Appendix 4

Pambalong Nature Reserve Monitoring Plan: 2009/10

Monitoring Report

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Pambalong Nature Reserve Monitoring Plan:
2009/10 Monitoring Report.

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2009/10 Monitoring Report.

April 2010

Report prepared for Donaldson Coal Pty Ltd.

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Executive Summary

Donaldson Coal Pty Ltd commenced operations at Abel Underground Coalmine at Beresfield in the lower Hunter Valley, New South Wales, during 2008. To comply with part of the conditions of consent a Flora and Fauna Management Plan was prepared in late 2007 by **ecobiological**.

This plan identified the need to establish a monitoring plan for Pambalong Nature Reserve (a 34ha freshwater wetland located between the eastern extent of the Abel coal mine lease and the F3 freeway). The reserve provides critical habitat for wader and water bird species and is part of a chain of protected wetlands (including Hexham Swamp, Shortland Wetlands and Kooragang Nature Reserve). The wetland depends on freshwater from Blue Gum Creek to maintain and replenish aquatic and terrestrial habitats in the reserve. Consequently any changes to the quantity and quality of water delivered from the Blue Gum Creek catchment arising from mining activities or subsidence could compromise the ecological integrity of the wetland (ecobiological 2007).

It is estimated that it will be approximately 14 years before there could be any potential for subsidence impacts on Pambalong Nature Reserve. Specific potential detrimental impacts on the wetland could be brought about by increased rates of sedimentation and a decline in the quantity and quality of water, producing a decline in wetland area and an overall loss of aquatic and terrestrial floral and faunal biodiversity. Negative impacts could also result from weeds and/or feral animals, and population increases of exotic species could occur as a result of the reserve ecosystem being weakened by external factors (ecobiological 2007).

This is the second annual report to establish baseline conditions at Pambalong Nature Reserve against which any changes over time can be measured and evaluated. It is important that data is collected over approximately the next 14 years to determine what constitutes normal variation so that any impacts resulting from subsidence can be properly identified and addressed with suitable management actions.

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1. Introduction

Donaldson Coal Pty Ltd (Donaldson) commenced mining during 2008 at a new underground mine (known as Abel Underground Coal Mine), located approximately 23 kilometres north-west of Newcastle. The mine will extract up to 4.5 million tonnes per year over 21 years using high productivity continuous miner based bord and pillar systems, and pillar extraction techniques.

Underground coal mining is often associated with adverse environmental impacts because of subsidence (Bell *et al.* 2000, Sidle *et al.* 2000). Subsidence can cause loss of productive land, damage to underground pipelines and above-ground structures, decreased stability of slopes and escarpments, contamination of groundwater by acid drainage and dewatering of streams and groundwater supplies (Sidle *et al.* 2000). Of these, one of the major environmental concerns arising from the Abel mine is the effect of subsidence on local and regional hydrology. Surface and sub-surface cracking associated with mining subsidence can alter and create preferential flow paths, thus causing dewatering and rerouting of surface water and groundwater (Sidle *et al.* 2000). Alterations in channel and drainage morphology may also affect channel erosion, sediment delivery, and routing in streams and riparian habitat.

Associated with development approval for the Abel coal mine were a number of conditions of consent. These conditions included a requirement for the preparation of a Flora and Fauna Management Plan (F & FMP) which was prepared by **ecobiological** in 2007. The F & FMP, which forms part of a comprehensive Environmental Management System for the Abel mine, sets out a strategy to monitor the effectiveness of the conservation measures proposed in the Environmental Assessment (EA) Statement of Commitments for the overall operation of the mine. Part of this strategy was to establish a Surface Ecological Monitoring Plan (SEMP) to monitor the effectiveness of the conservation measures proposed in the EA to mitigate against subsidence impacts on three distinct habitat areas; farm dams that form a belt across the mine site; subtropical rainforest areas of Long Gully Creek; and Pambalong Nature Reserve.

The SEMP outlines a monitoring plan for each of these areas by which baseline and subsequent monitoring data are to be gathered to inform future management. This report forms the baseline report for Pambalong Nature Reserve which forms part of the overall SEMP.

2. Location

The Abel Underground Mine is located within Newcastle, Cessnock and Maitland local government areas (LGAs). The majority of the underground mine and surface infrastructure area is within the Cessnock LGA. The seams to be mined are located under the Black Hill rural residential and adjoining forested areas. Mine access and associated surface infrastructure is located within the existing Donaldson Coal mine open cut void at Beresfield, with transfer of coal to the existing Bloomfield Coal Handling and Preparation Plant (CHPP) immediately to the north for coal washing and rail transport to the Port of Newcastle (Figure 1).

The Abel underground mine area is approximately 2750 ha and consists of low undulating forested hills with patches of cleared land for 110 rural/residential properties. A ridgeline associated with Black Hill runs east-west through the proposed underground mine area. Tributaries of Buttai Creek, Viney Creek, Weakley's Flat Creek and Four Mile Creek drain northwards from this ridgeline. A wide catchment containing Long Gully and Blue Gum Creek drains from the ridgeline providing water to the wet swamp at Pambalong Nature Reserve. Some cliff-lines and steeper gullies are located along sections of the Black Hill ridge.

The underground mine area is bounded on the eastern side by Pambalong Nature Reserve and the F3 Freeway; the western and southern sides by a tract of forest that extends south to the Central Coast and beyond to Hornsby, and the northern side by existing open cut coal mining activities within the Donaldson and Bloomfield mine leases (Figure 1).

Pambalong Nature Reserve consists of 34 hectares of predominantly freshwater wetland on the western side of the of the F3 freeway, approximately 20km north-west of Newcastle (Figure 2 and 3). The reserve was gazetted in December 2000 over former farmland acquired by the Roads and Traffic Authority during construction of the freeway (DEC 2006).

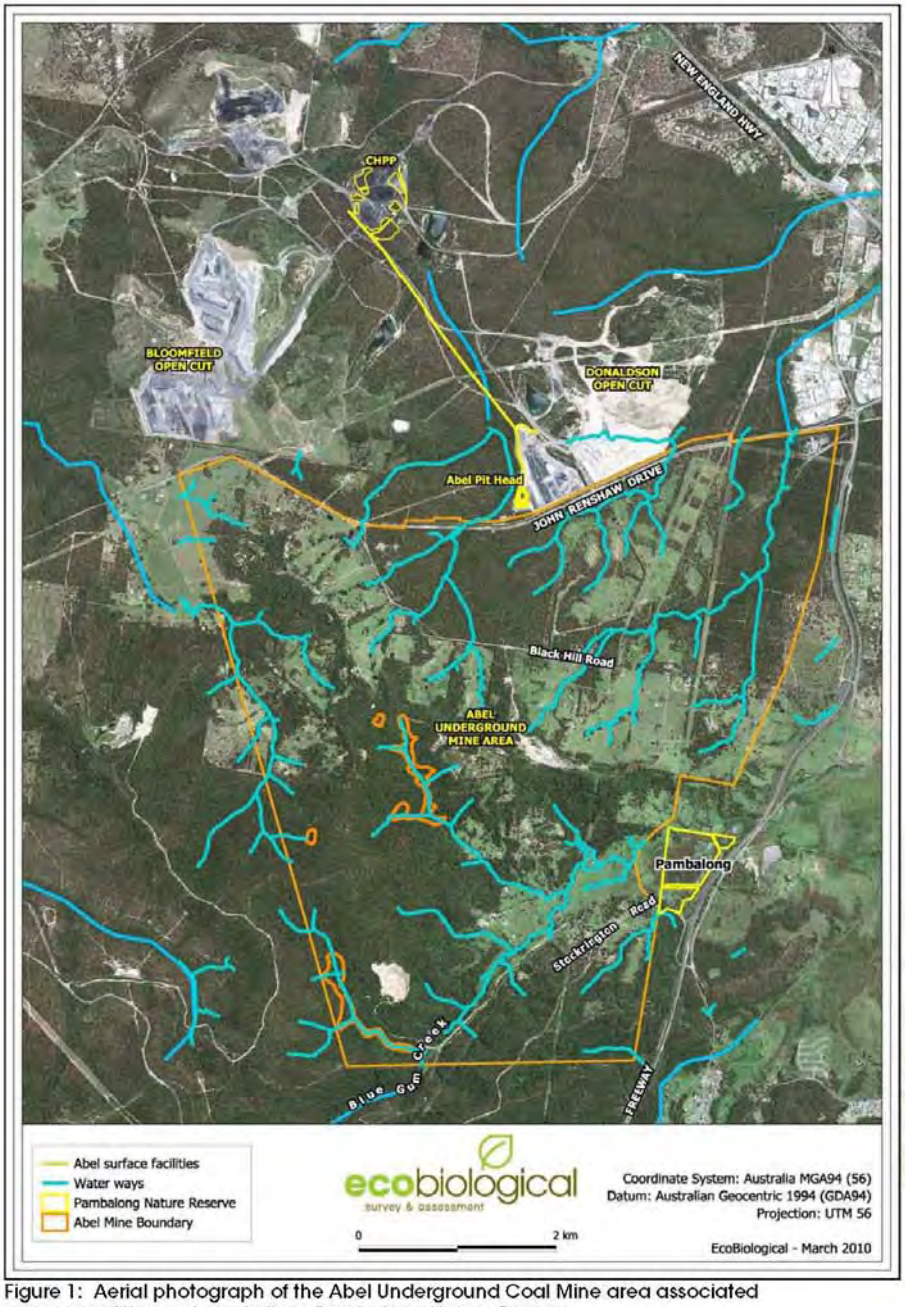

Figure 1: Aerial photograph of the Abel Underground Coal Mine area associated surface facilities and proximity to Pambalong Nature Reserve.

