and particulates from industry, build-up on roads, paths and roofs of buildings. The first rains in spring wash these pollutants into the waterways. Black stormwater runoff was observed in Sandy Creek during the first rainstorm of the summer. Other areas draining roadways and light industrial areas prone to such pollution are the McCauley Channel, Colac Street Channel, Melrose Park Channel (urban land and roadways) and Cannery Creek and nearby channels (industrial land and roads).

- Seepage from landfill sites. At Zion Hill the channel had a reddish oily material covering the water surface in the vicinity of the landfill site. There are many landfill sites adjacent to Kedron Brook; older sites may be more prone to seepage due to the uncontrolled types of fill used.

- Recurring disturbance by sediment removal and vegetation control by slashing. This is a disruptive process the aquatic fauna and wildlife using stream bank vegetation. The frequency and timing of such work will affect the impact on wildlife.

Some release of sediment into the system after rainfall is inevitable despite sediment control measures being taken. For most of the time Kedron Brook has relatively clear water and periods of high sediment load tend to be related to particular development activities and high rainfall events – the brook clears soon after rainfall. During periods of low flow a high nutrient load appears to contribute to high volumes of algal growth in the middle (channelised) reaches.

7.4 Other threats

Feral or domestic animals can cause ongoing disturbance and interfere with mating, nesting or feeding activities as well as predation on native fauna. Ground-dwelling wildlife are most vulnerable although domestic cats will hunt birds. There is no available information on the extent and impact of feral dog and cat predation on wildlife in the Kedron Brook catchment.

Isolation of wildlife populations form one another can lead to a subtle decline in the number and distribution if individuals do not find mates, can not recolonise habitat or disperse to utilise seasonally variable resources populations may eventually die out. Current woodland populations along Kedron Brook have probably developed

according to their ability to use existing habitat – ongoing contraction of existing habitat will be the greatest threat to these populations.

8 Undertaking a fauna habitat assessment

The one-off assessment undertaken during this project has revealed just a part of the fauna represented in Kedron Brook. The fauna present and the habitat they are using, vary with season and conditions. Longer-term changes may occur as populations are excluded or colonise different areas. It is important to know what species are around and what they are doing in order to understand ways in which Bushcare groups and others may assist in conservation.

Bushcare co-ordinators and group members undertake monitoring of the success of projects. This may be in the form of the Habitat Brisbane Group Records that are used to record activities, species planted and personnel involved.

An Urban Bushland Assessment and Monitoring Kit has been developed for Southeast Queensland, it has a simple format for monitoring animals using bushland patches. The kit provides assessment sheets used to determine the landscape-scale impacts on bushland remnants, vegetation present and fauna using the site. The assessments are repeated every 6 months to identify changes in fauna use of bushland areas.

The Bushland Assessment Kit is designed for use on patches of remnant bushland. Unfortunately, only a few of the Bushcare sites along Kedron Brook contain areas of remnant bushland that falls within the types identified in the Bushland Assessment Kit. Many Bushcare sites are located in or adjacent to abandoned land or parklands. Notwithstanding this, the kit can be applied as far as possible to Bushcare sites along Kedron Brook.

The kit concentrates on positive and negative faunal habitat features in each vegetation community. The value of weeds as a fauna resource is not recognised in this assessment scheme. Fauna are recorded in terms of the diversity or number of different types of animals in the main faunal groups. Plant and animal identification are not necessary to complete the assessment. There are a number of other monitoring and assessment methodologies published, some are listed in the bibliography.

The following section extends the basic habitat assessment methods to identify additional features that may be observed at a site. Wildlife observation of a site over time leads to a better understanding of the function of wildlife communities near a Bushcare site.

8.1 Current site status

Determine the current site status to get a base-line of information. This involves assessing the Bushcare area to identify

- What species are present?
- Which resources do they use?
- How reliant are they on the local resources?
- What threats are there to species?
- Are the natural systems balanced?

- What is the regenerative capacity of the vegetation?
- Are there opportunities for fauna dispersal to other habitats?

Methods for identifying and observing fauna are described below. This is followed by some descriptions of features of a site that indicate or provide wildlife habitat, assist in identification of threats and habitat condition.

8.2 Observing fauna

Many people walk, recreate or work outdoors but give little heed to the fauna that surrounds them. Awareness and observation are keys to success. Within Bushcare groups, individuals may have expertise or a particular interest in a group of animals – draw on this expertise if you can.

For Bushcare groups or individuals new to fauna study, focus on a group of fauna to start with – birds are good and before long, you will be familiar with the common species and be ready to find more cryptic species in your area.

