saving our species

Brogers Creek BioBlitz report

December 2016–January 2017

NSW GOVERNMENT Office of Environment & Heritage

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Cover: The opportunistic sighting of a pair of greater gliders (*Petauroides volans*) during the BioBlitz is the first record of the species within the Upper Brogers Creek catchment. This pair was photographed in Watagans National Park. Photo: M Todd

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Executive summary

Fauna and flora surveys were conducted in the Upper Brogers Creek catchment as part of a survey to assess the biodiversity of the area. The survey targeted species and communities listed under the *Threatened Species Conservation Act* 1995 (TSC Act) and the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act); in particular the spotted-tailed quoll (*Dasyurus maculatus*), greater glider (*Petauroides volans*), large forest owls (powerful, masked and sooty owls), long-nosed potoroo (*Potorus tridactylus*), large-footed myotis (*Myotis macropus*) and golden-tipped bat (*Kerivoula papuensis*). The fauna surveys resulted in the detection of 24 (five exotic) species of mammal, 56 species of bird, 10 species of reptile, eight species of frog and three species of fish. Two of those species, the large-footed myotis and the eastern bent-wing bat are listed under the TSC Act, while the greater glider is listed under the EPBC Act. Flora surveys identified six plant community types, with 135 component plant species. No threatened plants were found.

1 Introduction

1.1 Background

In recent years the Office of Environment and Heritage (OEH) has conducted surveys and monitoring for spotted-tailed quolls in the Barren Grounds Nature Reserve and Budderoo National Park. The presence of this threatened native predator in these conservation reserves, along with other threatened species including the long-nosed potoroo, eastern bristlebird, ground parrot and eastern pygmy-possum indicates a hotspot for threatened fauna species. It is vital that efforts to protect these species are expanded to maintain vital links between the South Coast escarpment forests and the southern Blue Mountains.

With funding under the OEH *Saving our Species* program available until at least 2021, the Barren Grounds and Budderoo reserve complex is one of four priority areas identified for targeted monitoring and conservation actions in NSW for the spotted-tail quoll. A five-year project began in 2016-17 under a partnership involving multiple land management and research agencies, including OEH, National Parks and Wildlife Service (NPWS), University of Wollongong, South East Local Land Services, National Parks Association, local governments and private land owners. The project is aiming to build on the established NPWS conservation works of fox baiting and fire management for threatened species in the two conservation reserves, and buffer these core habitat areas with the long-term aim to gradually increase the resilience and size of the local quoll population.

The BioBlitz event provided an opportunity to survey private land for spotted-tailed quolls within the known home ranges of the local quoll population. By incorporating the complete survey for all flora and fauna, the BioBlitz also provided opportunities for local landholder engagement. The intention of this engagement is to encourage landholders to understand and get interested in the broader biodiversity values of their land and participate in a coordinated fox control program to buffer and enhance the habitat of local quolls and other threatened species within the nearby reserves.

This report summarises the results of a fauna and flora survey conducted in the Upper Brogers Creek valley between 2 December 2016 and 13 January 2017. The surveys were conducted broadly across the Brogers Creek focus area and specifically within the 15 participating freehold properties (Figure 1).

1.2 Location and description of subject area

Study area

Brogers Creek (Kangaroo Valley1: 25,000 topographic map altitude 160-440m AHD) is located in the Sydney Basin bioregion, approximately eleven kilometres north-east of the town of Kangaroo Valley, within the Shoalhaven Local Government Area, NSW. A total of 15 private holdings, comprising 485ha were surveyed within the Upper Brogers Creek catchment and nearby Broughton Vale (Figure 1).

The area is a mosaic of native vegetation and cleared paddocks. Much of the forest on the lower and mid-slopes is regrowth, but some sites support hollow-bearing trees that offer nesting and denning habitat requirements for a range of forest-dependent fauna.

Geology and soils

The 1:100 000 Soil Landscape Sheet for Kiama (Hazelton 1993) indicates the lower elevations of the focus area has soil derived from Budgong Sandstone (described under the classification Wattamolla Road). This red podsolic soil is relatively deep, with high organic content and high fertility. On the upper slopes there is a band of latite soil derived from the Cambewarra series. This soil occurs on steep slopes and has high fertility often supporting rainforest. There are also many large blocks of Hawkesbury sandstone rock that have fallen from the surrounding cliffs that surround the Upper Brogers Creek valley.

Vegetation

The dominant vegetation communities in the Upper Brogers Creek valley include warm temperate rainforest, mixed warm temperate/subtropical rainforest, wet sclerophyll forests and riverine forests. The vegetation types have previously been mapped within the compilation map *Biometric vegetation types and endangered ecological communities of the Shoalhaven, Eurobodalla & Bega Valley local government areas* (OEH 2013).