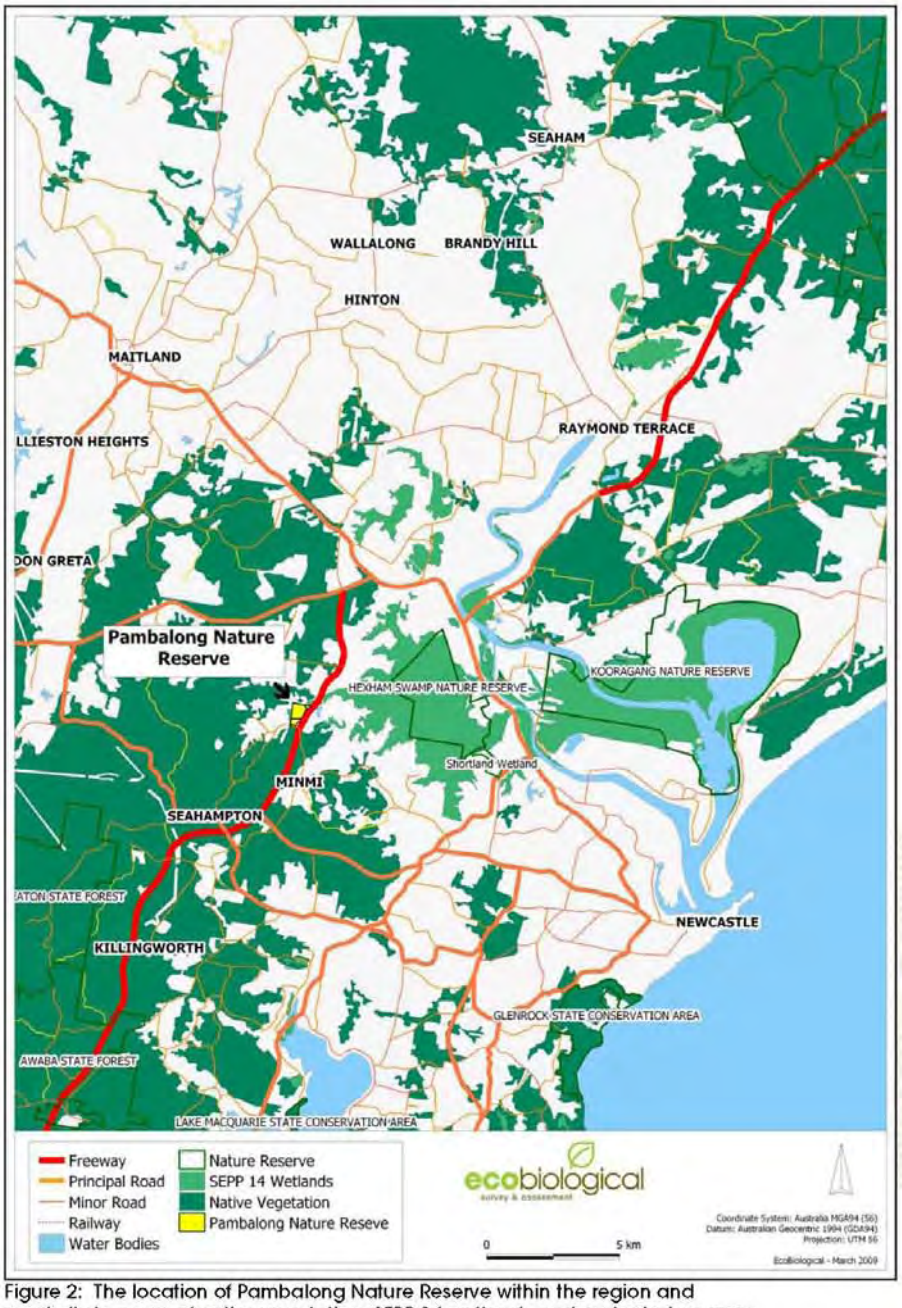

Figure 2: The location of Pambalong Nature Reserve within the region and proximity to areas of native vegetation, SEPP 14 wetlands and protected reserves.

Figure 3: Aerial photograph of Pambalong Nature Reserve and eastern extent of the Abel Coal Mine lease.

3. Methods

3.1. Floral Diversity and Vegetation Mapping

Flora and vegetation mapping has been undertaken in accordance with the requirements of the F&FMP (section 5.2.3.2).

A base vegetation map of the wetland was prepared using a combination of aerial photograph interpretation and ground-truthing to delineate community boundaries. Communities were classified based on the type of habitat provided as well as on the floristic content and structure. Vegetation community boundaries will be mapped and monitored yearly to identify any variations from year to year.

Standard 0.04ha (20m x 20m) floristic plots and a 50m transect were established in representative areas of identifiable vegetation structure. Data collected in these quadrats included total floristic content and the cover abundance score for each species in the plots using the Braun-Blanquet scale which will be applied consistently over time.

Targeted searches for threatened flora species (*Tetratheca juncea, Maundia triglochinoides, Persicaria elatior* and *Zannichellia palustris*) were also conducted in appropriate communities through random meandering. The location of any threatened flora species would be recorded using a GPS.

The surveys also recorded the presence and distribution of weed species across the subject site. The dominant weed species, outbreak areas and recently treated areas were mapped.

Floristic identification and nomenclature was based on Harden (1992, 1993, 2000, 2002) with subsequent revisions as published on PlantNet (http://plantnet.rbgsyd.nsw.gov.au). Plants listed under the ROTAP scheme (Briggs and Leigh 1995) were also considered in this assessment along with species and vegetation deemed to be of local conservation significance.

3.2. Faunal Diversity

All observation points and transects were established and documented in such a way as to ensure that data collected for each year is from the same location. Faunal diversity monitoring was centred on two transects, one situated in the Spotted Gum – Ironbark open forest fringing the South Swamp and the other situated in the Melaleuca Swamp Forest fringing the Main Swamp.

Table 1 depicts the total trap night count. Table 2 provides details of survey effort undertaken to record faunal diversity across the subject site. The location of fauna survey activities is shown in Figure 4.

Table 1: Trapping statistics for the subject site.

Trap type	Traps	Nights	Trap nights
Elliott A	40	4	160
Elliott B Tree	3	4	12
Elliott B Ground	6	4	24
Cage trap	4	4	16
Harp Trap	2	4	8
Hair tubes	8	4	32

Table 2: Fauna survey effort for the subject site.

Survey method	Days/nights	Locations
Anabat recording	2	4
Spotlighting	2	2
Owl call playback	2	3
Frog transect survey	2	3
Bird transect survey	2	2
Bird water body survey	8	3
Roosting bird abundance estimate	2	1
Opportunistic fauna observations	15	Across entire site

Figure 4: Aerial photograph showing the location of flora and fauna survey methods within Pambalong Nature Reserve.

3.2.1. Arboreal Mammals

For arboreal mammals, 3 Elliott B traps and 8 hair tubes were placed in trees at heights of 3m or above, along two transects and baited with a mixture of rolled oats, honey, peanut butter and treacle. The trunks of trees containing the traps were sprayed with a mixture of honey and water. These traps were checked daily for arboreal species and wafers from the hair tubes were collected after a 4-night period and checked for the presence of hair samples. Hair identification methods followed those of Brunner *et al.* (2002). If any hair sample was from a vulnerable or endangered species, the sample was sent to Barbara Triggs, an expert in the field of hair identification for a second opinion.

Spotlighting was undertaken along each transect from dusk over 2 nights to identify the presence of any arboreal mammals. Trees were inspected during daylight hours for the presence of habitat hollows and if present these were watched at dusk to see if any nocturnal birds or mammals emerged.

3.2.2. Terrestrial Mammals

Forty Elliott A, 6 Elliott B and 4 cage traps were placed along two transects at regular intervals to target terrestrial mammal species. The traps were baited with a mix of rolled oats, honey, peanut butter and treacle and set in position for 4 consecutive nights and checked each morning.

Spotlighting was undertaken along each transect from dusk over 2 nights to identify the presence of any terrestrial mammals. Careful daytime searches were conducted to detect the presence of fauna activity such as diggings, droppings or scratch marks.

3.2.3. Bats

A harp trap was erected along each transect in bat 'flyways' such as across a track at the South Swamp and in a natural forest opening in the Main Swamp to maximise the likelihood of captures. The harp traps were set in position for four consecutive nights and checked each morning. Bats captured were identified in the field and placed in specially designed 'soft release' boxes tethered to nearby trees which enable the bats to shelter during the day and exit the boxes on nightfall from narrow openings at the base of the box.

Anabat II bat-call recorders (Titley Electronics, Ballina) were used to record the calls of any Microchiropteran bats feeding in the area. The units were set up at dusk and recording occurred for a total of four hours at four locations over two nights. Spotlighting searches of blossoming trees were also undertaken to identify any Megachiropteran bat species.

3.2.4. Birds

A bird survey of vegetation fringing the Main Swamp and South Swamp was undertaken by walking the lengths of each trapping transect for 20 minutes on 12 November 2009 and again on 20 November 2009. Birds were identified either visually, with the aid of binoculars, or by call interpretation.

Four surveys (two dusk and two dawn) of each water body (North, Main and South) was undertaken approximately 1-week apart in Spring (November 2009) and replicated in Autumn (March 2010). A permanent monitoring location was established at each site and marked with a star picket to allow replication in future years. One observer undertook all surveys which involved a 20-minute survey of all birds seen and heard within the radius of each monitoring location (focusing on open water bodies). Birds were identified either visually, with the aid of binoculars and/or a spotting scope, or by call interpretation.

Bird surveys were conducted in the morning or late afternoon when bird activity is maximised (Bibby *et al.* 2000). Opportunistic sightings were also recorded and listed separately to actual survey results. Transect surveys were intended to record species diversity, not density whereas water body surveys were designed to assess water bird density, therefore counts, wherever possible, or density estimates were made to facilitate statistical comparison in future years.

At the completion of one of the dusk surveys in November 2009 and one of the dusk surveys in March 2010, an abundance estimate of birds roosting in the Melaleuca Swamp Forest within the Main Swamp was undertaken. This method will be replicated at the same time (on nightfall) in future years to facilitate statistical comparison of changes in roosting bird density and/or diversity.

After dark calls of threatened owl species (Powerful Owl, Masked Owl, Sooty Owl, Barking Owl and Grass Owl) were broadcast over a megaphone in an attempt to encourage a call back response. The subject site was also searched to locate any regurgitated owl pellets. The size, shape and

content of any pellets found were analysed to determine the species of owl from which the pellet originated as well as the prey species the owl had been feeding on. Analysis methods followed those of Brunner *et al.* (2002) and Triggs (1996).

3.2.5. Amphibians

Standardised survey techniques for amphibians were carried out at each of the three main water bodies in the reserve across two days and nights. Survey techniques included diurnal habitat searches, nocturnal spotlight surveys, call playback and dip netting for tadpoles. During diurnal surveys, dip netting and visual searches were carried out to locate any tadpoles present in any water bodies. During nocturnal surveys, spotlight searches were carried out by walking lengths of suitable habitat and using head torches to search for frogs by eye shine or by physical sightings. Call playback for the endangered Green and Golden Bell Frog was carried out due to the species' historical occurrence at the site and suitable habitat being present.

Adult frogs encountered were identified by visual confirmation or by their distinct advertisement calls. Tadpoles were keyed out using diagnostic features including mouthparts (tooth rows, jaw sheaths and papillae), pigmentation, body size, tail structure (musculature, fin depth, fin shape, tip shape), eye direction and spacing, pupil pigmentation, nare shape and spacing, spiracle height and direction, vent length and direction, and tadpole behaviour according to Anstis (2002).

3.2.6. Feral fauna

Several species of feral fauna such as Black Rats, rabbits, foxes, Common Myna, Spotted Dove, House Sparrow, Red-whiskered Bulbul and Common Starling have previously been recorded within the reserve (White, 2000; Straw, 2000; HBOC 1990 - 2008). The biodiversity of the reserve can be negatively impacted by increases in these species. Observations of any introduced species were recorded during field surveys of the subject site. Liaison with DECCW staff throughout the monitoring process will be undertaken to address any evidence of increasing numbers of feral fauna within the Reserve.

4. Results and Discussion

4.1. Weather Conditions and Survey Activities

The prevailing weather conditions throughout the trapping survey period at the subject site were warm to hot, humid days and warm nights with clear skies to light cloud cover and light winds. The mean minimum temperature was 17 ° C, and the mean maximum temperature was 26° C. A full list of survey activities and weather conditions during the survey period are provided in Table 3.

Table 3: Schedule of activities and weather conditions during the survey period.

Activity	Day	Date	Weather Conditions
Flora			
Transect and plot surveys and vegetation community mapping	Tue	3/11/2009	Fine conditions
Threatened species search and weed surveys	Tue Fri	3/11/2009 11/12/2009	Fine conditions
Fauna			
Trapping	Mon - Fri	2 – 6/11/09	Warm to hot days, clear to partly cloudy, no rain, mild to warm clear evenings
Nocturnal field work (Spotlighting, owl call playback, Anabat recording)	Mon	2/11/09	Warm humid evening, no rain, light cloud and light breeze
	Mon	9/11/09	Mild humid evening, no rain, cloud or wind
Bird survey – Transects and morning water body surveys	Thu	12/11/09	Warm, no rain, light cloud and light breeze
Bird survey – Dusk water body surveys	Wed	11/11/09	Warm, no rain, light cloud and calm to light breeze
Bird survey – Transects and morning water body surveys	Fri	20/11/09	Warm, no rain, cloud or wind
Bird survey – Dusk water body surveys	Wed	18/11/09	Warm, no rain or wind, light cloud
Bird survey – Dusk water body surveys	Tue	16/3/10	Warm, no rain, cloud or wind
Bird survey – Morning water body surveys	Wed	17/3/10	Warm, no rain, cloud or wind
Bird survey – Dusk water body surveys	Tue	23/3/10	Warm, no rain, cloud or wind
Bird survey – Morning water body surveys	Wed	24/3/10	Warm, no rain or wind, light cloud
Amphibian survey	Wed	11/11/09	No rain, cloud or wind
	Tue	24/11/09	Overcast, light shower, no wind

4.2. General Environmental Monitoring

Changes in the wetland and surrounds could be caused by a variety of activities not associated with mining such as rainfall levels, bushfire events and large-scale farming activities (ecobiological 2007). No significant bushfire events occurred within proximity of Pambalong Nature Reserve during 2009 and **ecobiological** is not aware of any large-scale farming activities such as clearing, road construction or dam building in the surrounding area that would have impacted on water flow or quality.