Keeping records is highly recommended; don't just record the presence of species, note their activities, the types of plants or insects they are feeding on, nesting and mating behaviour, response to disturbance etc, etc. The number of individuals in an area can be recorded on a 4-point scale (rare, a few, common, very large numbers). Remember numbers can fluctuate throughout the year so this can be useful information to work out local patterns of fauna migration and habitat use.

General procedures for detecting and observing fauna are presented below. These are discussed in terms of the different groups and provide basic information for detection and observation. In Queensland, a permit is required for the trapping or collection of fauna, the methods outlined here involve observation and related activities that can be undertaken by all Bushcare members.

Bird and reptile species can be observed by sitting quietly for a while. Use a field guide to identify species – there are several listed at the end of this report. Birds are most active at dawn and dusk and some species travel widely during the day. Reptiles become more active as the day warms and are best observed during the morning or mid to late afternoon. Searching for reptiles can be undertaken with care. Look under logs and rocks, in crevices on the ground, under leaf litter and under the bark of trees.

Frogs can occur almost anywhere but are best seen at breeding sites after rain. They are usually heard calling and individuals may be seen at the waters edge, in nearby vegetation, under rocks or logs or other cover. Frogs are more active at night and therefore easier to find. Their eyes give a golden reflection in torchlight. They are usually spotted by homing-in on the call.

The calls of different species of frogs can be used as a method for identification. Several tapes are available of local frog calls. Listen to these and see if the calls match those in your area. Another alternative is to play the call near a breeding pond and see if this stimulates the males of the species to return the call (only male frogs vocalise).

Nocturnal mammals are best observed by spotlighting at night. Often they have a red eye-shine in torchlight. Other evidence of mammals such as tracks, diggings, droppings, scratches on smooth-barked gums and remains of dead animals provide indicators of species present in an area.

Flying foxes are readily visible as they travel to and from feeding sites in the summer months. The smaller insectivorous bats are more difficult to locate, their high-pitched echolocation sounds may be discerned. Microbats hibernate during the colder months when food resources are low hence are more likely to be seen during the warmer summer months.

8.3 Habitat condition

Identification of wildlife habitat near Bushcare sites involves recording some of the features readily visible. These are listed in Table 3.

Table 3 Habitat features and their potential uses

Habitat feature	Uses
Old trees	Birds use for nesting, food source – nectar, insect attractant, insect resources – food, shelter.
Visible hollows	Nesting – various species
Fallen and standing dead timber	Shelter, nest sites, food source, nutrient return to soil. Protected site for small plants.
Ground hollows	Shelter – various groups
Shrub layer	Shelter, nesting sites – woodland birds, flowers – food resource
Flowering resources	Food for birds, bats and insects
Dense vegetation adjacent to stream	Shelter, food for emergent insects and frogs, also habitat for streamside birds, reptiles
Deep waterholes	Habitat for larger fish and aquatic vertebrates including potential platypus habitat
Earth banks	Nesting sites for swallows and other mud nesting birds, potential burrow sites for platypus when part of stream bank.
Off-stream ponded water	Important frog breeding sites if water is retained and is of good quality, needs to be surrounded by vegetation that will protect emerging frogs

Large trees are critical habitats for hollow requiring mammals and birds. The trees provide useful foraging, sheltering and nesting opportunities for birds, reptiles and insects and a prolific source of food and nectar when in flower. Large eucalypts also support sizable insect populations in the foliage – important food resource for insectivorous bats and birds. Paperbarks (*Melaleuca quinquenervia*) and eucalypts are the most commonly encountered hollow forming trees along Kedron Brook. Exotic species tend not to have formed hollows in the time they have become established.

Dead timber provides shelter, feeding and nesting opportunities for wildlife. Even small dead saplings can provide shelter for bats and frogs and perching opportunities for birds. “Cleaning-up” removes this potential habitat and removes a source of nutrients and microhabitat from an area.

The addition of sticks, twigs and leaves will “lighten” the mulch hence providing opportunities for reptiles (skinks and lizards) and invertebrate fauna. Use dead foliage and leaves from nearby native plants. Do not introduce weeds by using the foliage of introduced trees or weedy shrubs. Eventually trees within a planting will mature and produce debris of their own that will add to the complexity of the litter layer. As far as possible retain dead plant material on site (Not twigs or foliage of weed species as attached seed may germinate and establish).

Areas with special features such as a rocky outcrop, deep pools, wetland areas, sheltered gullies and cliffs offer important wildlife habitat.

8.4 Creating or supplementing fauna habitat

By planting more native plants Bushcare groups are investing in future wildlife habitat. Often it will be many years before the plantings yield observable changes to wildlife habitat use in a local area.