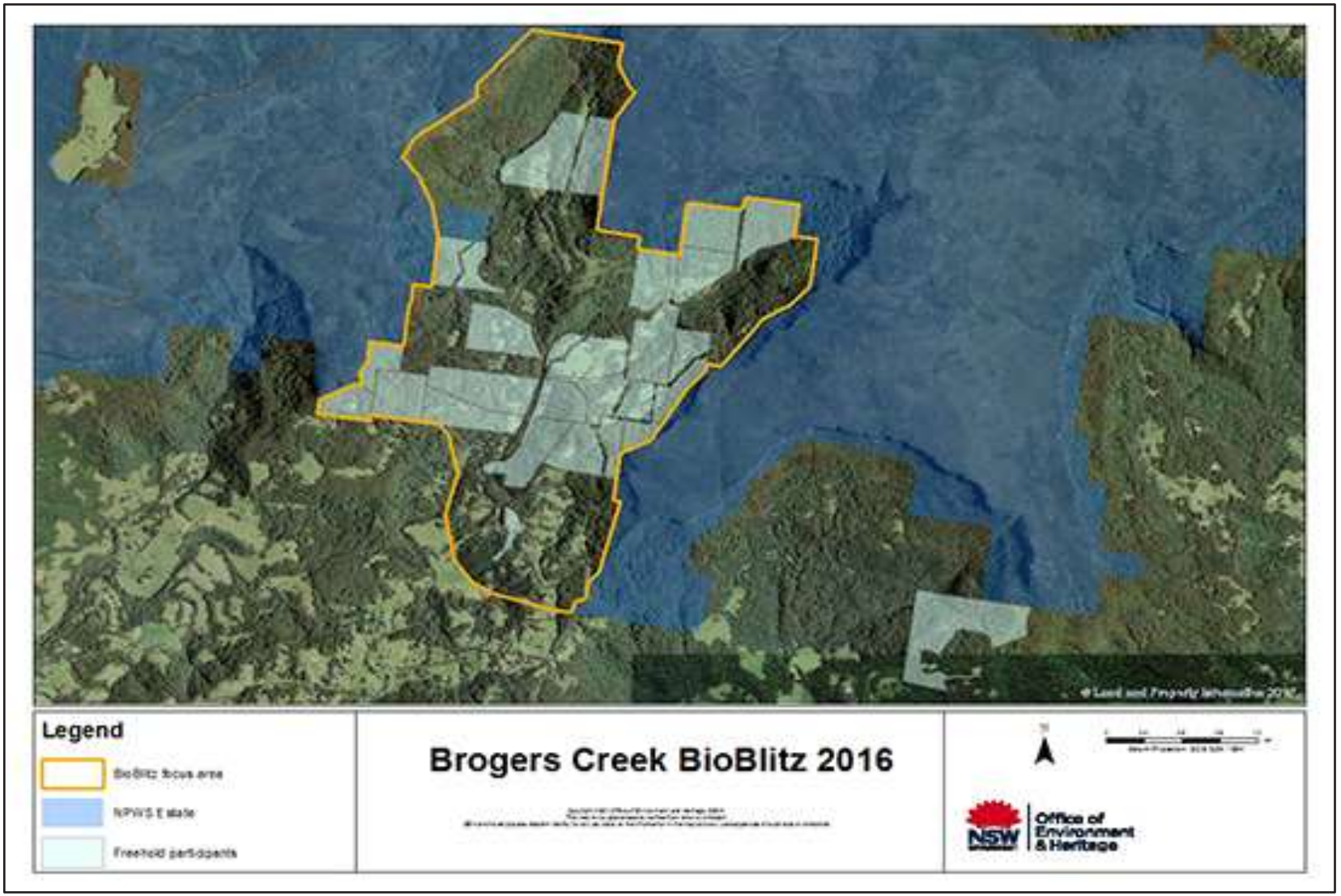

Figure 1 Brogers Creek BioBlitz focus area

1.3 Previous surveys/records

The Barren Grounds and Budderoo National Park's estate which surrounds the Brogers Creek BioBlitz focus area provides home to resident populations of up to 15 threatened fauna species including the spotted-tailed quoll (*Dasyurus maculatus*), eastern pygmy-possum (*Cercatetus nanus*), Littlejohn's tree frog (*Litoria littlejohni*), giant burrowing frog (*Heleioporus australiacus*), eastern bristlebird (*Dasyornis brachypterus*), eastern ground parrot (*Pezoporus wallicus*), gang gang cockatoo (*Callocephalon fimbriatum*), powerful owl (*Ninox strenua*), long-nosed potoroo (*Potorous tridactylus*), varied sittella (*Daphoenositta chrysoptera*), large-eared pied bat (*Chalinolobus dwyeri*), eastern false pipistrelle (*Falsistrellus tasmaniensis*) and eastern bentwing bat (*Miniopteris schreibersii*).

Three species of threatened plants are found in Budderoo National Park; the Carrington Falls grevillea (*Grevillea rivularis*), Carrington Falls pomaderris (*Pomaderris walshii*) and Deane's boronia (*Boronia deanei*). All these species occur above the cliffs on the Budderoo Plateau.

Previous fauna surveys have been conducted in the region in the Broughton Vale, Foxground and Saddleback Mountain areas (Gaia Research 2015). These surveys were conducted using some of the systematic survey methods used in this survey. Three species of micro-bats listed as vulnerable under the TSC Act were trapped during the Broughton Vale-Saddleback surveys including the large-eared pied bat (*Chalinolobus dwyeri*), eastern bent-wing bat (*Miniopteris schreibersii*), and the large-footed myotis (*Myotis macropus*).

Examination of the OEH BioNet Atlas of NSW Wildlife records revealed that the following threatened species listed as vulnerable under the TSC Act have previously been recorded in the Upper Brogers Creek BioBlitz focus area and participating freehold lots; spotted-tailed quoll (*Dasyurus maculatus*), sooty owl (*Tyto tenebricosa*) and turquoise parrot (*Neophema pulchella*).

2 Methods

Surveys were undertaken over two separate periods during the course of this survey.

- 2-4 December 2016: the primary objective was to undertake systematic flora and fauna surveys (outlined below) including the set-up of remote infra-red cameras, and to record incidental fauna observations.
- 13 January 2017: collection of the remote cameras set during the first visit and incidental fauna observation.

The survey techniques used in this BioBlitz followed the standardised fauna survey methodologies used in systematic fauna surveys across the Sydney Basin Bioregion (DECC 2007). Because cage and Elliott trapping was not conducted over four nights (standardised survey requirement) the data from these methods is not comparable to other survey data gained using those guidelines. The complete survey effort is summarised in Table 1. The locations of the sites were recorded by GPS (GDA 94, Zone 56) and were entered into the BioNet Atlas of NSW Wildlife.

2.1 Floristic surveys

Three full floristic flora survey plots were undertaken within the Brogers Creek BioBlitz focus area on 2 December 2016, and were spread across the remnant vegetation types identified within participating freehold lots from historical and preliminary mapping of the area. Plots were fixed to a 0.04ha (20 x 20m or 10 x 40m) quadrant. Within each site all vascular plant species were recorded with projected foliage cover and abundance scores, consistent with the Native Vegetation Interim Type Standard (Sivertsen 2009). Plots were targeted toward previously unsampled areas, and were placed to avoid ecotones, or transitions between different vegetation types.

All floristic information recorded was undertaken in accordance with the relevant guidelines (e.g. Sivertsen 2009) and uploaded into the VIS Flora Survey database module on BioNet. This enables the data to contribute to the development of the NSW Plant Community Type (PCT) classification (OEH, 2016), and any future revision of vegetation maps.