Presently, there is no rainfall monitoring station at Pambalong Nature Reserve or within immediate proximity that can provide reliable long-term rainfall data. Instead, historical rainfall data has been sourced from the Cockle Creek (Pasminco Metals) rainfall station (Source: Rainman Streamflow v4) as it is relatively close by (~10km directly to the south of Pambalong and a similar distance ~14km inland) and provides rainfall data over a 110-year period (1900 - 2009). Historical mean monthly rainfall (mm) from 1900 - 2009 and monthly rainfall (mm) from 2008 and 2009 is presented for comparison in Table 4 and Figure 5.

Table 4: Monthly rainfall (mm) recorded from Cockle Creek (Pasminco Metal) in 2008 and 2009 compared with mean monthly rainfall (mm) from 1900 - 2009

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008 actual	169	240	109	284	11	169	56	26	178	100	68	60	1470
2009 actual	24	208	42	128	177	97	25	3	23	82	57	75	941
1900-2009 historical mean	96	120	124	116	96	105	74	63	66	72	73	91	1,096

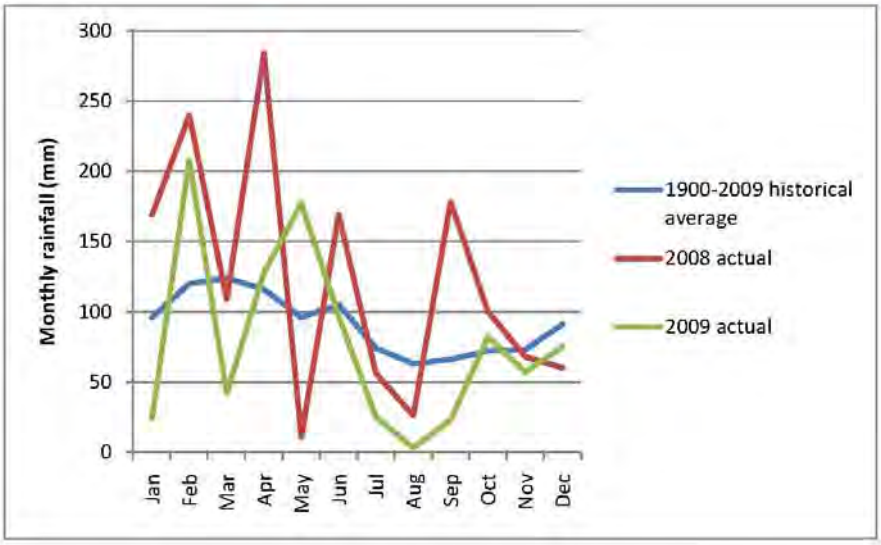

Figure 5: Monthly rainfall (mm) recorded from Cockle Creek (Pasminco Metal) in 2008 and 2009 compared with mean monthly rainfall (mm) from 1900 – 2009.

Below average rainfall was recorded during 2009 as compared with the historical yearly average. Well above average falls were recorded in February and May during 2009, however, several months (January, March, July, August, September) experienced well below average rainfall. During **ecobiological**'s field surveys in Spring 2009 and Autumn 2010 each of the three water bodies had high water levels with no muddy margins present.

The F&FMP (ecobiological 2007) recommends that sufficient weather stations are to be established in order to record rainfall in the catchment. This would assist in the collection of more accurate rainfall data over the next 10 – 15 years of pre-mining monitoring.

The installation of permanent water depth indicators in the Main and South Swamps would also be useful to provide a quantitative level during each survey event. Permission for installation would need to be sought from DECCW.

4.3. Survey limitations

It is acknowledged that water levels within Pambalong Nature Reserve fluctuate in response to climatic conditions. Climatic conditions are also recognised to affect the distribution and abundance of flora and fauna (predominantly amphibians and waterbirds) species within the swamp.

Flora and fauna surveys conducted by **ecobiological** were undertaken during a wet period where open water covered significant parts of the swamp. Access to some of these areas covered by open water was restricted due to water depth, thereby reducing our ability to place survey plots in these areas. **ecobiological** acknowledge this limitation and have reviewed the flora survey work undertaken by Eco Logical in 2002 (Eco Logical 2003) which was undertaken during a particularly dry period and enabled access into these areas. Over time as conditions allow, **ecobiological** will rectify collection of flora species data in each representative vegetation community as required by the F & FMP (ecobiological 2007).

It is also acknowledged that collection of bird species presence and abundance in only two seasons (Spring and Autumn) does not fully account for the total diversity likely to occur within the wetland. To address this, **ecobiological** will incorporate records from the Birds Australia Atlas, Hunter Bird Observers Club and any other reputable sightings in addition to its own in each annual report.

4.4. Flora

Flora surveys and vegetation mapping for this report were conducted during November and December 2009. A total of 162 flora species have been identified on the site since surveying commenced in 2008 within four survey plots, a single 50m transect and a meandering survey. Ninety-nine native species of flora were recorded in 2009 (Appendix 1).

The Coastal Foothills Spotted Gum - Ironbark Forest (dry sclerophyll) was found to have the highest species diversity in 2008 with 50 species recorded at this plot. In 2009, 47 species were recorded in Plot 1 including five new species not recorded in 2008.

Fifteen species were recorded in the Paperbark Swamp Forest plot (Q3) and 12 species were recorded in Plot 4 in 2008. In 2009, 19 species were recorded in Q3 (with four additional weeds recorded) and 18 species were

recorded at the relocated Q4 (this quadrat was relocated as per a request from the National Parks and Wildlife Service, see Figure 4). Additional species in Q4 included two epiphytic orchids, two *Juncus* species and two weed species.

Ten species were recorded in the Freshwater Wetland/Reedland plot (Q2) in 2008. This plot was also relocated as per a NPWS request (Figure 4) and recorded 18 species in 2009.

A total of 13 species were recorded in the 50m transect.

No threatened flora species were recorded during field surveys. Three regionally significant species were detected in the surveys (*Cyperus odoratus, Melaleuca linariifolia* and *Enydra fluctuans*). All three species have been recorded in previous studies.

4.4.1. Weeds

The Reserve had significant weed infestations across both disturbed areas and within the natural vegetation. The total weed count in 2009 was 63 species. The primary weeds at the time of survey were:

- Water Hyacinth (*Eichornia crassipes*) – survives in the system for a long time and when conditions are favourable, can spread rapidly and cover large areas of open water. This rapid spread can choke out sunlight for natural inundated plant species and reduce open water access and usage for water birds. The plant was found dominating the water outlet from the Main Swamp to the North Swamp in 2008 (Plate 1, Figure 6). It is likely the species has established from local seed and plant sources on the site and upstream. The life cycle of this plant means that it would continue to become established from both local and regional sources as it can float downstream and seeds can be delivered by transient birdlife.

  Water Hyacinth is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority. Ongoing management would need to be coordinated through local government and stakeholders. The NPWS Hunter Region Pest Management Strategy (2002) has identified control of Water Hyacinth at Pambalong Nature Reserve as a "high priority" and an active program has been operating in the reserve since 2002.

Further growth and spread of the weed must be controlled to prevent the weed from flowering or seeding and the plant material must be prevented from spreading through movement and/or transport by any means. Since the initial flora surveys conducted as part of this monitoring requirement (2008), some Water Hyacinth has been extracted from the open water and a grate installed to prevent this weed blocking the under road culvert (Plate 2).

Plate 1: Water Hyacinth at the Northern Swamp inlet 2008.

Plate 2: Water Hyacinth at the Northern Swamp inlet in 2009 (shows grate construction).

- Kikuyu (*Pennisetum clandestinum*) is forming dense, monoculture grassy thickets at the disturbed areas of the subject site. The thickets are preventing any other growth at the wetland edges which is in turn preventing natural vegetation recruitment.

  Kikuyu is a species listed under the Key Threatening Process (KTP) *'Invasion of native vegetation communities by exotic perennial grasses'*.

  The boundary of Kikuyu dominance is restricted by the hydrological regime, generally adjacent to the high water mark, and the thickets are unlikely to spread into the wetland areas.

- Blackberry (*Rubus fruticosus* aggregate) is found in areas of previous disturbance, and forms a dense thicket to 1m high, preventing natural regeneration. Blackberry thickets have capabilities to restrict fauna access to the wetland areas and provide shelter for feral animals.

  Blackberry is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed.

The NPWS Hunter Region Pest Management Strategy (2002) identifies Blackberry as a "high priority" weed. The main outbreaks identified in 2008 are shown in Figure 6; however, these outbreaks have been treated in the previous 12 months prior to the 2009 surveys and are showing mortality for the majority (Plate 3).

Plate 3: Treated Blackberry at the northern part of the subject site (December 2009). Some green shoots are showing as the patch regenerates.

- Lantana (*Lantana camara*) is a primary weed of the dry sclerophyll woodland at the southern portion of the subject site (Figure 6). This species is dominating the shrub and mid stratum, effectively out-competing natural vegetation regeneration in areas. The thickets of Lantana reduce the natural plant biodiversity and also offer refuge for feral wildlife.

  The 'Invasion, establishment and spread of *Lantana camara*' is listed as a Key Threatening Process (KTP) under the NSW TSC Act.

  Lantana is a declared Class 4 Noxious Weed in Cessnock and Class 5 Noxious Weed in all of NSW. The NPWS Hunter Region Pest Management Strategy (2002) identifies Lantana as a "high priority" weed, although at this stage there is no specific control program for this species in the reserve.

- Crofton Weed (*Ageratina adenophera*) is tolerant of wet soils and will extend into wetlands if unmanaged. This species is a Noxious Weed and control is required where the weed is found. The NPWS Hunter Region Pest Management Strategy (2002) identifies Crofton Weed as a "high priority" weed, although at this stage there is no specific control program for this species in the reserve. There were no significant outbreaks of this species recorded in the 2009 surveys.

  Crofton Weed is a declared Class 4 Noxious Weed in Newcastle, Cessnock and Maitland and the growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

- Other weeds found at the subject site were general weeds of disturbed areas (e.g. former rail line, roadsides etc.) and pastures. These weeds are confined to the fringes of the reserve, roadsides and the former rail line. Generally these species are located outside the natural vegetation areas.

Other significant weeds not identified during field surveys but which have the potential to be present were:

- Alligator Weed (*Alternanthera philoxeroides*) – has been identified from previous studies. Alligator Weed has the potential to infest waterways and invade adjoining land. Alligator Weed is easily spread and once established it is virtually impossible to eradicate. It is a declared noxious weed and eradication measures are required. The NPWS Hunter Region Pest Management Strategy (2002) identifies Alligator Weed as a "high priority" weed, although at this stage there is no specific control program for this species in the reserve.

- Noogoora Burr (*Xanthium occidentale*) – has been identified from previous studies. The NPWS Hunter Region Pest Management Strategy (2002) identifies Noogoora Burr as a "high priority" weed, although at this stage there are no specific control programs for this species in the reserve.