Bushcare group interests and resources will determine the nature of wildlife habitat projects. A diversity of different habitats is required in the landscape to meet the needs of the diversity of wildlife that occur. Some general recommendations are:

- Maintain and improve existing wildlife habitat first. This is much more effective than re-creating habitat.
- Connect wildlife habitat areas to one another where possible but don’t destroy other types of habitat in the process.
- Connect wildlife habitat areas to the watercourse as much as possible; many of the species using the habitat will need to access water.
- Re-create missing components of the habitat i.e. shrubby understorey, herbaceous plants etc.
- Avoid damage to functioning wildlife habitat

Attempting to provide habitat for all fauna groups may result in little long-term achievement. If habitat is enhanced for one fauna group then enhancement for other groups may automatically follow. Completion of one habitat project will always leave many more projects waiting to be undertaken.

Work to protect and enhance existing habitat first – there is no need to put resources into recreating habitat if remnant areas are threatened by degradation.

The larger an area of habitat the more fauna it may support – larger populations have a greater viability. Extend existing habitat rather than create new isolated and small patches.

A key step in any wildlife habitat creation project is identifying what is possible.

Several factors will influence the decision.

1. Fauna. Aim to provide habitat for wildlife already occurring in the area or recorded within a reasonable distance so that individuals are likely to find the habitat that has been created. Ensure that by attracting the species to your location you are not exposing them to threats such as predation and road kills.

2. Bushcare group constrains. All activities are constrained by time, budget, labour and support. Fauna habitat creation has an additional component of monitoring to determine the success of the project. In addition, most habitat creation projects will take years to be realised.

3. Information available. There are many gaps in the knowledge of faunal requirements, particularly when dealing with the specific adaptations of species to an urban environment.

If a fauna group is targeted for habitat creation, the resources required by the species or group must be identified. It is necessary to meet every need if the species is to survive in the area; this includes food, shelter, nest, protection and other resources. If any one resource cannot be met in the local area, the habitat creation may not be effective. To be effective, habitat management must first meet the most limiting resource(s).

Threats to the fauna group or species need to be identified; commonly these are habitat loss, predation by domestic or feral animals, and human related interference or development.

Endeavour to copy successful models and report on outcomes so others may learn from your experience – There is often little information available that applies specifically to the survival of fauna in an urbanised environment.

Most importantly, if a habitat is functioning to provide the feeding, nesting or other requirements for wildlife **DO NOT INTERFERE**.

9 Summary of Bushcare Projects

The efforts of many years of work by Bushcare groups along Kedron Brook have improved fauna habitat and ecosystem quality at locations where work has been undertaken. Several Bushcare groups have applied alternative rehabilitation methods to the more commonly practised planting and mulching procedure. The projects have varied and sometimes unexpected results.

Appendix 2 contains summary sheets of observations and recommendations relevant to specific Bushcare sites visited during this study.

9.1 Bushcare Group Projects

Grinstead Park
Grinstead Park is a mown parkland on an old landfill site. There are mature eucalypts and paperbarks in which nesting hollows are used by lorikeets and cockatoos. The park lies close to Sparkes Hill and Grange Forest Park, the largest remnants of bushland along the urbanised sections of Kedron Brook. Following recommendations from the Kedron Brook Fauna Study (Hayes *et al.* 1996), two frog-breeding sites were developed. One involved bunding of a small drain and associated planting which has led to a marked increase in frog numbers detected in this area (see section 5.3).

The second frog habitat project involved the protection of an ephemeral soak used in summer for breeding. In summer when the soak fills, it is protected by temporary fencing and associated signage to notify visitors of the purpose of the fencing. This is effective in protecting the soak.

To enhance the habitat value of the soak the local Bushcare group has undertaken several projects. One involved the planting of trees and shrubs under nearby eucalypts to offer protection for adult and juvenile frogs when not using the soak. The second involved exclusion of mowing from part of the parkland understorey to facilitate the development of a native grass and herb understorey.

Like all Bushcare projects, vegetation development has been slow and subsequent habitat development a gradual process. In both areas the parkland has taken on a "wild" look which unfortunately has not been well received by some members of the public. Fires have been lit to "tidy up" and protests to council regarding the untidy nature of this site are on going.

Despite the negative public perception, frog numbers appear to have increased in the area (BFS 1998) and a local finch family use the native regeneration area for feeding and, this past spring, for nesting. The fact that the regenerating vegetation is weed dominated at present has not deterred the breeding finches. It is expected that this small-unmown area also provides habitat for invertebrates and reptiles which are less suited to survival in the regularly mown parkland. Patience and on-going management (planting and selective weeding) are required.

Australian Catholic University
A tributary flowing through the grounds of the Australian Catholic University supports a stand of mature paperbark and eucalypts. At the commencement of the project, a dense canopy of exotic celtis and camphor laurel grew amongst the paperbark. Bushcare group activity concentrated on removal of exotic trees and vines and facilitating the natural regeneration of native plants.