Information on the VIS classification system and descriptions of PCTs can be found on the OEH website.

2.2 Elliott and cage trapping

Five Elliott traps were each spread along five transects at 20m intervals for two consecutive days from 2 and 4 December 2016 (50 trap nights). Traps were set on the ground and baited with a mixture of peanut butter and rolled oats. Dacron was placed in the traps to provide insulation for captured animals. Traps were checked in the early morning and captured animals were released at point of capture after identification.

Four small cage traps (0.15 x 0.2 x 0.55m) were spread along the same five transects near each Elliott trap and set for the same two night period (40 trapping nights). The cage traps were baited with a mixture of peanut butter and rolled oats. Cage traps were rebaited on day two or when animals had been caught.

2.3 Harp trapping

Three harp traps were built and armed in expected flyways such as creek lines, to capture microbats (Figure 2). Traps were checked at night and in the early morning. Captured animals were released after identification at night or held in calico bags during day and released at dusk.

Figure 2 Ecologist Garry Daly installs a harp trap in Brogers Creek during the BioBlitz. Photo: S Tedder/OEH

2.4 Diurnal bird surveys

Diurnal birds were surveyed for a period of 20 minutes within a two hectare area (eg. 100 x 200 m). Birds detected outside the two hectare plot were also recorded. Animals were identified by their species-specific calls and by direct observation.

2.5 Nocturnal spotlighting (on foot)

Spotlighting was conducted for arboreal mammals using two spotlights for 15 minutes over a 200m transect. Presuming 50m penetration each side, this is equivalent to 2ha. Animals were identified by their species-specific calls and by direct observation. A total of five spotlighting transects were conducted over the focus area.

2.6 Nocturnal call playback

Nocturnal birds and mammals are often detected when they vocalise to proclaim their territory or during social interaction. This behaviour is exploited when surveying by broadcasting pre-recorded species-specific calls to elicit a response if that particular species is within the immediate area. On arrival at the survey site, the surrounding area was searched by spotlight to detect any fauna in the immediate vicinity. This was followed by 15

minutes of listening for unelicited vocalisations. The pre-recorded calls were then broadcast through a modified loud speaker. No spotlights were operated during the playback. Only one nocturnal call playback survey was conducted during the Brogers Creek BioBlitz.

Call playback was given in the following order:

- Powerful owl *Ninox strenua*
- Barking owl *N. connivens*
- Masked owl *Tyto novaehollandiae*
- Sooty owl *T. tenebricosa*.

2.7 Infra-red cameras

Ten Reconyx HC600 remote cameras were set throughout the BioBlitz focus area for 40 consecutive nights (400 camera trap nights). The cameras were aimed at bait stations baited with chicken necks, or peanut butter and rolled oats. All cameras were set to take ten photographs in rapid fire succession on detecting motion or heat. After the survey, photographs were downloaded to a computer for species identification.

2.8 Diurnal reptile surveys

The herpetofauna census involved active 60 minute search effort across four separate 0.5ha (50 x 100m) sites. Surveys were conducted by either one or two people, but the total search effort was maintained. Searches involved searches for active animals and lifting rock and fallen timber for inactive animals.

2.9 Nocturnal streamside surveys

Nocturnal streamside searches involved a 30 minute search effort at three sites. Searches involved direct observation of frogs and recognition of species by call and were conducted along 200m of a stream or 0.5ha of a standing water body.

2.10 Ultrasonic bat detection

Four separate SD1 AnaBat detectors were installed in likely bat flyways across the focus area for two consecutive nights (Figure 3). Anabat recordings were transferred to a computer and analysed by Leroy Gonsalves using AnaScheme. Only calls that were definite were recorded in the BioNet Atlas of NSW Wildlife.

Figure 3 During the BioBlitz, OEH staff and volunteers install an Anabat ultrasonic recording device within a Lamonds Creek flyway. Photo: S Tedder/OEH

2.11 Targeted surveys and incidental observations

Targeted trapping was conducted for the golden-tipped bat. This species favours riparian areas where yellow-browed scrubwrens nest. The study area had numerous secondary creeks that had habitat suitable for this rare species and harp traps were set in an effort to trap individuals.

All species of fauna detected outside or adjacent to the systematic survey location were recorded in an incidentals species list.

Table 1 Survey effort during the Brogers Creek BioBlitz, December 2016–January 2017.

Survey method	Survey effort during the BioBlitz
Elliot and cage trapping	90 trap nights
Harp trapping	6 trap nights
Diurnal bird surveys	7 survey sites
Nocturnal spotlighting (on foot)	5 spotlighting transects
Nocturnal call playback	1 survey site
Infrared cameras	400 camera trap nights
Dirurnal reptile surveys	5 survey sites
Nocturnal streamside surveys	3 survey transects
Ultrasonic bat detection	8 survey nights

3 Results

3.1 Fauna surveys

The surveys detected 24 species of mammal (five exotic), 56 species of bird, 10 species of reptile, eight species of frog and three species of fish. Two species currently listed under the TSC Act were detected; the large-footed myotis (*Myotis macropus*) and the eastern bent-wing bat (*Miniopterus schreibersii oceanensis*). One species of mammal listed nationally under the EPBC Act was observed, the greater glider (*Petauroides volans*).

Figure 4 Feather-tailed glider *(Acrobates pygmaeus)*. This glider was an opportunistic sighting during the BioBlitz. Seen here with an OEH staff participant. Photo: G Daly

Elliott and cage trapping

Elliott and cage trapping caught the bush rat (*Rattus fuscipes*). No other species of small mammal was trapped.

Harp and Anabat microbat detection

Three species of microbat were caught in the harp traps. They were the little forest bat (*Vespadelus vulturnus*), large-footed myotis (*Myotis macropus*) and Gould's long-eared bat

(*Nyctophilus gouldii*) (Figure 5). Five species of microbats were detected using the ultrasonic Anabat recording devices, including the eastern bent-wing bat (*Miniopterus schreibersii oceanensis*). An additional species, white-striped mastiff bat (*Austronomous australis*) has an audible echolocation call and was detected opportunistically.