Legislation requires that noxious weeds be controlled. Alligator Weed, Blackberry, Crofton Weed, Water Hyacinth and Lantana are considered noxious in the Newcastle, Maitland and Cessnock City Council LGA's.

Some naturally occurring species may also present a problem if they become too abundant. Typha (*Typha orientalis*) and Phragmites (*Phragmites australis*) have the potential to spread into areas of open water, restricting the habitat of species preferring or utilising open water, such as pelicans, ducks and swans. If these native plant species threaten the habitat value of the reserve, they may require control.

Figure 6: Aerial photograph showing the main locations of weed infestation within Pambalong Nature Reserve and treated weeds (December 2009).

4.5. Vegetation Communities

Three natural vegetation communities and associated variations, and two altered vegetation types were mapped on the subject site in 2008 (Figure 7). The community extent did not physically change in the 2009 surveys.

Figure 7: Mapped vegetation communities as at December 2009 – areas constituting Endangered Ecological Communities (EEC) are delineated.

4.5.1. Coastal Foothills Spotted Gum – Ironbark Forest (Dry Sclerophyll Forest)

Open forest on the knoll at the southern portion of the subject site. The overall community shows significant past disturbance and subsequent weed infestation.

The community is dominated by *Corymbia maculata* and *Eucalyptus siderophloia* with some *Eucalyptus acmenoides* scattered. The mid stratum had a high abundance of *Lantana camara* and to a lesser extent, *Bursaria spinosa* and *Acacia maidenii*. The shrub layer had *Daviesia ulicifolia* common and the ground cover was grassy with *Themeda australis, Dichelachne micrantha, Entolasia stricta, Echinopogan caespitosus* and *Aristida vagans* common.

Lantana has been removed from this survey plot by **ecobiological** when surveying. In 2009 and five new species were recorded at this site; *Aristida ramosa* (Three-awned Spear Grass), *Cymbopogon refractus* (Barbed Wire Grass), *Dianella revoluta* (Blueberry Lily), *Juncus usitatus* (Common Juncus) and *Dendrophthoe vitellina* (Mistletoe). These species are potentially being observed as a result of the Lantana removal (with the exception of the Mistletoe species).

This community is not dependent on the wetland and associated hydrology. Coastal Foothills Spotted Gum - Ironbark Forest is not listed as a Threatened Ecological Community.

4.5.2. Paperbark Swamp Forest (Swamp Sclerophyll Forest)

The Paperbark communities at the subject site were restricted to more elevated ground and areas bordering the freshwater wetland complex. The Paperbark community at the centre of the Reserve was the most mature, and had a scattered *Casuarina glauca* canopy over dense Melaleuca sub-canopy. The quadrat survey (Q3) was conducted at the northern portion, adjacent to the Water Couch-Triglochin Swamp Meadow community and centrally on the core forested area (Q4). At the time of surveying, the majority of this core community was inundated to about 30cm.

The species composition within Q3 was typically dominated by *Melaleuca linariifolia* and *Melaleuca styphelioides* in the canopy. One juvenile *Ficus macrophylla* was found in the quadrat. The vine *Parsonsia straminea* was found within the quadrat, however, is more common in mature vegetation. Some *Melaleuca ericifolia* was present within the quadrat indicating the

frequency of inundation is significant; however, this species was more common in permanent swamp at the ecotone between the Paperbark community and the freshwater wetlands.

The mid stratum was sparse or absent. The ground cover within the quadrat comprised *Bolboschoenus caldwellii, Eleocharis acuta, Paspalum distichum, Persicaria hydropiper* and *Juncus usitatus*. The site was drier than the 2008 surveys and *Triglochin procera* and *Triglochin striata* were absent in 2009, and the additional weeds were *Aster subulatus, Bromus cathaticus, Conyza canadensis var. canadensis,* and *Sonchus oleraceus,* which are indicative of a drier environment.

The core community was surveyed in Q4. This survey had similar paperbark species; however, with the more permanent inundation several other species were present, namely *Enydra fluctuans, Juncus pallidus* (Pale Rush), *Ludwigia peploides* subsp. *montevidensis* (Water Primrose); *Typha orientalis* (Broadleaf Cumbungi) and *Casuarina glauca* (Swamp Oak). The Swamp Oak was seen to have epiphytes *Dendrobium linguiforme* (Tongue Orchid) and *D. teretifolium* (Rat's Tail Orchid). The weed water hyacinth was present in low and scattered numbers in this community.

Other common ground species found in the Paperbark communities but not within the quadrats included *Commelina cyanea, Dichondra repens, Persicaria decipiens, Viola hederacea, Carex appressa, Cynodon dactylon, Entolasia marginata, Lomandra longifolia, Microlaena stipoides var. stipoides, Oplismenus imbecillus* and *Phragmites australis.*

The Paperbark Swamp Forest and Paperbark Woodland would form a part of the NSW TSC Act-listed *Swamp Sclerophyll Forest on Coastal Floodplains EEC.*

4.5.3. Freshwater Wetland Complex (Freshwater Wetland)

The Freshwater Wetland Complex occurs in deeper depressions having a permanent or periodical inundation of fresh water, such that the species composition is comprised of water tolerant species. At the subject site the Freshwater Wetland Complex consisted of three variations: Typha Reedland; Rushland Swamp/Open Water; and Water Couch-Triglochin Swamp Meadow.

Specifically, these mapped freshwater wetland variations changed from open water bodies, with tall reeds and sedges, to a mixed reedland,

rushland or swamp meadow integrating with the Paperbark Swamp Forest community. The integration is likely to be a dynamic and moving boundary, at the present time directed by seasonal and climatic conditions.

The Freshwater Wetland Complex would form a part of the NSW TSC Act-listed *Freshwater Wetlands on Coastal Floodplains* EEC.

4.5.3.1 Typha Reedland

The Typha Reedland dominated deeper permanently inundated areas and related directly to the depth within Open Water freshwater lagoons. The Typha Reedland generally borders the lagoon areas as the water is generally too deep within these open water lagoons. The extent of Typha relates to the seasons and water levels. During the warmer months, growth in the Typha Reedland areas will expand and is likely to reduce in the cooler months or when water levels rise. The plot Q2 is located in this community variant, with dominant species being *Typha orientalis* (Broadleaf Cumbungi), *Schoenoplectus validus, Paspalum distichum* (Water Couch) *Eleocharis equisetina* and *Bolboschoenus caldwellii*.

4.5.3.2 Rushland Swamp/Open Water

The Rushland Swamp was in shallow semi permanent and permanent water. Transect T1 was set out in this community in the South Swamp and the species composition within this community was relatively low (13 species). The water levels varied from deeper water to boggy substrate in the survey transect. The community was dominated by *Bolboschoenus caldwellii, Eleocharis acuta* and *Paspalum distichum. Ludwigia peploides* subsp. *montevidensis, Spirodela punctata* and *Triglochin procera* were common throughout.

The Open Water areas occupied large portions of the Main Swamp and the North Swamp at the time of surveying. This community is very variable due to seasonal and local climatic conditions and is related to the extent of the Typha Reedland and Rushland Swamp. The results of the 2009 surveys were not significantly different to the 2008 surveys and the water depths were similar.

4.5.3.3 Water Couch-Triglochin Swamp Meadow

The Water Couch-Triglochin Swamp Meadow is found at the northern end of the Main Swamp. The presence of ruined fence lines indicated the previous land use for grazing purposes and the composition and structure are indicative of this grazing and trampling type of disturbance. The

community is dominated by dense *Paspalum distichum* with *Triglochin sp.* and *Persicaria sp.* also common. The Swamp Meadow is fringed on the deeper inundations by Typha Reedland.

4.5.4. Altered Vegetation - Swamp Oak Forest (planted)

Two isolated sections of the subject site had monospecific *Casuarina glauca* stands that have been physically planted (still having plastic bags around stems). These communities are not natural and composition does not adequately represent a natural community. However, the *Casuarina glauca* is found naturally throughout the Paperbark Swamp Forest.

4.5.5. Altered Vegetation - Disturbed/Kikuyu Grassland

The Kikuyu dominated grasslands and disturbed areas had a monoculture of Kikuyu or a weed dominated composition. The Kikuyu Grass dominated large areas adjacent the south swamp and Coastal foothills Spotted Gum – Ironbark Forest community and north from the main swamp. These Kikuyu areas had significant Blackberry clumps which have been recently treated.

The rail line between South Swamp and Main Swamp had a weed infestation; however, this was relatively contained to the elevated area and did not impact upon the swamp areas.

4.5.6. Endangered Ecological Communities

The vegetation mapping encompasses two natural vegetation communities listed as EEC's; *Freshwater Wetlands on Coastal Floodplains* EEC; and, *Swamp Sclerophyll Forest on Coastal Floodplains EEC*. The EEC areas are delineated in Figure 7. These EEC's comprise a majority of the subject site.

4.5.6.1 Freshwater Wetlands

Description

Freshwater Wetlands are associated with coastal areas subject to periodic flooding and in which standing fresh water persists for at least part of the year in most years. Soils are typically silts, muds or humic loams in low-lying parts of floodplains, alluvial flats, depressions, drainage lines, backswamps, lagoons and lakes but may also occur in backbarrier landforms where floodplains adjoin coastal sandplains (DEC 2005).

The species composition of freshwater wetlands at the subject site are indicative of the EEC as they are dominated by herbaceous plants and have few woody species. The vegetation composition (grassland, open water or sedgeland vegetation) is known to vary both spatially and temporally depending on the water regime.

Distribution
Hexham Swamp and Pambalong Nature Reserve are recognised as important reserves for freshwater wetlands.

4.5.6.2 Swamp Sclerophyll Forests

Description
The Paperbark Swamp Forest is recognised as a Swamp Sclerophyll Forest EEC. The community composition of mainly *Melaleuca linariifolia, Melaleuca ericifolia* and *Melaleuca styphelioides* (paperbarks) and scattered *Casuarina glauca* is indicative of a sclerophyllous community; however, it does lack a tree layer of eucalypts. The subject site was inundated at the time of surveying; however, previous reports indicate these areas become dry land during extended dry periods.

The groundcover was indicative of the EEC and is composed of abundant sedges, ferns, forbs, and grasses.

Distribution
Within the Lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian Melaleuca Swamp Woodland (map unit 42) and Melaleuca Scrub (map unit 42a) of NPWS (2000).

4.6. Faunal diversity

Fauna trapping and surveys were conducted in November 2009 with bird surveys repeated in March 2010. A total of 99 fauna species were recorded on the subject site, compared with 107 species in 2008 (Appendix 2 – Table 1). Species recorded in 2009 comprised one fish, five frog, two terrestrial mammal, eight bat and 83 bird species. Of these, five species are listed as significant (Vulnerable) under the NSW TSC Act and one species (Latham's Snipe *Gallinago hardwickii*) is listed as a marine species under the Commonwealth *Environment Protection & Biodiversity Conservation Act* 1999 (EPBC Act) and as a migratory species under several international conventions (Table 5).

A probable call of the threatened Eastern Falsistrelle (*Falsistrellus tasmaniensis*) was recorded at the southern trapping transect. This species has not previously been recorded at the site.

A dead Grey-headed Flying-fox caught on the barb wire fence that runs through the North Swamp was observed during the Spring 2009 bird surveys. It is likely that the animal was skimming over the water to take a drink and became entangled. Removal or replacement with plain wire is recommended to avoid any future fauna injuries or mortalities.

Table 5: Threatened and migratory fauna species recorded on the subject site.