As a result of weed removal, a more open understorey has developed with native grasses, Bracken fern and Lomandra present. Weeds are still geminating on the site and invasive vines threaten the native plants. The site supports a suite of birds including kookaburras nesting in an arboreal termite nest. Earthen drains flowing from the University campus have potential as frog habitat as they flow through the paperbark forest area.

Many years of on-going work have increased the proportion of native plants in the stand and protected the rare stand of mature paperbarks. The campus will relocate in the next year and land use will potentially change. Unless weeds are controlled as an on-going process, the camphor laurel and celtis will re-establish. Continuity of Bushcare activities is essential to the long-term survival of most remnants within a largely developed landscape. Often such continuity is difficult to achieve in the longer term.

Sparkes Hill and Grange Forest Park
Sparkes Hill and Grange Forest Park are two long running Bushcare groups. Both areas have well-developed eucalypt forest canopies and planting seeks to increase diversity and provide habitat for target species such as woodland birds and butterflies. Bushcare activity in these locations has, over many years, removed weeds and undertaken supplementary planting to enhance the natural diversity of forest remnants. Even after nearly 20 years, weed control and supplementary planting are still required. By increasing the number of native plants in the understorey, weeds are excluded to some extent but have not been eliminated.

There are several areas within the Sparkes Hill reserve where understorey planting could be undertaken but is limited by the nature of the substrate. Like many of the parklands and bushland near Kedron Brook, areas of landfill are associated with the locality. Fill was deposited in these areas many years ago when there was little knowledge of the hazardous consequences of asbestos and other material. Even more recent dumping of broken glass and metal wastes can injure Bushcare group members working in these areas.

In Grange Forest Park a steep and sheltered gully was filled with debris from broken bottles to remains of cars. Removal of the debris became impractical hence, soil was used to cover and fill part of the gully. The gully has been planted with rainforest trees; including palms that have formed a closed canopy overhead – a cool respite on a hot day. Scrub turkeys inhabit this area and understorey growth is sparse still (the site was assessed before any rainfall)

Kalinga Park
Bushcare group has been active for many years undertaking planting and weed control and trail construction. Currently the open forest is eucalypt dominated with

developing other species of native trees. Shrubby weeds and vines are predominant in the understorey. The site is in need of management and weed control.

Amenity plantings
Several Bushcare plantings were described as amenity planting at the outset of this project. These areas occur within the Lutwyche reach of Kedron Brook and often occur on the upper banks of Kedron Brook. They are clearly separated from other plantings by expanses of mown grassland. Despite their location, these plantings provide more than visual amenity.

The plantings are part of a network of resources within the surrounding urban landscape and adjacent to Kedron Brook that provide birds with food and shelter resources. Never underestimate the value of a planting of native trees. They are an important investment in habitat resources for the future. Isolated and small areas of planted trees and shrubs provide limited habitat on which species are solely reliant, but they do provided resources used by species that come from a wider area.

Direct linkages with other rehabilitation sites are beyond the scope of this group's activity however, the planting contributes to the network of habitat for avian species in the urban landscape.

Colac Street Bushcare Group
This group is rehabilitating a rock-lined channel. Plantings are on steep rock reinforced banks where topsoil and erosion control matting are used to stabilise the slope before planting. The revegetated channel receives water from a large stormwater drain. Particular conditions at this site include high velocity of water flowing through the site during and soon after high rainfall events. Destabilisation of rock walls and planted vegetation during high flow events are the greatest threat to this Bushcare site.

Downstream from the Bushcare site the channel is concreted. Concreted channels typically provide limited habitat, do not reduce stream velocity, and provide no filtering of the polluted water that drains industrial areas and major roadways. Cane toad eggs and tadpoles were abundant in the concreted sections of the channel where water was shallow (~2 cm deep) and warm. Diversifying the channel form and introducing vegetation could achieve an improvement in the function of concrete channels however activities are limited by flood constraints. Installation of a narrow meandering drainage depression within the concrete channel bed will diversity the non-flood flow, keep the water confined and therefore, cooler and less suited to cane toad breeding.

Hillbrook College
Steep earthen banks on Kedron Brook near Hillbrook College are prone to erosion during high flow and floods. Past flooding has caused excessive bank slippage. The bank has been revegetated with a variety of trees. Included in this planting are a number of short-lived and small trees –including several wattles.

Supplementary planting is required to establish deep-rooted trees with a long life span (figs and selected rainforest trees), which will stabilise the stream bank. This planting should be extended as far as possible away from the stream to maximise stability; the extension of tree planting will be limited by playing field location.