Figure 5 Gould's long-eared bat (*Nyctophilus gouldii*) trapped in a harp trap and released by an OEH staff participant during the BioBlitz surveys. Photo: G Daly

Diurnal birds

Thirty-five species of bird were detected during the systematic surveys. Opportunistic observations revealed the presence of an additional 21 species (Appendix 1). The Upper Brogers Creek area has a high species diversity of birdlife as it supports a range of habitat types. A number of summer breeding migrants were detected, including the rufous whistler, rufous fantail, sacred kingfisher, black-faced monarch, scarlet honeyeater and brush cuckoo.

Nocturnal spotlighting (on foot)

Eleven fauna species, including arboreal mammals, frogs and nocturnal birds were observed or identified by calls during the survey period. The greater glider, recently listed as vulnerable under the EPBC Act, was observed opportunistically after the cessation of a standard survey transect.

Nocturnal call playback

No species responded to the singular nocturnal call playback survey during the BioBlitz.

Infrared cameras

Despite the targeting of habitats likely to host spotted-tailed quoll, no quolls were captured by infrared cameras during the BioBlitz. Many common species were captured, several of which had been observed in other surveys or opportunistically during the BioBlitz. In total, seven species of bird, six species of native mammals and four species of feral animals were captured across the participating freehold properties (Appendix 2). The cameras also detected the only record of a long-nosed bandicoot during the BioBlitz event (Figure 6).

Figure 6 Long-nosed bandicoot (*Perameles nasuta*), captured using a herbivorous lure on a participating freehold property during the BioBlitz. Photo: OEH

Diurnal reptile surveys

Six species of reptiles were found during diurnal herpetological surveys and an additional four reptile species were found opportunistically within the focus area, including diamond python (*Morelia spilota*), golden-crowned snake (*Cacophis squamulosus*) and eastern small-eyed snake (*Cryptophis nigrescens*) (Figure 7).

Figure 7 The eastern small-eyed snake (*Cryptophis nigrescens*) is often misidentified as a juvenile red-bellied black snake. The species is very common along the east coast of Australia.
Photo: S Tedder/OEH

Nocturnal streamside surveys

The streamside searches were successful in detecting three species of frog and one species of eel, *Anguilla australis.* The southern stony-creek frog or Lesueur's frog (*Litoria lesueuri*) was the most numerous with 24 individuals (and several in amplexus) recorded along one transect in Brogers Creek (Figure 8). An additional five species of frogs and two species of fish were detected opportunistically and are listed in Appendix 2.

Figure 8 Southern stony-creek frog (*Litoria lesueuri*) occupies Brogers Creek in large numbers. This pair photographed in amplexus. Note the difference in size and colour between male and female frogs. Photo: S Tedder/OEH

3.2 Flora surveys

Three full floristic plots (400m^2) were undertaken within the study area. An additional 38 species were found that had not been recorded in previous surveys captured in the NSW Vegetation Information System. The species list is outlined in Appendix 1 and highlights species found within this survey, and also those captured in previous surveys. The vegetation types observed in the study area are outlined below and are represented here as they relate to the NSW Vegetation Classification Types of New South Wales (OEH, 2014).

Wet sclerophyll forests

Sydney blue gum x bangalay - lilly pilly moist forest in gullies (PCT 1245) (Biometric type SR652)

Sydney blue gum x bangalay - lilly pilly moist forest in gullies dominates the lower slopes of upper Brogers Creek and often grades into brown barrel-mountain grey gum tall forests. The community occurs on sheltered slopes in gullies and on escarpments with loamy soils below 400m.

Dominant canopy species are eucalyptus saligna x botryoides, blackbutt (*Eucalyptus pilularis*), white-topped box (*Eucalyptus quadrangulata*), lilly pilly (*Syzygium smithii*) and cabbage-tree palm (*Livistona australis*). Other common species are scentless rosewood (*Synoum glandulosum*), sweet pittosporum (*Pittosporum undulatum*) and jackwood (*Cryptocarya glaucescens*).

Characteristic mid-canopy species are *Notelaea venosa*, *Clerodendrum tomentosum*, *Eupomatia laurina*, *Smilax australis*, *Pandorea pandorana*, *Morinda jasminoides*, *Marsdenia rostrata* and *Stephania japonica*.

Characteristic ground cover species are rasp fern *Doodia aspera*, *Pseuderanthemum variabile*, *Oplismenus imbecillis*, *Gymnostachys anceps*, gristle fern (*Blechnum cartilagineum*), wombat berry (*Eustrephus latifolius*), bearded tylophora (*Tylophora barbata*) and scrambling lily (*Geitonoplesium cymosum*). OEH (2013) states that there is 9,692ha of the forest type in the Shoalhaven.

Blackbutt - turpentine - bangalay moist open forest on sheltered slopes and gullies (PCT 694) (Biometric type SR516)

Occurs on sheltered slopes in gullies and on escarpments with loamy soils below 400m, south from the Illawarra to near Batemans Bay. In Brogers Creek this community dominates the lower valley slopes.

Canopy species include white-topped box (*Eucalyptus quadrangulata*), lilly pilly (*Syzygium smithii*), cabbage palm (*Livistona australis),* blackbutt (*Eucalyptus pilularis),* Jackwood (*Cryptocarya glaucescens),* sweet pittosporum (*Pittosporum undulatum),* scentless rosewood (*Synoum glandulosum),* bolwarra (*Eupomatia laurina),* milk vine (*Marsdenia rostrata),* sweet morinda (*Morinda jasminoides),* veined mock-olive (*Notelaea venosa),* wonga wonga vine (*Pandorea pandoran),* lawyer vine (*Smilax australis),* snake vine (*Stephania japonica),* hairy clerodendrum (*Clerodendrum tomentosum)*. Ground cover includes wombat berry (*Eustrephus latifolius),* scrambling lily (*Geitonoplesium cymosum),* settlers twine (*Gymnostachys anceps), Oplismenus imbecillis,* pastel flower *(Pseuderanthemum variabile),* bearded yylophora (*Tylophora barbata),* gristle fern (*Blechnum cartilagineum)* and prickly rasp fern (*Doodia aspera)*.