Scientific Name	Common Name	Legal status	Survey Method
Falsistrellus tasmaniensis	Eastern Falsistrelle	V – TSC Act	Anabat recording
Gallinago hardwickii	Latham's Snipe	Marine – EPBC Act Listed on Bonn Convention and JAMBA/CAMBA/ROKAMBA	Opportunistic sighting of one individual during herpetofauna survey
Miniopterus australis	Little Bentwing-bat	V – TSC Act	Anabat recording
Miniopterus oceanensis	Eastern Bentwing-bat	V – TSC Act	Anabat recording
Micronomus norfolkensis	East-coast Freetail-bat	V – TSC Act	Anabat recording
Pteropus poliocephalus	Grey-headed Flying-fox	V – TSC Act / V – EPBC Act	Opportunistic sighting of a dead animal during bird survey

NB: taxonomy for bats follows Churchill (2008)
V = vulnerable; JAMBA = Japan-Australia Migratory Bird Agreement; CAMBA = China-Australia Migratory Bird Agreement; RoKAMBA = Republic of Korea-Australia Migratory Bird Agreement

The native Brown Antechinus (*Antechinus stuartii*) and Bush Rat (*Rattus fuscipes*) previously recorded by White (2000) and by **ecobiological** in 2008 were not trapped during 2009. The Sugar Glider (*Petaurus breviceps*) previously recorded by White (2000) has not been recorded on site by **ecobiological** in either survey to date. Introduced competitors such as the House Mouse and Black Rat and predators such as the Red Fox, Feral Cat and Dog have the potential to reduce or wipe out native mammal populations at the site. Future surveys will assist in confirming the ongoing presence or absence of these native species at the site.

A total of 83 bird species were recorded on site by **ecobiological** in 2009, compared with 84 species in 2008. Records of 83 species collected by the Hunter Bird Observers Club (HBOC) during July and December 2009 are attached in Appendix 3. While total bird species diversity was similar

between survey events, species composition was found to be quite variable between seasons and year-to-year. For example, 15 bird species recorded by **ecobiological** in 2008 were not recorded in 2009, while 14 species recorded by **ecobiological** in 2009 were not recorded in 2009. Additionally, 12 species not recorded by **ecobiological** in either year were detected by HBOC observers during a winter (July) and summer (December) survey in 2009.

Factors likely to affect bird species detection between years include seasonality issues (e.g. arrival times of migratory species), flowering times of foraging resources for nectarivorous species, climatic conditions and individual species ecology (e.g. some species have a large home range and may be absent from the study area during surveys or have cryptic traits which make them more difficult to detect). Differences in survey methodology between **ecobiological** and HBOC such as the type of survey method employed (i.e. fixed point, transect, area search), the length of survey and the number of observers are also likely to influence the type of species detected.

An annual count of Latham's Snipe was again undertaken by the HBOC in December 2009 with a total of 18 individuals sighted, which is quite low compared to previous years. However, this is potentially due to the high water levels, leaving very little suitable shallow muddy margins on which to forage. Counts of roosting birds in the Main Swamp were considerably lower in 2009 than in 2008. Future surveys will assist in identifying natural fluctuations in bird species diversity and abundance at the site.

Records from the HBOC have been obtained which provide diversity and density data on 155 species of bird detected within Pambalong Nature Reserve between 1997 and 2008 (ecobiological 2008). Data from the Birds Australia New Atlas collected between 1998 and 2009 have also been obtained of 145 bird species recorded from Pambalong Nature Reserve (ecobiological 2008). This information and any other reputable opportunistic sightings will continue to be incorporated on a yearly basis to provide a more complete record of the variations in bird assemblages and abundance at Pambalong Nature Reserve.

Photographs of each water body surveyed for birds and amphibians are provided in Appendix 4. Photographs from both the November 2009 and March 2010 survey period are provided to enable a visual comparison of water levels, areas of open water and aquatic vegetation occurring at each of the three water bodies.

Four introduced fauna species were recorded during field surveys in 2009. The Black Rat (*Rattus rattus*) and House Mouse (*Mus domesticus*) was trapped within the forested areas of the Reserve and the following bird species were recorded as individuals or in low numbers (<5 individuals): Common Myna and Common Starling.

5. Conclusions and Recommendations

Monitoring of Pambalong Nature Reserve has been undertaken in 2009/10 in accordance with the Flora and Fauna Management Plan for Abel Underground Coalmine (ecobiological 2007). This second annual monitoring report continues the data collection that will build a picture of what constitutes normal variation so that any impacts from subsidence can be identified and appropriate management actions taken.

In all there were 99 flora and 99 fauna species comprising one fish, five frog, two terrestrial mammal, eight bat and 83 bird species recorded by **ecobiological** within Pambalong Nature Reserve during the survey period. The following threatened species were recorded during field surveys (NB: taxonomy follows Churchill 2008):

- Eastern Bentwing-bat (*Miniopterus oceanensis*);
- Little Bentwing-bat (*Miniopterus australis*);
- East-coast Freetail-bat (*Micronomus norfolkensis*);
- Eastern Falsistrelle (*Falsistrellus tasmaniensis*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

The Latham's Snipe (*Gallinago hardwickii*) which is listed as a marine species under the Commonwealth EPBC Act and as a migratory species under several international conventions was recorded on site by both **ecobiological** and the Hunter Bird Observers Club during 2009.

Vegetation mapping identified three natural vegetation communities and two altered vegetation types as occurring within the reserve, with three variations described within the Freshwater Wetland complex. Two of the natural vegetation communities were mapped as forming part of Endangered Ecological Communities listed under the NSW TSC Act - *Freshwater Wetlands on Coastal Floodplains* and *Swamp Sclerophyll Forests on Coastal Floodplains*. These EECs were mapped over a majority of the subject site.

No significant changes to the vegetation community extent were recorded in the 2009 surveys. Weed management has been conducted by NPWS, aiming at restricting the spread of Water Hyacinth and Blackberry. Blackberry control was seen to be effective at the time of the 2009 surveys, and future observations will determine the success of the control program. The Kikuyu grass covers significant areas and any treatment over these areas would require follow up regeneration and rehabilitation of the preferred community type and species.

The following recommendations are made to improve the reliability and robustness of future survey data (i.e. build a more reliable picture of what constitutes normal variation in the system) and to mitigate negative impacts on native flora and fauna:

- Sufficient weather stations should be established at or in the immediate vicinity in order to record rainfall in the catchment. This would assist in the collection of more accurate rainfall data over the next 10 – 15 years of pre-mining monitoring (Donaldson Coal to liaise with Bureau of Meteorology and DECCW).
- The installation of permanent water depth indicators in the Main and South Swamps would be useful to provide a quantitative water level during each survey event. Permission for installation would need to be sought from DECCW and coordinated between involved parties.
- Ongoing control of noxious weeds is required (DECCW responsibility).
- Removal or replacement of the barbed wire spanning the North Swamp is recommended to avoid any future fauna injuries or mortalities (DECCW responsibility).

Ongoing annual monitoring will be undertaken over the same time period each year describing the results of the current year's investigation and placing them in the context of the cumulative data. Additional data collected over the period of initial monitoring will be recorded for ongoing analytical purposes. At an appropriate time, statistical analysis will be applied to investigate whether any significant trends are developing. The future implications of any evident trends should be used to inform best practice measures to be incorporated into the Subsidence Management Plan (SMP).

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Appendix 1: 2009 flora results

Key to symbols/abbreviations	
Q1 = Dry Sclerophyll Forest Plot	**Cover abundance (CA)**
Q2 = Freshwater Wetland Plot	1 = <5% cover, few individuals or sparse occurrence
T1 = Freshwater Wetland 50m Transect	2 = <5% cover, many individuals
Q3 = Swamp Sclerophyll Paperbark Swamp Plot 1	3 = 5 - <25% cover
Q4 = Swamp Sclerophyll Paperbark Swamp Plot 2	4 = 25 - <50% cover
* Introduced species	5 = 50 - <75% cover
+ Indicates presence in transect survey	6 = 75 - 100% cover

Family	Botanical Name	Common Name	Q1	Q2	T1	Q3	Q4
Adiantaceae	*Cheilanthes sieberi*	Mulga Fern					
Alismataceae	*Alisma plantago-aquatica*	Water Plantain					
Amaranthaceae	*Alternanthera denticulata*	Lesser Joyweed				2	1
Apiaceae	**Foeniculum vulgare*	Fennel					
Apiaceae	**Hydrocotyle bonariensis*	Pennywort					
Apocynaceae	**Araujia sericifera*	Moth Vine					
Apocynaceae	**Gomphocarpus fruticosus*	Wild Cotton					
Apocynaceae	*Parsonsia straminea*	Monkey Rope				2	
Asparagaceae	**Protasparagus aethiopicus*	Fern Asparagus					
Asteraceae	**Ageratina adenophora*	Crofton Weed					
Asteraceae	**Ambrosia tenuifolia*	Lacy Ragweed					
Asteraceae	**Aster subulatus*	Wild Aster		1		3	1
Asteraceae	**Bidens pilosa*	Cobblers peg	2				
Asteraceae	**Cirsium vulgare*	Black Thistle					
Asteraceae	**Conyza canadensis var. canadensis*	Canadian Fleabane				2	
Asteraceae	**Conyza sumatrensis*	Tall Fleabane					
Asteraceae	**Crassocephalum crepidioides*	Thickhead					
Asteraceae	**Euchiton sp.*	Cudweed					
Asteraceae	**Hypochaeris radicata*	Catsear					
Asteraceae	**Senecio madagascariensis*	Fireweed	2				
Asteraceae	**Sonchus oleraceus*	Milk Thistle	1			2	1
Asteraceae	**Tagetes minuta*	Stinking Roger					
Asteraceae	*Brachycome multifida var dilatata*	Cut-leaf daisy	2				
Asteraceae	*Cotula coronopifolia*	Water Buttons					
Asteraceae	*Enydra fluctuans*			2	+		
Asteraceae	*Euchiton involucratus*	Star Cudweed					
Asteraceae	*Ozothamnus diosmifolius*	White dogwood					
Asteraceae	*Senecio pterophorus*						
Asteraceae	*Vernonia cinerea var cinerea*		2				
Azollaceae	*Azolla filiculoides*	Pacific Azolla		3	+		
Bignoniaceae	*Pandorea pandorana ssp pandorana*	Wonga Wonga Vine	1				
Campanulaceae	*Wahlenbergia gracilis*	Native Bluebell					
Caryophyllaceae	**Stellaria media*	Chickweed					
Casuarinaceae	*Casuarina glauca*	Swamp Oak		3			1
Celastraceae	*Maytenus silvestris*	Orange Bark	2				
Ceratophyllaceae	*Ceratophyllum demersum*	Hornwort			+		