9.2 Recommendations from the Kedron Brook fauna study (1996)

The Kedron Brook fauna habitat study was commissioned by the WPSQKBB in 1996 and recommended a number of actions to supplement existing habitat along Kedron Brook. The report discusses sections of Kedron Brook in terms of planning units identified by BCC. For many of the reaches, habitat planting of a general nature is recommended with the objective of connecting different areas of remnant vegetation. Other recommendations are infilling planting under the canopy of existing Bushcare sites and the creation of specific habitat for frogs and butterflies (particularly the Richmond Birdwing).

Many of the general recommendations regarding corridor and connection plantings recommended by Hayes *et al*. (1996) have not been realised. Bushcare group and Local Authorities have not had the resources available to such large-scale corridor formation projects. Some of the specific recommendation by Hayes *et* al. (1996) have been undertaken by Bushcare groups as well as weed control and on-going planting recommendations.

Planting of the vine *Aristolochia praevenosa,* the food plant for the larvae of the Richmond Birdwing have been limited by the number of plants available. Most of the available stock comes from the same seed source. Plantings have been undertaken by the Ferny Hills State High School although no Richmond birdwings have used the site.

Hayes *et al*. (1996) recommended nesting boxes for many sites. The level of use of nesting boxes by native wildlife was not determined during this study. Although many boxes appear vacant, use of boxes by cockatoos, lorikeets and galahs was reported from different locations along Kedron Brook The widespread installation of nesting boxes requires assessment as the nesting boxes encourage starlings and Indian mynah, birds that exclude native birds from an area.

Specific recommendations for frog habitat restoration by Hayes *et al*. (1996) include the Grinstead Park habitats discussed above. A second frog restoration site was recommended for Hickey Park where an earthen stormwater drain was excavated and bunded to retain water in an off-stream habitat. Rocks were laid to reduce Para grass and assist in the retention of stormwater. The area surrounding the drain was planted with *Acacia* sp., *Cissus antarctica, Lomandra longifolia, Melaleuca quinquenervia, Syzigium* sp., and *Themeda triandra*. Recommended frog habitat restoration at Emma Street (Wooloowin) has not been undertaken.

The Hickey Park site was not included in the BFS (1998) survey of frog habitat. Currently the status of the site for frog breeding is unclear. The site however supports a dense swathe of Para grass and *Panicum* sp. Introduced Easter cassia (*Senna obtusifolia*), Singapore daisy (*Wedelia trilobata*) and small bushes of lantana also occur in the vicinity of the drain. Exotic vines such as Madera vine and Morning glory are present but the (planted) Native grape (*Cissus antarctica*) is growing vigorously and predominant in places.

Rocks placed in the channel appear to have had no effect in inhibiting the development of dense grasses. The channel is fed from a stormwater drain and by overland flow from the surrounding parkland. Both enter at the same location and carry debris and refuse into the frog breeding site. The dense grass prevents movement of sediment and rubbish in the channel this it has accumulated near the inflow where a small pool is surrounded by a sediment dam. No tadpoles were observed in this section of the drain, other sections appeared dry at the time of observation despite recent rainfall.

Detailed assessment of the Hickey Park channel is required to determine its effectiveness in providing frog-breeding habitat. Shading plants and native vines have been unsuccessful in excluding dense exotic grasses; further planting is required. Garden refuse has been deposited within this drain. Hickey Park is in need of the custodianship of a Bushcare group.

Floodway planting for channelised sections of Kedron Brook between Gilbert and Webster Roads were recommended by Hayes *et al*. (1996). Trial plantings have been undertaken and are doing well. The mix of species planted includes native grasses, herbs, shrubs some trees and vines. The native Bluebell (*Wahlingbergia gracilis*) is common in the plantings and has potentially regenerated from seed. It has been many years since bluebells were seen in such abundance along the floodway (*pers. obs.*).

The floodway plantings have concentrated pedestrian traffic to the bank edge; this has cause compaction in this locality. These areas are still vegetated. Floodway plantings are beginning to mature in the vicinity of Webster Road. There are still concerns over the impact these plantings may have on flood levels, should these be shown to be real, the some of the trees may need to be removed.

9.3 Overview of the Bushcare network

Twenty-five Bushcare locations were identified in this study. Many are active, some groups have disbanded, some areas face an uncertain future. Some groups are very small and informal, others are well established and undertaking frequent and extensive projects. Each Bushcare area, like the individuals that comprise the groups is different. They each have different needs and potential. Site-based decisions on local projects need to be made; these should be within the framework of broader catchment management goals and objectives.