Rainforests

Coachwood - lilly pilly warm temperate rainforest in moist sandstone gullies, Sydney Basin Bioregion (PCT 769) (Biometric type SR529)

Occurs in the Blue Mountains and on Budderoo and Moreton plateaux. Closed forest with lianas and ferny groundcover. In the Brogers Creek Valley this occurs on the upper south facing slopes south of Barren Grounds.

Key canopy species include coachwood (*Ceratopetalum apetalum),* lillypPilly (*Syzygium smithii),* sassafras (*Doryphora sassafras),* mountain cedar wattle (*Acacia elata)*. Key midstory species include grey myrtle (*Backhousia myrtifolia),* black wattle (*Callicoma serratifolia),* sweet morinda (*Morinda jasminoides),* lawyer vine (*Smilax australis),* brush pepperbush (*Tasmannia insipida),* king fern *(Todea barbara)* and rough treefern (*Cyathea australis)*. Ground cover is often ferny with gristle fern (*Blechnum cartilagineum)*.

Lilly pilly - coachwood warm temperate rainforest (PCT 905) (Biometric type SR567)

The overstorey of the forest community on the upper sandstone soil slopes within the Brogers Creek focus area, is dominated by extensive stands of coachwood (*Ceratopetalum apetalum)*, lilly pilly (*Syzygium smithii)*, (*Livistona australis)*, sassafras (*Doryphora sassafras)*, jackwood (*Cryptocarya glaucescens)* and *Schizomeria ovata*. This is typical of simple closed forest found on the upper slopes of the Illawarra range. In addition, there were some regenerating red cedar (*Toona ciliata)* and pencil cedar (*Polyscias murrayi)*.

Characteristic mid-storey species include *Synoum glandulosum*, *Tasmannia insipida*, *Eupomatia laurina*, *Cyathea australis*, *Ficus coronata*, *Psychotria loniceroides* and the vines *Morinda jasminoides*, *Smilax australis*, *Microsorum scandens*, *Marsdenia rostrata*, *Palmeria scandens*, *Pandorea pandorana*, *Parsonsia straminea* and *Cissus hypoglauca*. Characteristic groundcover species are the ferns *Lastreopsis microsora*, *Blechnum cartilagineum*, *Blechnum patersonii*, *Asplenium australasicum* and *Doodia aspera*. OEH (2013) states that there are about 10,825ha of the forest type in the Shoalhaven.

Lilly pilly - sassafras warm temperate rainforest in moist sheltered gullies (PCT907) (Biometric type SR569)

Found well below the escarpment and in fertile latite soils, this vegetation community is dominated by canopy species lilly pilly (*Syzygium smithii)*, sassafras (*Doryphora sassafras)*, blackwood (*Acacia melanoxylon)*, giant stinging tree (*Dendrocnide excelsa)*, grey myrtle (*Backhousia myrtifolia)*.

Characteristic midstorey species include *Pittosporum undulatum*, *Cyathea australis*, *Coprosma quadrifida*, *Notelaea venosa*, *Myrsine howittiana*, *Pandorea pandorana*, *Smilax australis*, *Marsdenia rostrata*, *Microsorum scandens.* Common ground cover includes *Asplenium flabellifolium*, *Lastreopsis acuminata*, *Eustrephus latifolius*, *Tylophora barbata* and *Morinda jasminoides.*

Only 1,348ha of this vegetation type remains in the Shoalhaven (OEH 2013). This community is also sometimes referred to as Complex Subtropical Rainforest (Mills 2000). It is within these vegetation types that the majority of floristic surveys were conducted during the Brogers Creek BioBlitz.

Riverine forests

Water gum - coachwood riparian scrub along sandstone streams, Sydney Basin Bioregion (PCT 1292) (Biometric type SR660)

This community is found around the edges of the Sydney Basin on streams draining Triassic Hawkesbury and Narrabeen sandstone, from the Blue Mountains south to the Clyde River in Morton National Park (Tozer et al, 2010). This community occurs along the riparian zone of Brogers Creek.

Dominant species include *Ceratopetalum apetalum, Tristaniopsis laurina/Leptospermum morrisonii, Lomatia myricoides, Tristania neriifolia /Entolasia stricta, Lomandra fluviatilis, Lomandra longifolia* and *Schoenus melanostachys.*

Further full floristic sampling in the Upper Brogers Creek catchment would benefit from sampling of the riverine forests and the upper escarpment slopes.

3.3 Species of interest

Large footed myotis (*Myotis macropus*)

It is Australia's only fishing bat, with extra-long toes that it uses to swoop and capture fish or insects from the surface of lakes and creeks (Figure 9). It weighs up to 15 grams and has a wingspan of about 28cm. They generally roost in tree hollows but are also found beneath bridges in more developed areas. In NSW, females have one young each year usually in November or December (Richards 1995).

The detection of this species during the BioBlitz indicates the condition and availability of habitat in Upper Brogers Creek is of a high quality. It also highlights the importance of maintaining high water quality in Brogers Creek and reducing impacts from sewage and fertilizer run-off, chemical pollution and altered flow regimes from driveways and weirs.

Figure 9 Large-footed myotis (*Myotis macropus*) caught in a harp trap in Brogers Creek and released by an OEH staff participant. Photo: G Daly

Eastern bent-wing bat (*Miniopterus schreibersii oceanensis*)

These microbats weigh around 13–17g and can reach speeds of up to 50km per hour, hunting in forested areas, catching moths and other flying insects above the tree tops. They roost in large maternity colonies - from hundreds to thousands of individuals - during spring and summer, but disperse later in the year, up to 300km from maternity caves. Despite their potential for huge range dispersal, the high number, frequency and distribution of calls recorded on Anabat detectors throughout the BioBlitz focus area indicates they may have a nearby roost.

Greater glider *Petauroides volans*

The greater glider is a large gliding marsupial (900–1700g) that feeds exclusively on eucalypt leaves and buds (Figure 10). Greater gliders shelter during the day in tree hollows and at night movements are primarily restricted to gliding between tree canopies, indicating their requirement for mature forests. Adult greater gliders occupy a relatively small home range with an average size of one to three hectares (Kavanagh and Wheeler 2004) from which they rarely disperse.