Family	Botanical Name	Common Name	Q1	Q2	T1	Q3	Q4
Chenopodiaceae	*Einadia hastata*	Berry Saltbush	2			3	
Commelinaceae	**Tradescantia albiflora*	Wandering Jew					
Commelinaceae	*Commelina cyanea*	Scurvy Weed					
Convolvulaceae	**Ipomoea purpurea*	Common Morning Glory					
Convolvulaceae	*Dichondra repens*	Kidney weed	2				
Cyperaceae	**Cyperus difformis*						
Cyperaceae	*Bolboschoenus caldwellii*			3		3	3
Cyperaceae	*Cyperus inversa*						
Cyperaceae	*Cyperus odoratus*				+		
Cyperaceae	*Eleocharis acuta*	Tall Spike-rush					
Cyperaceae	*Eleocharis equisetina*				+	2	3
Cyperaceae	*Eleocharis sphacelata*	Tall Spike-rush			+		
Cyperaceae	*Fimbristylis dichotoma*	Common Fringe-sedge					
Cyperaceae	*Schoenoplectus subulatus*						
Cyperaceae	*Schoenoplectus validus*				+		4
Euphorbiaceae	**Ricinus communis*	Castor Oil Plant					
Fabaceae - Faboideae	**Trifolium repens*	White Clover					
Fabaceae (Caesalpinoideae)	**Senna pendula subsp glabrata*	Cassia					
Fabaceae (Faboideae)	**Trifolium dubium*	Yellow Suckling Clover					
Fabaceae (Faboideae)	**Trifolium fragiferum*	Strawberry Clover					
Fabaceae (Faboideae)	**Vicia sativa*	Common Vetch					
Fabaceae (Faboideae)	**Vicia sativa*	Common Vetch					
Fabaceae (Faboideae)	*Daviesia ulicifolia*	Gorse Bitter Pea	2				
Fabaceae (Faboideae)	*Desmodium rhytidofilum*	Tick-trefoil	2				
Fabaceae (Faboideae)	*Desmodium varians*	Slender Tick-trefoil					
Fabaceae (Faboideae)	*Glycine clandestina*	Twining Glycine					
Fabaceae (Faboideae)	*Glycine tabacina*		2				
Fabaceae (Faboideae)	*Hardenbergia violacea*	Purple Twining Pea	1				
Fabaceae (Faboideae)	*Kennedia rubicunda*	Red Kennedy Pea					
Fabaceae (Faboideae)	*Kennedia rubicunda*	Red Kennedy Pea					
Fabaceae (Mimosoideae)	*Acacia falcata*	Sickle Wattle					
Fabaceae (Mimosoideae)	*Acacia fimbriata*						
Fabaceae (Mimosoideae)	*Acacia implexa*	Hickory					
Fabaceae (Mimosoideae)	*Acacia irrorata subsp irrorata*						
Fabaceae (Mimosoideae)	*Acacia maidenii*	Maidens Wattle	2				
Gentianaceae	**Centaurium erythraea*	Common Centaury					
Goodeniaceae	*Goodenia heterophylla*		1				
Juncaceae	*Juncus continuus*			1		1	
Juncaceae	*Juncus pallidus*	Pale Rush		1			2
Juncaceae	*Juncus usitatus*	Common Juncus	1				
Juncaginaceae	*Triglochin procera*			3			

Family	Botanical Name	Common Name	Q1	Q2	T1	Q3	Q4
Juncaginaceae	*Triglochin striata*	Steaked Arrowgrass					
Lamiaceae	*Plectranthus parviflorus*	Cockspur Flower	2				
Lemnaceae	*Spirodela punctata*	Duck Weed		4	+		
Lobeliaceae	*Pratia purpurascens*	White root	2				
Lomandraceae	*Lomandra multiflora*	Iron Grass	2				
Loranthaceae	*Dendrophthoe vitellina*	Mistletoe	1				
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling Lily	1				
Malvaceae	**Sida rhombifolia*	Paddy's Lucerne	2				
Moraceae	*Ficus macrophylla*	Moreton Bay Fig				1	
Myoporaceae	*Eremophila debilis*	Winter Apple					
Myrtaceae	*Corymbia maculata*	Spotted Gum	3				
Myrtaceae	*Eucalyptus acmenoides*	White mahogany	2				
Myrtaceae	*Eucalyptus siderophloia*	Grey Ironbark	4				
Myrtaceae	*Eucalyptus tereticornis*	Forest Redgum					
Myrtaceae	*Melaleuca ericifolia*			4		3	
Myrtaceae	*Melaleuca linariifolia*	Flax-leaved Paperbark		4		5	1
Myrtaceae	*Melaleuca styphelioides*					4	
Oleaceae	*Notelaea longifolia*	Mock olive	2				
Onagraceae	**Oenothera stricta*	Evening Primrose					
Onagraceae	*Epilobium billardierianum* subsp. *billardierianum*					2	
Onagraceae	*Ludwigia peploides subsp. montevidensis*	Water Primrose		2	+		
Orchidaceae	*Dendrobium linguiforme*	Tongue Orchid		1			
Orchidaceae	*Dendrobium teretifolium*	Rat's Tail Orchid		1			
Passifloraceae	**Passiflora edulis*	Common Passionfruit					
Phormiaceae	*Dianella caerulea*	Blue Flax-lily	2				
Phormiaceae	*Dianella revoluta*	Blueberry Lily	1				
Phyllanthaceae	*Breynia oblongifolia*	Coffee Bush					
Pittosporaceae	*Bursaria spinosa*	Box Thorn	2				
Plantaginaceae	**Plantago lanceolata*	Lambs Tongue	2				
Poaceae	**Andropogon virginicus*	Whisky Grass					
Poaceae	**Axonopus fissifolius*	Narrow-leafed Carpet Grass					
Poaceae	**Briza maxima*	Quaking Grass					
Poaceae	**Bromus cathaticus*	Praire Grass				2	
Poaceae	**Chloris gayana*	Rhodes Grass					
Poaceae	**Cortaderia selloana*	Pampas Grass					
Poaceae	**Cynodon dactylon*	Couch					
Poaceae	**Ehrharta erecta*	Panic Veldtgrass	2				
Poaceae	**Eragrostis curvula*	African Lovegrass					
Poaceae	**Hyparrhenia hirta*	Coolatai Grass					
Poaceae	**Lolium perenne*	Perennial Ryegrass					
Poaceae	**Melinis repens*	Red Natal Grass					
Poaceae	**Panicum maximum*	Guinea Grass					

Family	Botanical Name	Common Name	Q1	Q2	T1	Q3	Q4
Poaceae	**Paspalum dilatatum*	Paspalum	1				
Poaceae	**Paspalum urvillei*	Tall Paspalum					
Poaceae	**Pennisetum clandestinum*	Kikuyu					1
Poaceae	**Setaria pumilla*	Pale Pigeon Grass					
Poaceae	**Setaria sphaecelata*	South African Pigeon Grass					
Poaceae	**Setaria verticillata*	Whorled Pigeon Grass					
Poaceae	**Sporobolus africanus*	Parramatta Grass					
Poaceae	*Aristida ramosa*	Three-awned Spear Grass	2				
Poaceae	*Aristida vagans*	Three-awned Spear Grass	2				
Poaceae	*Capillipedium parviflorum*	Scented-top Grass					
Poaceae	*Cymbopogon refractus*	Barbed Wire Grass	1				
Poaceae	*Cynodon dactylon*	Couch			+	4	2
Poaceae	*Dichelachne micrantha*	Shorthair Plumegrass	2				
Poaceae	*Echinopogan caespitosus*	Tufted Hedgehog Grass					
Poaceae	*Entolasia stricta*	Wiry panic	4				
Poaceae	*Imperata cylindrica*	Bladey grass	2				
Poaceae	*Imperata cylindrica var. major*	Bladey grass					
Poaceae	*Oplismenus aemulus*	Basket Grass	1				
Poaceae	*Panicum simile*	Two Colour Panic	1				
Poaceae	*Paspalum distichum*	Water Couch		2	+	2	3
Poaceae	*Themeda australis*	Kangaroo grass	3				
Poaceae	*Austrodanthonia tenuior*	Wallaby Grass					
Polygonaceae	**Polygonum arenastrum*	Wireweed				2	
Polygonaceae	**Rumex crispus*	Dock				3	2
Polygonaceae	*Persicaria decipiens*	Slender Knotweed		2	+		1
Polygonaceae	*Persicaria hydropiper*	Water Pepper					
Pontederiaceae	**Eichhornia crassipes*	Water Hyacinth		2			
Ranunculaceae	**Ranunculus repens*	Creeping Buttercup					
Ranunculaceae	*Clematis glycinoides*	Old Mans Beard					
Ranunculaceae	*Rnunculatus inundatus*	River Buttercup					2
Rhamnaceae	*Alphitonia exelsa*	Red Ash	1				
Rosaceae	**Rubus fruticosus* aggregate	Blackberry					
Rubiaceae	*Opercularia diphylla*		2				
Scrophulariaceae	*Bacopa monnieri*	Bacopa					
Solanaceae	**Solanum mauritianum*	Wild Tobacco					
Solanaceae	**Solanum nigrum*	Blackberry Nightshade					
Solanaceae	*Solanum brownii*	Violet Nightshade	2				
Solanaceae	*Solanum prinophyllum*	Forest Nightshade	1				
Typhaceae	*Typha orientalis*	Broadleaf Cumbungi		4	+	2	5
Verbenaceae	**Lantana camara*	Lantana	2				
Verbenaceae	**Verbena bonariensis*	Purpletop					1

Family	Botanical Name	Common Name	Q1	Q2	T1	Q3	Q4
Violaceae	*Viola hederacea*	Ivy-leaved Violet					
Vitaceae	*Cayratia clematidea*	Native Grape	1				

Appendix 2: Fauna species recorded on the subject site

Table 1: Fauna species (excluding birds) recorded from trapping and nocturnal survey activities by ecobiological in baseline study (October 2008), November 2009 and White (2000).

Scientific Name	Common Name	Method	2008	2009	White (2000)
Fish					
Gambusia holbrooki	Plague Minnow	Tadpole search	+	+	+
Amphibians					
Crinia signifera	Common Eastern Froglet	Nocturnal amphibian survey	+		
Limnodynastes peronii	Striped Marsh Frog	Nocturnal amphibian survey	+	+	
Litoria fallax	Eastern Dwarf Tree Frog	Nocturnal amphibian survey	+	+	
Litoria freycineti	Freycinet's Frog	Nocturnal and diurnal survey			+
Litoria latopalmata	Broad-palmed Frog	Nocturnal and diurnal survey			+
Litoria peronii	Peron's Tree Frog	Nocturnal amphibian survey	+	+	
Litoria tyleri	Southern Laughing Tree Frog	Nocturnal amphibian survey	+	+	
Litoria verreuxii	Verreux's Tree Frog	Nocturnal amphibian survey		+	
Reptiles					
Chelodina longicollis	Eastern Long-necked Turtle	Diurnal reptile survey			+
Eulamprus quoyii	Eastern Water Skink	Diurnal reptile survey			+
Amphibolurus muricatus	Jacky Lizard	Diurnal reptile survey			+
Ctenotus robustus	Robust Ctenotus	Diurnal reptile survey			+
Lampropholis delicata	Garden Skink	Diurnal reptile survey			+
Physignathus lesueurii lesueurii	Eastern Water Dragon	Opportunistic sighting	+		
Pseudechis porphyriacus	Red-bellied Black Snake	Opportunistic sighting	+		+
Terrestrial/ Scansorial Mammals					
Antechinus stuartii	Brown Antechinus	Trapping	+		+
Mus domesticus	*House Mouse	Trapping	+	+	
Petaurus breviceps	Sugar Glider	Spotlighting			+
Rattus fuscipes	Bush Rat	Trapping	+		+
Rattus rattus	*Black Rat	Trapping/spotlighting	+	+	+
Vulpes vulpes	*Red Fox	Spotlighting/scat analysis			+

Table 1 cont: Fauna species recorded from trapping and nocturnal survey activities by ecobiological in baseline study (October 2008), November 2009 and White (2000).

Scientific Name	Common Name	Method	2008	2009	White (2000)
Bats					
Pteropus poliocephalus	# Grey-headed Flying-fox	Spotlighting (2008) / dead animal observed in 2009	+	+	+
Austronomus australis	White-striped Mastiff-bat	Anabat analysis			+
Chalinolobus gouldii	Gould's Wattled Bat	Anabat analysis/trapping	+	+	+
Chalinolobus morio	Chocolate Wattled Bat	Anabat analysis/trapping			+
Falsistrellus tasmaniensis	Eastern Falsistrelle	Anabat analysis		+	
Miniopterus australis	# Little Bentwing-bat	Anabat analysis	+	+	
Miniopterus oceanensis	# Eastern Bentwing-bat	Anabat analysis	+	+	
Micronomus norfolkensis	# East-coast Freetail-bat	Anabat analysis	+	+	
Mormopterus ridei	Eastern Freetail-bat	Anabat analysis	+		
Nyctophilus sp.	Unidentified Long-eared Bat	Anabat analysis	+		
Nyctophilus gouldii	Gould's Long-eared Bat	Trapping			+
Scoteanax rueppellii	# Greater Broad-nosed Bat	Anabat analysis	+		
Vespadelus pumilus	Eastern Forest Bat	Anabat analysis	+	+	
Vespadelus vulturnus	Little Forest Bat	Trapping & Anabat analysis	+	+	+

* denotes an introduced species
# denotes a threatened species under the NSW TSC Act 1995

NB: Taxonomy for bats follows Churchill (2008).