At this stage, all Bushcare groups are working towards an improvement of the natural biodiversity associated with Kedron Brook. Many groups do not have specific objectives with regard to provision of general or specific fauna habitat. Increasing the native plant biodiversity in the landscape will lead to an increase in the habitat or resources available to local wildlife. The most effective contribution the relatively small (on a landscape scale) Bushcare groups can make to provision of fauna habitat is to protect and supplement existing habitat.

The formation of corridor links between Bushcare sites is an objective beyond the scope of most groups along Kedron Brook. The groups are scattered at distances of up to several kilometres apart along Kedron Brook. Even if the planting of such corridors were achieved, the follow-up weed management would be an enormous task.

10 Recommendations

Current environmental degradation and land management issues are a consequences of past land use along Kedron Brook. Residents living in the vicinity of Kedron Brook use and value (in different ways) the network of open space, parkland and bushland associated with Kedron Brook.

Fauna Groups
Remnant bushland areas are key locations for local wildlife populations although fauna use resources in urban areas, parkland, modified channels and on abandoned land, which is often weed dominated. **Remnant natural vegetation or modified vegetation currently providing resources for wildlife must be protected.**

Aquatic invertebrates are an important fauna group. There is a need to increase knowledge of species diversity and distribution along Kedron Brook. **The impact of stream modifications (sediment control devises (SQIDs), sediment removal and rocky wall construction) on aquatic invertebrates is not known and requires investigation**.

As introduced (aquarium) fish have replaced small native species **creation of off-stream breeding locations for native fish** may be successful if water input is carefully controlled. Exotic fish can easily enter stormwater drains from overflow from backyard ponds.

Frog populations and distribution is poorly known along Kedron Brook. At Bushcare sites where frog populations have been investigated a diverse frog fauna occurs. Frog breeding areas need to be free from introduced fish and toads, these are probably limiting in the landscape. Suitable temporary breeding habitats are prone to damage through management or public interference. **The types of frogs occurring along Kedron Brook, their numbers and distribution require investigation**. Such investigations should be undertaken over several summer seasons.

The Bushcare network may undertake a project to clarify frog species and numbers along the catchment. A workshop with an associated frog assessment kit (including photographic identification, habitat notes and taped calls for species) would assist Bushcare groups undertake their own assessment. Identification of potential frog habitat and developing management strategies for these areas will assist in protecting the few breeding resources available to frogs. Careful planning is required before construction of new breeding habitats to ensure they meet all frog requirements and exclude toads.

Reptiles are another fauna group for which little is known of their distribution and abundance along Kedron Brook. **Reptile population assessment may be undertaken as a Bushcare network project similar to the frog assessment described above**.

Incorporation of fallen timber and leaves (of native species) into the mulch and ground layers can assist reptile habitat creation or enhancement.

Nesting hollows and food resources in the form of large trees with abundant flowers are probably the most limiting resources in the landscape for persistent mammals. **Protection of large native trees is required**.

Shrubby species plantings and ground layer flowers will attract forest birds and butterflies – best undertaken when weeds are in manageable proportions. Ground-dwelling birds and forest birds that require dense understorey are declining in urban and rural areas. **Inclusion of dense shrubs and ground layer plants in Bushcare plantings is required.**

Nesting boxes are used by lorikeets and cockatoos and by the introduced Starlings and Indian mynah. **Nesting design and location requires review to best provide resources specifically for native fauna**. Some existing boxes are not in use – some were too low (<3m above the ground), mounting these 5m or more above the ground will be more successful. Placement of nesting boxes in dense foliage may deter the introduced species.

The **occurrence of platypus within Kedron Brook requires investigation**. Restoration and protection of platypus habitat is required should any individuals be confirmed to occur in Kedron Brook

Maintaining the continuity of streamside vegetation is important, increasing the native plant components of this vegetation is a recommended long-term goal.

Identify areas of significant habitat with distinctive signage. If such signage is widespread, the public will become aware of the meaning. Signage may be used to identify frog breeding sites, nesting hollows, stream habitats etc. This would be particularly useful in areas threatened by accidental damage such as mowing and tree pruning or removal of timber debris (rubbish).

Identify threats to wildlife in an area and address these as far as possible.

Water quality

Maintaining water quality is key to the long –terms survival of wildlife along Kedron Brook. Sediment control devises should be assessed for their effectiveness. Where possible, constructed wetlands should be installed. Potential sites for these are on Sandy Creek just before the confluence with Kedron Brook and on the McCauley channel.

Sediment control and mowing need to be undertaken at a frequency and during appropriate seasons to avoid nesting wildlife.

Bushcare groups

Observation and documentation of plantings and fauna habitat creation is essential, repeated review of the success of habitat creation provides important information on which other Bushcarers can develop future habitat. Bushcare groups should seek to incorporate observations and habitat development experience within the Habitat Brisbane Reports, newsletters, and report to Catchment Group meetings.