The opportunistic sighting of a pair of greater gliders during the BioBlitz is the first record of the species within the Upper Brogers Creek catchment. The species was listed as vulnerable in the Commonwealth EPBC Act in May 2016. Greater gliders are not listed as threatened in NSW, although there are three endangered populations listed in the TSC Act (Seven Mile Beach National Park, Mt Gibraltar and Eurobodalla) due to their isolation from other populations.

Figure 10 A pair of greater gliders (*Petauroides volans*) photographed in Watagans National Park. Photo: M Todd

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Appendix 1: Brogers Creek BioBlitz flora species list

This species list represents the species detected within the Brogers Creek study area both from this survey, and previous systematic survey plots currently captured in the OEH Vegetation Information System (VIS).

Family	Species	Detected during this survey	Detected in previous surveys
Acanthaceae	*Pseuderanthemum variabile*	•	
Adiantaceae	*Adiantum formosum*	•	
Adiantaceae	*Adiantum hispidulum*	•	
Adiantaceae	*Pellaea falcata*	•	•
Apiaceae	*Centella asiatica*		•
Apiaceae	*Hydrocotyle laxiflora*	•	•
Apocynaceae	*Marsdenia flavescens*	•	
Apocynaceae	*Marsdenia rostrata*	•	•
Apocynaceae	*Parsonsia straminea*		•
Apocynaceae	*Tylophora barbata*	•	•
Araceae	*Alocasia spp.**	•	
Araceae	*Gymnostachys anceps*	•	•
Araliaceae	*Polyscias murrayi*		•
Arecaceae	*Livistona australis*	•	•
Aspleniaceae	*Asplenium australasicum*	•	•
Aspleniaceae	*Asplenium flabellifolium*	•	•
Asteraceae	*Ageratina riparia**	•	•
Asteraceae	*Cassinia longifolia*		•
Asteraceae	*Cassinia trinerva*		•
Asteraceae	*Helichrysum elatum*		•
Asteraceae	*Helichrysum rutidolepis*		•
Asteraceae	*Olearia argophylla*		•
Asteraceae	*Olearia stellulata*		•
Asteraceae	*Ozothamnus diosmifolius*		•
Bignoniaceae	*Pandorea pandorana*	•	•
Blechnaceae	*Blechnum cartilagineum*		•
Blechnaceae	*Blechnum patersonii*	•	
Blechnaceae	*Blechnum wattsii*		•
Blechnaceae	*Doodia aspera*	•	•
Boraginaceae	*Austrocynoglossum latifolium*	•	
Boraginaceae	*Ehretia acuminata*	•	
Caryophyllaceae	*Stellaria flaccida*	•	•

Family	Species	Detected during this survey	Detected in previous surveys
Celastraceae	*Celastrus australis*		•
Commelinaceae	*Aneilema acuminatum*	•	
Commelinaceae	*Tradescantia fluminensis**	•	
Convolvulaceae	*Dichondra repens*		•
Cunoniaceae	*Ceratopetalum apetalum*	•	•
Cyatheaceae	*Cyathea australis*	•	•
Cyperaceae	*Carex longebrachiata*	•	•
Cyperaceae	*Carex spp.*		•
Cyperaceae	*Cyperus spp*	•	
Cyperaceae	*Lepidosperma laterale*		•
Davalliaceae	*Arthropteris tenella*	•	•
Dennstaedtiaceae	*Dennstaedtia davallioides*		•
Dennstaedtiaceae	*Histiopteris incisa*		•
Dennstaedtiaceae	*Hypolepis glandulifera*		•
Dennstaedtiaceae	*Hypolepis muelleri*	•	•
Dennstaedtiaceae	*Pteridium esculentum*		•
Dicksoniaceae	*Calochlaena dubia*	•	•
Dicksoniaceae	*Dicksonia antarctica*	•	
Dilleniaceae	*Hibbertia aspera*		•
Dilleniaceae	*Hibbertia scandens*		•
Dryopteridaceae	*Lastreopsis microsora*	•	
Ebenaceae	*Diospyros australis*	•	•
Elaeocarpaceae	*Elaeocarpus kirtonii*		•
Elaeocarpaceae	*Sloanea australis*	•	
Escalloniaceae	*Polyosma cunninghamii*		•
Euphorbiaceae	*Claoxylon australe*	•	
Eupomatiaceae	*Eupomatia laurina*	•	•
Fabaceae (Mimosoideae)	*Acacia binervata*	•	•
Fabaceae (Mimosoideae)	*Acacia maidenii*	•	
Fabaceae (Mimosoideae)	*Acacia melanoxylon*		•
Gesneriaceae	*Fieldia australis*		•
Goodeniaceae	*Goodenia ovata*		•
Hymenophyllaceae	*Hymenophyllum cupressiforme*		•
Icacinaceae	*Citronella moorei*		•
Icacinaceae	*Pennantia cunninghamii*	•	

Family	Species	Detected during this survey	Detected in previous surveys
Juncaceae	*Juncus usitatus*		•
Lamiaceae	*Clerodendrum tomentosum*	•	•
Lamiaceae	*Plectranthus parviflorus*	•	•
Lauraceae	*Cryptocarya glaucescens*	•	•
Lauraceae	*Litsea reticulata*	•	
Lomandraceae	*Lomandra longifolia*		•
Luzuriagaceae	*Eustrephus latifolius*	•	•
Luzuriagaceae	*Geitonoplesium cymosum*	•	•
Meliaceae	*Synoum glandulosum*	•	•
Meliaceae	*Toona ciliata*	•	•
Menispermaceae	*Legnephora moorei*	•	
Menispermaceae	*Stephania japonica var. discolor*		•
Monimiaceae	*Doryphora sassafras*	•	•
Monimiaceae	*Hedycarya angustifolia*		•
Monimiaceae	*Palmeria scandens*		•
Moraceae	*Ficus coronata*	•	
Moraceae	*Maclura cochinchinensis*	•	
Moraceae	*Streblus brunonianus*	•	
Moraceae	*Trophis scandens*	•	
Myrsinaceae	*Myrsine variabilis*	•	
Myrsinaceae	*Myrsine howittiana*		•
Myrtaceae	*Acmena smithii*	•	•
Myrtaceae	*Eucalyptus fastigata*		•
Myrtaceae	*Eucalyptus muelleriana*		•
Myrtaceae	*Eucalyptus quadrangulata*		•
Myrtaceae	*Syzygium australe*	•	•
Myrtaceae	*Tristaniopsis collina*		•
Oleaceae	*Notelaea venosa*		•
Orchidaceae	*Gastrodia sesamoides*	•	
Phormiaceae	*Dianella caerulea var. caerulea*		•
Phyllanthaceae	*Breynia oblongifolia*	•	•
Piperaceae	*Piper novae-hollandiae*	•	•
Pittosporaceae	*Pittosporum multiflorum*	•	•
Pittosporaceae	*Pittosporum undulatum*	•	•
Plantaginaceae	*Veronica plebeia*		•