Table 2: Bird species recorded along Transects by ecobiological during Spring 2008 compared with Spring 2009.

			Spring 2008				Spring 2009			
Family	Scientific Name	Common Name	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S
Acanthizidae	*Gerygone mouki*	Brown Gerygone	h		h		h		h	
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill			h		A		A	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	h		h	h	h		A	
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	A				A		A	A
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	1							
Acrochephalidae	*Acrocephalus australis*	Australian Reed-Warbler	h	h			h	h	h	h
Ardeidae	*Ardea ibis*	Cattle Egret					B			
Ardeidae	*Egretta novaehollandiae*	White-faced Heron		1						
Artamidae	*Cracticus tibicen*	Australian Magpie	h	+	h	h	h	h	h	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	h	h						h
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird	h	h	h		h			h
Artamidae	*Strepera graculina*	Pied Currawong	h							
Artamidae	*Artamus leucorhynchus*	White-breasted Woodswallow		A						
Cacatuidae	*Eolophus roseicappilus*	Galah			h	h				
Cacatuidae	*Cacatua sanguinea*	Little Corella					h			
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	h				h	h		h
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike		h	h		A		h	
Charadriidae	*Vanellus miles*	Masked Lapwing	h		h		h		2	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	h		h	h	h		h	h
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove					h		h	
Columbidae	*Ocyphaps lophotes*	Crested Pigeon			h		h			h
Corvidae	*Corvus coronoides*	Australian Raven	h			h	A		h	
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo		h	h				h	
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo							h	
Cuculidae	*Eudynamys orientalis*	Eastern Koel			h					
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo		h	h		h			
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo					h			
Cuculidae	*Centropus phasianaus*	Pheasant Coucal					h		h	
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo		h					h	

Table 2 cont: Bird species recorded along Transects by ecobiological during Spring 2008 compared with Spring 2009.

			Spring 2008				Spring 2009			
Family	Scientific Name	Common Name	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch					h		h	
Estrildidae	*Neochmia temporalis*	Red-browed Finch	A		h				h	
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	h	h	h		h			
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra		h	2		A	1		
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	A	A	h	h	A	h		
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	A		h		A		A	
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	h	h	h	h	B	h	h	h
Maluridae	*Malurus lamberti*	Variegated Fairy-wren			h	h	A			
Megaluridae	*Megalurus gramineus*	Little Grassbird		h						
Megaluridae	*Megalurus timoriensis*	Tawny Grassbird					h			
Meliphagidae	*Manorina melanophrys*	Bell Miner		h		h	h	h	h	h
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater		h						
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	h	h	h	h	h		h	h
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird					A			
Meliphagidae	*Manorina melanocephala*	Noisy Miner		h		h		h		B
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	h	h	h	h				
Meliphagidae	*Plectorhyncha lanceolata*	Striped Honeyeater		h		h	h			
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater		h	h	h				A
Meropidae	*Merops ornatus*	Rainbow Bee-eater	h							
Monarchidae	*Grallina cyanoleuca*	Magpie-lark		h	h			h	h	h
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird							h	B
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole		h				h		h
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	h	h		h	h		h	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	h		h	h	h	h	h	
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	h							
Psittacidae	*Alisterus scapularis*	Australian King-Parrot					h			
Psittacidae	*Platycercus eximius*	Eastern Rosella	h	h	A	4	A	A	h	A
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet		h		2				
Rallidae	*Porphyrio porphyrio*	Purple Swamphen		h						h
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail	h		h		h	h	A	h
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	h	h	h	h	A		h	h

Table 2 cont: Bird species recorded along Transects by ecobiological during Spring 2008 compared with Spring 2009.

			Spring 2008				Spring 2009			
Family	Scientific Name	Common Name	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S	T1 - N	T2 - S
Sturnidae	*Sturnus tristis*	*Common Myna					A			
Sturnidae	*Sturnus vulgaris*	*Common Starling			2					
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	2	1						
Timaliidae	*Zosterops lateralis*	Silvereye	h		B		h		B	h
		No. of Species	29	30	30	19	39	13	29	20

The list follows the taxonomy of Christidis & Boles (2008).
h = heard only.
Where numbers were counted, these are shown. In other cases the estimate of abundance is represented by the following approximations:
A=1-5 birds present; B=6-20 birds present; C=21-50 birds present; D=51-100 birds present; E=more than 100 birds present.

Table 3: Bird species recorded from the North Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Da - 1	Du - 1	Da - 2	Du - 2	Da - 1	Du - 1	Da - 2	Du - 2	Du - 1	Da - 1	Du - 2	Da - 2	Du - 1	Da - 1	Du - 2	Da - 2
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren							h					h		h		
Acanthizidae	*Acanthiza nana*	Yellow Thornbill		B														
Accipitridae	*Circus approximans*	Swamp Harrier	1													1		
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	1															
Accipitridae	*Haliastur sphenurus*	Whistling Kite				1												
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler	h	h	h	1					h	h	h	h		h		
Anatidae	*Anas platyrhynchos*	*Northern Mallard				1												
Anatidae	*Anas rhynchotis*	Australasian Shoveler		2							1							
Anatidae	*Chenonetta jubata*	Australian Wood Duck		2														
Anatidae	*Cygnus atratus*	Black Swan		4			3	3	1	2fo	3	3	3	3	2		2	2
Anatidae	*Anas castanea*	Chestnut Teal	13		1	1			9	8		42	87	22				
Anatidae	*Anas gracilis*	Grey Teal	53	7	4		2				58		28	7				
Anatidae	*Aythya australis*	Hardhead	25	7	9	12					2		2	2				
Anatidae	*Anas superciliosa*	Pacific Black Duck	63	15	23	16	9		6	4	106	122	32	108	4		8	16
Anatidae	*Dendrocygna arcuata*	Wandering Whistling Duck			8	5												
Anhingidae	*Anhinga melanogaster*	Australasian Darter		1				1										
Ardeidae	*Ardea ibis*	Cattle Egret					5			1		1	3	28	6fo			
Ardeidae	*Ardea intermedia*	Intermediate Egret										1	1	1				
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	2				1						1		1			
Artamidae	*Cracticus tibicen*	Australian Magpie													h			h
Artamidae	*Cracticus torquatus*	Grey Butcherbird								h						h		
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird			h							h				h		
Artamidae	*Artamus leucorhynchus*	White-breasted Woodswallow	1	3	1													
Cacatuidae	*Cacatua sanguinea*	Little Corella								7fo								
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo					h				h							h
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike			1			1			h							h
Charadriidae	*Vanellus miles*	Masked Lapwing	1		h	1	2		2	2	h			A		h		
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola										h	h		A			h
Columbidae	*Streptopelia chinensis*	*Spotted Dove		h														
Columbidae	*Ocyphaps lophotes*	Crested Pigeon	A												A			
Columbidae	*Leucosarcia picata*	Wonga Pigeon	h															
Corvidae	*Corvus coronoides*	Australian Raven	h				h	2	2	h	h		h		h	h		A
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			h						h							
Cuculidae	*Eudynamys orientalis*	Eastern Koel			h									h				
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	h															
Cuculidae	*Centropus phasianinus*	Pheasant Coucal											h					
Estrildidae	*Neochmia temporalis*	Red-browed Finch	A													A		
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird		h	h	h	h	h		h	h		h	h	h	h	h	h
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra					h	1		1fo						h		
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	1		2	h					h	A						
Hirundinidae	*Hirundo neoxena*	Welcome Swallow			A										A			
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h	h
Maluridae	*Malurus lamberti*	Variegated Fairy-wren					h	h		h						h		h
Megaluridae	*Megalurus gramineus*	Little Grassbird					h	h			h			h	1		h	A
Meliphagidae	*Manorina melanophrys*	Bell Miner					h							h	h			
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater					h	h							h	h	h	h
Meliphagidae	*Manorina melanocephala*	Noisy Miner					2	2										
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater		h	h								h			h		
Monarchidae	*Grallina cyanoleuca*	Magpie-lark		4	h	2	h	h		h	h		h	h	h		h	h
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	h	h	h			h	h		h				h			
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler		h	h	h					h							

Table 3 cont: Bird species recorded from the North Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Da - 1	Du - 1	Da - 2	Du - 2	Da - 1	Du - 1	Da - 2	Du - 2	Du - 1	Da - 1	Du - 2	Da - 2	Du - 1	Da - 1	Du - 2	Da - 2
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote						h										
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican											2	2				
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin														h		
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant				2								1	2		1fo	
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	1					1		2	1							
Phalacrocoracidae	*Phalacrocorax varius*	Pied Cormorant		1			2											
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	12	3	7	8				1		2			2	3	2	2
Psittacidae	*Platycercus eximius*	Eastern Rosella			h							h	h	h	h			A
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet														A		
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen		2	2		2			1								
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	4	4	3	3	h	3	3	1	7	6	8	10	h		4	7
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail		h	h	h	h	1	h	h	h		h	h	h	h	h	
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	A	h	h	h	h	h	h	h	h		1	h	A	h	h	h
Sturnidae	*Sturnus tristis*	*Common Myna	A			1												
Sturnidae	*Sturnus vulgaris*	*Common Starling				1		1				A			A	A	1	A
Threskiornithidae	*Threskiornis moluccus*	Australian White Ibis					1		10fo			1	2			4fo		
Threskiornithidae	*Platalea regis*	Royal Spoonbill	1								1		2	8				
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis			2													
Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill											1	1				
Timalidae	*Zosterops lateralis*	Silvereye	h		h		h	h	h	h			h			A		
		No. of Species	25	23	28	20	24	20	13	20	23	15	25	24	23	22	13	18

The list follows the taxonomy of Christidis & Boles (2008).
h = heard only.
Where numbers were counted, these are shown. In other cases the estimate of abundance is represented by the following approximations:
A=1-5 birds present; B=6-20 birds present; C=21-50 birds present; D=51-100 birds present; E=more than 100 birds present.