Workshops and less formal meetings may be held to investigate wildlife distribution and habitat requirements.

Extend and strengthen the network. There is a need for Bushcare groups to continue work previously undertaken at Teralba Park and at Kalinga Park.

Weed management

Some weeds provide habitat and resources for wildlife, others threaten natural diversity. **Identify which weeds are threatening and prioritise these for control**.

Weed control is as important, and probably more time consuming, than planting. Weed management is desirable to facilitate natural species regeneration and the associated fauna habitat provision.

Weed management should entail

- Identification of habitat value of weeds, their threats to plantings and species diversity.
- Gather information on weed species, ecological information such as sources, dispersal mechanisms, flowering and seeding times and use this information to targe species prior to periods of seed production and maximum growth
- Survey sites to identified areas most prone to weed invasion – target these for planting and weed control
- How far beyond the Bushcare site does the weed extend? Broader control is required in the catchment otherwise; localised control of readily dispersed weeds will have to continue indefinitely.
- Develop/adopt a weed management plan for Bushcare sites this would be based on the most efficient removal methods and most threatening species.

11 Sources of information

A selection of reference information is listed below. There are many reports and works not included but provide good information for Bushcare groups.

Downfall Creek Bushland Centre on Rode Road has an information centre that specialises in providing ecological information to the local community. Here pamphlets, reports and specialist books are available to members of Bushcare groups.

Information may also be obtained from the Boondall Wetlands Visitor Centre and from the Nudgee Beach Environment Centre.

The WPSQ office has reports and publications available to members.

Council Libraries have many of the resources. The Mt Coot-tha Botanic Gardens branch has an extensive collection of books on flora.

Government and other organisations that may provide useful information or reply to queries include;

QNPWS – wildlife queries, injuries etc.
Queensland Herbarium – plant identification, vegetation/ecosystem inquiries
EPA – environmental monitoring, habitat protection/threats
Queensland Museum – Wildlife enquiries – identification Brisbane City Council

11.2 Online information sources

Through the World Wide Web there appears no limit to the information that can be accessed. Searching by topics (i.e. animal name) is the simplest way to find information. For those without Internet access at home, council libraries provide an accessible Internet service.

Some Internet sites with information specific to Kedron Brook are listed below. All are Brisbane City Council sites.

http://www.brisbane.qld.gov.au/ourcity_andsuburbs/brisbanes_waterways/kedron_brook/flora.shtml - vegetation description along Kedron Brook

http://www.brisbane.qld.gov.au/ourcity_andsuburbs/brisbanes_waterways/kedron_brook/fauna.shtml - fauna along Kedron Brook

http://www.brisbane.qld.gov.au/ourcity_andsuburbs/brisbanes_waterways/kedron_brook/history.shtml - aboriginal influence along Kedron Brook

http://www.brisbane.qld.gov.au/ourcity_andsuburbs/brisbanes_waterways/kedron_brook/weeds.shtml - weeds along Kedron Brook

http://www.brisbane.qld.gov.au/council_at_work/environment/bushland/habitat_brisbane/habitat_groups/north.shtml - overview of the habitat Brisbane Groups.

11.2 Selected Bibliography

The following references are only a selection of those available. Some older references are included as they contain information or useful keys relevant to bushland remnants.

Animal Identification

Baker J., Grigg, G. C. & Tyler M. J. (1995) A Field Guide to Australian Frogs. Beatty and Sons, Surrey, England.

Cogger H. G. (1996) Reptiles and Amphibians of Australia. Reed, NSW.
Definitive text on reptiles and amphibians in Australia.

Common I. F. B. & Waterhouse D. E. (1972) Butterflies of Australia. CSIRO, Canberra.
Comprehensive description and illustrations of Australian Butterflies. Photographs, species descriptions and larval food plant lists are included.

Pine Rivers Shire Council (2001) Butterflies in the Pine Rivers Shire.
Information leaflet provides photographs and general information on butterflies in the area. Lists the native caterpillar food plants used by some of the species.

Pizzey, G. & Knight F. (1997) Field Guide to the Birds of Australia. Viking Penguin, Ringwood, Victoria.

Poole S. (ed) (1995) Wildlife of the Greater Brisbane Region. Queensland Museum and Brisbane City Council Publication, Brisbane.
Most recent inventory of local wildlife. Photographs and brief descriptions of many wildlife species (including invertebrates). Handy for identification, good size for a field guide.

Robinson M. (1993) A field Guide to Frogs of Australia. Reed Publications, NSW.
Photographs and descriptions cover most of the frogs recorded in the Brisbane area.

Simpson K. & Day, N. (1996) Field Guide to Birds of Australia. Viking, Penguin, Ringwood, Victoria.