Family	Species	Detected during this survey	Detected in previous surveys
Poaceae	*Anthoxanthum odoratum**		•
Poaceae	*Echinopogon ovatus*		•
Poaceae	*Entolasia marginata*		•
Poaceae	*Microlaena stipoides var. stipoides*	•	•
Poaceae	*Oplismenus aemulus*	•	
Poaceae	*Oplismenus imbecillis*		•
Polypodiaceae	*Microsorum scandens*	•	•
Polypodiaceae	*Pyrrosia rupestris*	•	•
Proteaceae	*Banksia serrata*		•
Proteaceae	*Stenocarpus salignus*		•
Pteridaceae	*Pteris umbrosa*	•	
Ripogonaceae	*Ripogonum album*	•	
Rosaceae	*Rubus nebulosus*	•	•
Rubiaceae	*Coprosma quadrifida*		•
Rubiaceae	*Morinda jasminoides*	•	•
Rubiaceae	*Psychotria loniceroides*		•
Rutaceae	*Melicope micrococca*	•	•
Rutaceae	*Zieria smithii*		•
Sapindaceae	*Alectryon subcinereus*	•	
Sapindaceae	*Guioa semiglauca*	•	•
Smilacaceae	*Smilax australis*	•	•
Smilacaceae	*Smilax glyciphylla*		•
Solanaceae	*Solanum mauritianum**	•	
Solanaceae	*Solanum pseudocapsicum**	•	
Symplocaceae	*Symplocos thwaitesii*		•
Urticaceae	*Dendrocnide excelsa*	•	
Urticaceae	*Elatostema reticulatum*	•	
Urticaceae	*Urtica incisa*	•	
Violaceae	*Hymenanthera dentata*		•
Violaceae	*Melicytus dentatus*	•	
Violaceae	*Viola hederacea*	•	•
Vitaceae	*Cissus antarctica*	•	
Vitaceae	*Cissus hypoglauca*		•
Winteraceae	*Tasmannia insipida*		•

** Exotic species*

Appendix 2: Brogers Creek BioBlitz fauna species list

Common name	Scientific name	NSW Status	Federal Status	Detection method
	Mammals			
Insectivorous bats				
Eastern horseshoe bat	*Rhinolophus megaphyllus*	P		Anabat
Little forest bat	*Vespadelus vulturnus*	P		Harp trap/Anabat
Eastern bent-wing bat	*Miniopterus schreibersii oceanensis*	V		Anabat
Chocolate wattled bat	*Chalinolobus morio*	P		Anabat
Large forest bat	*Vespadelus darlingtoni*	P		Anabat
Long-eared bat	*Nyctophilus spp.*	P		Harp trap
Gould's wattled bat	*Chalinolobus gouldii*	P		Anabat
Eastern broad-nosed bat	*Scotorepens orion*	P		Anabat
Large footed myotis	*Myotis macropus*	V		Harp trap/Anabat
White-striped mastiff bat	*Tararida australis*	P		Opportunistic
Possums and gliders				
Common ringtail possum	*Pseudocheirus peregrinus*	P		Spotlight
Greater glider	*Petauroides volans*	P	V	Opportunistic
Sugar glider	*Petaurus breviceps*	P		Spotlight
Feather-tailed glider	*Acrobates pygmaeus*	P		Opportunistic
Kangaroos and wallabies				
Swamp wallaby	*Wallabia bicolor*	P		Opportunistic/infrared camera
Monotremes				
Short-beaked echidna	*Tachyglossus aculeatus*	P		Spotlight/infrared camera
Marsupial mice				
Bush rat	*Rattus fuscipes*	P		Elliot traps/infrared camera
Bandicoots				
Long-nosed Bandicoot	*Perameles nasuta*	P		Infrared camera
Wombats				

Common name	Scientific name	NSW Status	Federal Status	Detection method
Common wombat	*Vombatus ursinus*	P		Spotlight/opportunistic/infrared camera
Feral mammals				
Red fox	*Vulpes vulpes*			Opportunistic/infrared camera
Feral cat	*Felis catus*			infrared camera
Feral goat	*Capra hircus*			infrared camera
Red deer	*Cervus elaphus*			infrared camera
Rabbit	*Oryctolagus cuniculus*			Opportunistic
Native birds				
Pigeons				
Brown cuckoo-dove	*Macropygia amboinensis*	P		Diurnal bird survey
Topknot pigeon	*Lopholaimus antarcticus*	P		Opportunistic
Wonga pigeon	*Leucosarcia picata*	P		Diurnal bird survey/infrared camera
Frogmouths				
Tawny frogmouth	*Podargus strigoides*	P		Spotlight
Raptors				
Peregrine falcon	*Falco peregrinus*	P		Opportunistic
Grey goshawk	*Accipiter novaehollandiae*	P		Opportunistic
Swamphens				
Purple swamphen	*Porphyrio porphyrio*	P		Opportunistic
Cockatoos				
Yellow-tailed black cockatoo	*Calyptorhynchus funereus*	P		Opportunistic
Parrots				
Australian king parrot	*Alisterus scapularis*	P		Diurnal bird survey
Crimson rosella	*Platycercus elegans*	P		Diurnal bird survey
Rainbow lorikeet	*Trichoglossus haematodus*	P		Opportunistic
Cuckoos				
Fan-tailed cuckoo	*Cacomantis flabelliformis*	P		Diurnal bird survey
Eastern koel	*Eudnamys orientalis*	P		Opportunistic