Slater, P., Slater P. & Slater, R. (1990) The Slater Field Guide to Australian Birds, Eldon Publishing, Victoria.

Stewart, D. (n.d.) Frog Calls of Brisbane and South-east Queensland, Nature Sound, Wilsons Creek, NSW.

Strahan R. (1995) Photographic Guide to Mammals of Australia. Angus & Robertson, London.

Strahan R. (ed.) (1995) The Mammals of Australia, Australian Museum, Sydney, and Reed Books, Chatswood, NSW.

Triggs B. (1996) Tracks, Scats and other Traces: A Field Guide to Australian Mammals, Oxford University Press, Melbourne.
Useful text with illustrations for identifying the signs of mammals found in bushland.

Plant identification

Clifford H. T. (1972) Eucalypts of the Brisbane Region. Queensland Museum.
This guide provides simple keys to the eucalypts – may be difficult to obtain. Many of the names have changed since the book was published, new names can be determined from more recent publications or from the Queensland Herbarium.

Eustace R & Johnston L. (1985) Our Wildflower Heritage. SGAP, Redlands
Easy to follow keys and line illustrations. Includes understorey shrubs and herbs encountered in the upper catchment of Kedron Brook.

Kleinschmidt H., Holland S. & Simpson P. (1996) Suburban weeds. Department of Primary Industries, Brisbane.
Describes most common weeds encountered in Brisbane. Brief description of plant and control methods. Illustrated with line drawings.

Sainity G. R. & Jacobs S. W. L. (1994) Waterplants of Australia: A Field Guide. CSIRO.
Good pocket-size reference. Contain many plants local to Kedron Brook. Illustrated with photographs, species descriptions and habitat description. Also sections on water quality and ecology.

Stanley T. D. & Ross E. M. (1983-1989) Flora of South Eastern Queensland. Volumes 1-3. Queensland Herbarium, DPI, Brisbane.
Technical description of plants and keys to identification. No photographs and some illustration. Requires some botanical skills to get best use from these texts.

Ecology and habitat

Davies W. (ed) (1983) Wildlife of the Brisbane Area. Jacaranda Press, Queensland.
Provides descriptions of fauna resources in the survey area plus useful habitat information and general ecological discussion. Difficult to purchase but available in libraries. Good sources of ecological information relevant to the local area.

Habitat Brisbane (2001) Technical Seminar Series “Managing fauna in Bushcare activities: Seminar 2 – Big Critters” Unpublished BCC report.

Hayes P., McLoughlin A. & Comben P. (1996) Kedron Brook Wildlife Rehabilitation Project. Unpublished report to WPSQ.
Comprehensive fauna assessment of Kedron Brook. Identifies species present and makes recommendations re rehabilitation along Kedron Brook.

Low T. (1993) Dinkum Gardening. Greening Australia – Queensland.
Booklet has useful ecological information and recommendations re wildlife habitat creation – it is Brisbane specific.

Assessment of environment

Environmental Protection Agency (1999) Natural Resource Monitoring Guide. Department of Natural Resources, Brisbane.
Provides a guide to monitoring soil, vegetation, wildlife, pests and water quality etc. Designed for use by rural landowners and land managers – some technical detail included. Provides methods, illustrations and data sheets.

Rowston C. (2000) The Urban Bushland Assessment and Monitoring Kit for south East Queensland. Gold Coast City Council.

Offers basic methodology for bushland assessment. Recommended repeat assessment every 6 months. Aim of this assessment is to gauge the effectiveness of rehabilitation activities over time. Designed for bushland remnants therefore has some limitations in the highly modified ecosystems along Kedron Brook.

Vivian-Smith G., Connell M., Culpitt S. & Donatiu P. (2001) Tracking Your Community Vegetation Project. Greening Australia Queensland.

Produced to allow community groups to keep long-term records of change associated with their project sites. Provides comprehensive evaluation methods and data sheets.

Bibliography

Brisbane Frog Society (1998) Assessment and Monitoring of Frog Habitat Project sites in Brisbane. Unpublished report to Brisbane City Council

Caneris A. (2001) Ground-Dwelling Mammals in Habitat Brisbane Technical Series "Managing Fauna in Bushcare Activities: Seminar 2 – Big Critters. BCC Unpublished.

Hayes P., McLoughlin A. & Comben P. (1996) Kedron Brook Wildlife Rehabilitation Project. Unpublished report to WPSQ.

Poole S. (ed) (1995) Wildlife of the Greater Brisbane Region. Queensland Museum and Brisbane City Council Publication, Brisbane.

Robinson M.., (1993) A field Guide to Frogs of Australia. Reed Publications, NSW.