Common name	Scientific name	NSW Status	Federal Status	Detection method
Brush cuckoo	*Cacomantis variolosus*	P		Diurnal bird survey
Owls				
Southern boobook	*Ninox novaeseelandiae*	P		Spotlight
Kingfishers and kookaburras				
Laughing kookaburra	*Dacelo novaeguineae*	P		Diurnal bird survey
Sacred kingfisher	*Todiramphus sanctus*	P		Diurnal bird survey
Azure kingfisher	*Ceyx azureus*	P		Opportunistic
Lyrebirds				
Superb lyrebird	*Menura novaehollandiae*	P		Diurnal bird survey
Treecreepers				
White-throated treecreeper	*Cormobates leucophaea*	P		Diurnal bird survey
Bowerbirds				
Green catbird	*Ailuroedus crassirostris*	P		Diurnal bird survey
Satin bowerbird	*Ptilonorhynchus violaceus*	P		Diurnal bird survey
Fairy-wrens				
Superb fairy-wren		P		Diurnal bird survey
Australasian warblers				
Striated thornbill	*Acanthiza lineata*	P		Opportunistic
Brown thornbill	*Acanthiza pusilla*	P		Opportunistic
Brown greygone	*Gerygone mouki*	P		Diurnal bird survey
Yellow-throated scrubwren	*Sericornis frontalis*	p		Infrared camera
White-browed scrubwren	*Sericornis frontalis*	P		Diurnal bird survey
Pardalotes				
Spotted pardalote	*Pardalotus punctatus*	P		Diurnal bird survey
Honeyeaters				
Eastern spinebill	*Acanthorhynchus tenuirostris*	P		Diurnal bird survey
Lewins honeyeater	*Meliphaga lewinii*	P		Diurnal bird survey

Common name	Scientific name	NSW Status	Federal Status	Detection method
New Holland honeyeater	*Phylidonyris novaehollandiae*	P		Opportunistic
Little wattlebird	*Anthochaera chrysoptera*	P		Diurnal bird survey
Scarlet honeyeater	*Myzomela sanguinolenta*	P		Diurnal bird survey
Noisy friarbird	*Philemon corniculatus*	P		Opportunistic
Whipbirds				
Eastern whipbird	*Psophodes olivaceus*	p		Diurnal bird survey
Cuckoo-shrikes				
Black-faced cuckoo-shrike	*Coracina novaehollandiae*	P		Opportunistic
Whistlers				
Golden whistler	*Pachycephala pectoralis*	P		Diurnal bird survey
Grey-shrike thrush	*Colluricincla harmonica*	P		Diurnal bird survey
Orioles				
Olive-backed oriole	*Oriolus sagittatus*	P		Diurnal bird survey
Woodswallows, butcherbirds, currawongs and magpies				
Pied currawong	*Strepera graculina*	P		Opportunistic
Grey butcher bird	*Cracticus torquatus*	P		Opportunistic
Australian magpie	*Cracticus tibicen*	P		Opportunistic
Fantails				
Grey fantail	*Rhipidura albiscapa*	P		Diurnal bird survey
Rufous fantail	*Rhipidura rufifrons*	P		Diurnal bird survey
Willie wagtail	*Phipidura leucophrys*	P		Opportunistic
Ravens				
Australian raven	*Corvus coronoides*	P		Opportunistic
Monarch flycatchers				
Black-faced monarch	*Monarcha melanopsis*	P		Diurnal bird survey
Robins				
Eastern yellow robin	*Eopsaltria australis*	P		Opportunistic
Rose robin	*Petroica rosea*	P		Opportunistic
Silvereyes				

Common name	Scientific name	NSW Status	Federal Status	Detection method
Silvereye	*Zosterops lateralis*	P		Diurnal bird survey
Swallows and martins				
Welcome swallow	*Hirundo neoxena*	P		Opportunistic
Thrushes				
Bassian thrush	*Zoothera lunulata*	P		Diurnal bird survey
Ducks				
Australian wood duck	*Chenonetta jubata*	P		Opportunistic
Pacific black duck	*Anas superciliosa*	P		Opportunistic
Finches				
Red-browed finch	*Neochmia temporalis*	P		Opportunistic
Reptiles				
Skinks				
Eastern water-skink	*Eulamprus quoyii*	P		Opportunistic/Herp search
Grass skink	*Lampropholis delicata*	P		Herp search
Garden skink	*Lampropholis guichenoti*	P		Herp search
Weasel skink	*Saproscincus mustelinus*	P		Herp search
Maccoy's skink	*Anepischetosia maccoyi*	P		Opportunistic
Dragon lizards				
Gippsland water dragon	*Intellagama lesueurii howittii*	P		Opportunistic/Herp search
Snakes				
Red-bellied black snake	*Pseudechis porphyriacus*	P		Herp search
Eastern small-eyed Snake	*Cryptophis nigrescens*	P		Opportunistic
Golden-crowned snake	*Cacophis squamulosus*	P		Opportunistic
Pythons				
Diamond python	*Morelia spilota*	P		Opportunistic
Frogs				
Ground frogs				
Common eastern froglet	*Crinia signifera*	P		Streamside search

Common name	Scientific name	NSW Status	Federal Status	Detection method
Southern stony-creek frog	*Litoria lesueuri*	P		Opportunistic/streamside search
Tree frogs				
Bleating tree frog	*Litoria dentata*	P		Spotlight/streamside search
Leaf green stream frog	*Litoria nudigidita*	P		Spotlight/streamside search
Peron's tree frog	*Litoria peronii*	P		Opportunistic
Verreau's tree frog	*Litoria verreauxii*	P		Opportunistic
Dwarf tree frog	*Litoria fallax*	P		Opportunistic
Brown-striped frog	*Limnodynastes peronii*			Opportunistic
Fish				
Short-finned eel	*Anguilla australis*	P		Streamside search
Australian smelt	*Retropinna semoni*	P		Opportunistic
Striped gudgeon	*Gobiomorphus australis*	P		Opportunistic