Table 4: Bird species recorded from the Main Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Da - 1	Du - 1	Da - 2	Du - 2	Da - 1	Du - 1	Da - 2	Du - 2	Du - 1	Da - 1	Du - 2	Da - 2	Du - 1	Da - 1	Du - 2	Da - 2
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill															A	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren														h	A	h
Acanthizidae	*Acanthiza nana*	Yellow Thornbill								A		A						A
Accipitridae	*Accipiter novaehollandiae*	Grey Goshawk							1									
Accipitridae	*Circus approximans*	Swamp Harrier		1														1
Accipitridae	*Aquila audax*	Wedge-tailed Eagle										1						
Accipitridae	*Haliastur sphenurus*	Whistling Kite	1		1													
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler	h	h	h						h	h	h	h				
Anatidae	*Cygnus atratus*	Black Swan	9				2	3	1	1					1	3	1	2
Anatidae	*Anas castanea*	Chestnut Teal					4	2	4	2				2	1	2	4	4
Anatidae	*Anas superciliosa*	Pacific Black Duck		2	1		8	4	9	3		1			7	3	4	6
Ardeidae	*Ardea ibis*	Cattle Egret		Dfo												3fo		
Ardeidae	*Ardea modesta*	Eastern Great Egret									1							
Ardeidae	*Egretta novaehollandiae*	White-faced Heron			1		2		1									
Artamidae	*Cracticus tibicen*	Australian Magpie															A	
Artamidae	*Cracticus torquatus*	Grey Butcherbird		h			h		h					h				
Artamidae	*Artamus leucorhynchus*	White-breasted Woodswallow	1															
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	10fo															
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike												A				
Campephagidae	*Coracina tenuirostris*	Cicadabird													A			
Charadriidae	*Vanellus miles*	Masked Lapwing					1											
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola								h	h		h	h				
Corvidae	*Corvus coronoides*	Australian Raven	1	3					h				A					
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			h													
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo										1	h					
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	h		h													
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	h															
Estrildidae	*Neochmia temporalis*	Red-browed Finch					h		h	B						A		
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra						1										
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	1		h	h					h	h	h					
Hirundinidae	*Petrochelidon ariel*	Fairy Martin			8						3							
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	6								A							
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	h	h	h	h	h	h	h	5	h	h	h	h		h	h	
Maluridae	*Malurus lamberti*	Variegated Fairy-wren						h	h		h					h	A	h
Megaluridae	*Megalurus gramineus*	Little Grassbird									h	h		h				
Megaluridae	*Megalurus timoriensis*	Tawny Grassbird										h	h					
Meliphagidae	*Manorina melanophrys*	Bell Miner			h		h	h	h	h	h	h			h	h	h	h
Meliphagidae	*Manorina melanocephala*	Noisy Miner	h														h	
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater			1											h		
Monarchidae	*Mylagra rubecula*	Leaden Flycatcher		1														
Monarchidae	*Grallina cyanoleuca*	Magpie-lark		C	h		h		h				A				A	A
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole											h					
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	1															
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe			1													
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet										1fo			h			
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen		2	1	h	1	2	1	2				2	1			2
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	3	3	5	2	6	1	5	1	h	4	A	2	2	4	5	2
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail				h	h				A				h		h	
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	h			h	h	h	1	h					h	A		h
Threskiornithidae	*Threskiornis molucca*	Australian White Ibis	1fo							1fo								

Table 4 cont: Bird species recorded from the Main Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Da - 1	Du - 1	Da - 2	Du - 2	Da - 1	Du - 1	Da - 2	Du - 2	Du - 1	Da - 1	Du - 2	Da - 2	Du - 1	Da - 1	Du - 2	Da - 2
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	7fo	9fo	6fo													
Timaliidae	*Zosterops lateralis*	Silvereye								h	h	h		h				
		No. of Species	17	12	16	6	14	10	15	13	13	13	10	10	10	12	13	12

Opportunistic

Family	Scientific Name	Common Name	Comment
Scolopacidae	*Gallinago hardwickii*	Latham's Snipe	An individual bird was sighted by ecobiological during the spring 2009 diurnal herpetofauna survey

The list follows the taxonomy of Christidis & Boles (2008).
h = heard only.
Where numbers were counted, these are shown. In other cases the estimate of abundance is represented by the following approximations:
A=1-5 birds present; B=6-20 birds present; C=21-50 birds present; D=51-100 birds present; E=more than 100 birds present.

Table 5: Bird species recorded from the South Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Du -1	Du - 1	Du - 2	Du -2	Du -1	Du - 1	Du - 2	Du - 2	Du - 1	Du - 1	Du - 2	Du - 2	Du - 1	Du - 1	Du - 2	Du - 2
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill																
Accipitridae	*Circus approximans*	Swamp Harrier	1		1			1	A									
Accipitridae	*Haliastur sphenurus*	Whistling Kite			2													
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler	h	h	h	h					h	1						
Anatidae	*Cygnus atratus*	Black Swan			6		4	1		6	5	h	h	2		4	4	2
Anatidae	*Anas castanea*	Chestnut Teal	2	4	20						2						4	2
Anatidae	*Anas gracilis*	Grey Teal									2			1				
Anatidae	*Anas superciliosa*	Pacific Black Duck	7	9	8	7	10	29	6	12	11	2		5	14	10	35	23
Ardeidae	*Ardea ibis*	Cattle Egret									2	2		5				
Ardeidae	*Egretta novaehollandiae*	White-faced Heron			1		1			26			1	1				
Ardeidae	*Ardea pacifica*	White-necked Heron		1	1						1	1						
Artamidae	*Cracticus nigrogularis*	Australian Magpie	h	A	h		h					h			h	h	h	h
Artamidae	*Cracticus torquatus*	Grey Butcherbird	h	1	h		h	1		h		h	h		h			
Artamidae	*Cracticus nigrogularis*	Pied Butcherbird					h			h			h		h			
Artamidae	*Strepera graculina*	Pied Currawong			h					h								
Artamidae	*Artamus leucorhynchus*	White-breasted Woodswallow	B	4	2			1			A	A	A					
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	+							h	A	h	h		h			A
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike													h			
Campephagidae	*Coracina tenuirostre*	Cicadabird			h										h			
Charadriidae	*Vanellus miles*	Masked Lapwing		h	h	2				2				h			h	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola	+	h						h	h	h	h	h				h
Coraciidae	*Eurystomus orientalis*	Dollarbird			h													
Corvidae	*Corvus coronoides*	Australian Raven	+	h		h	h	h		h		A	h	h	h			
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	h														A	
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			h	h								h				
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo									16+			h				
Cuculidae	*Fudynamys orientalis*	Eastern Koel	h														h	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	+			h					h	h						
Cuculidae	*Centropus phasianinus*	Pheasant Coucal	+											h				
Cuculidae	*Chalcites lucidus*	Shining Bronze-Cuckoo	h														A	
Estrildidae	*Neochmia temporalis*	Red-browed Finch						A										
Ingestidae	*Psaltoda stevensi*	Eastern Whistler			h		h			h						h		
Hirundinidae	*Hirundo neoxena*	Welcome Swallow		1	A					2		B	B	B				A
Hirundinidae	*Petrochelidon ariel*	Fairy Martin												A				
Hirundinidae	*Tachybaptus novaehollandiae*	Australasian Grebe	h		3							h	h					
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	h			h												
Gruidae	*Grus rubicunda*	Brolga																
Gruidae	*Tribonyx ventralis*	Black-tailed Native-hen																
Gruidae	*Porphyrio porphyrio*	Purple Swamphen																
Gruidae	*Gallinula tenebrosa*	Dusky Moorhen																
Gruidae	*Fulica atra*	Eurasian Coot																
Gruidae	*Porzana fluminea*	Australian Crake																
Gruidae	*Porzana pusilla*	Baillon's Crake																
Gruidae	*Gallinula ventralis*	Black-tailed Native-hen																
Gruidae	*Porphyrio porphyrio*	Purple Swamphen																
Gruidae	*Gallinula tenebrosa*	Dusky Moorhen																
Gruidae	*Fulica atra*	Eurasian Coot																
Gruidae	*Porzana fluminea*	Australian Crake																
Gruidae	*Porzana pusilla*	Baillon's Crake																

Table 5 cont: Bird species recorded from the South Swamp by ecobiological during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

			Spring 2008				Autumn 2009				Spring 2009				Autumn 2010			
Family	Scientific Name	Common Name	Da - 1	Du - 1	Da - 2	Du - 2	Da - 1	Du - 1	Da - 2	Du - 2	Du - 1	Da - 1	Du - 2	Da - 2	Du - 1	Da - 1	Du - 2	Da - 2
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin										h	h	h				
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant											1fo					
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	1		1								1					
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe										2			1			
Psittacidae	*Platycercus eximius*	Eastern Rosella	h	1	2		2	h		2	A		A	h	h	h	h	h
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet					h								h			
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen		2	11		3	4	1	5			1	3	2	2	9	
Rallidae	*Fulica atra*	Eurasian Coot													3	2	4	
Rallidae	*Porphyrio porphyrio*	Purple Swamphen	4	3	1	1	5	3	3	4	4	2	3	5	4	1	4	1
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail			h		h	h		h	h			h	h			
Rhipiduridae	*Rhipidura leucophrys*	Willie Wagtail	h	1	h	h	h	h	h	3	A	A	h	h	h	h	h	h
Threskiornithidae	*Platalea regia*	Royal Spoonbill											1					
		No. of Species	29	23	33	12	18	17	7	22	25	24	27	26	22	12	15	15

The list follows the taxonomy of Christidis & Boles (2008). h = heard only.
Where numbers were counted, these are shown. In other cases the estimate of abundance is represented by the following approximations:
A=1-5 birds present; B=6-20 birds present; C=21-50 birds present; D=51-100 birds present; E=more than 100 birds present.

Table 6: Roosting bird count results from the Main Swamp during Spring 2008 and Autumn 2009 compared with Spring 2009 and Autumn 2010.

Family	Scientific Name	Common Name	15/10/08 - 7.15pm	5/3/09 - 7.40pm	18/11/09 - 7.50pm	23/3/10 - 7.20pm
Ardeidae	*Ardea ibis*	Cattle Egret	57	170	67	-
Ardeidae	*Ardea pacifica*	White-necked Heron	1	-	-	-
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant	17	10	5	-
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant			8	3
Threskiornithidae	*Threskiornis moluccus*	Australian White Ibis	9	50	37	44
Threskiornithidae	*Threskiornis spinicollis*	Straw-necked Ibis	125	40	8	3
		No. of individuals	209	270	125	50

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survey & assessment

Appendix 3: Hunter Bird Observers Club bird survey data for 2009

2009 SPECIES LIST FOR PAMBALONG NATURE RESERVE.

This list of the species found in the Pambalong Nature Reserve as requested by you in your communication dated 3/10/2010, is compiled using observations made by Hunter Bird Observers Club members on field outings and surveys of the specified area. The species listed are those that have been positively identified as using the area on the occasions shown. It should be noted that the absence of any species should not be considered to imply that such species does not occur, only that it was not found present on these specific occasions.

The list follows the Taxonomy of Christidis & Boles, [2008].

Where symbols are used these represent the fact that only occurrence of the species was recorded at the time. Where numbers were counted, these are shown. In other cases the estimate of abundance is represented by the following approximations:- A=1-5 birds present; B=6-20 birds present; C=21-50 birds present; D=51-100 birds present; E=more than 100 birds present.

Breeding: **fy** = fledged young; **cf** = birds seen carrying food; **ffy** = birds seen feeding fledged young; **n** = nest;.

PAMBALONG NATURE RESERVE.

I.D.#	Species	Scientific Name	7.7.09	13/12/09
203	Black Swan	*Cygnus atratus*	C [8 nests]	3
212	Australasian Shoveler	*Anas rhynchotis*	2	
211	Grey Teal	*Anas gracilis*	A	50
210	Chestnut Teal	*Anas castanea*	C	
208	Pacific Black Duck	*Anas superciliosa*	B	30
215	Hardhead	*Aythya australis*	2	
061	Australasian Grebe	*Tachybaptus novaehollandiae*	2	
989	Spotted Dove	*Streptopelia chinensis*		2
043	Crested Pigeon	*Ocyphaps lophotes*		4
100	Little Pied Cormorant	*Microcarbo melanoleucos*		30
106	Australian Pelican	*Pelecanus conspicillatus*		1
189	White-necked Heron	*Ardea pacifica*		1
187	Eastern Great Egret	*Ardea modesta*	1	B
186	Intermediate Egret	*Ardea intermedia*		2
977	Cattle Egret	*Ardea ibis*		B
188	White-faced Heron	*Egretta novaeholiandiae*	1	6
185	Little Egret	*Egretta garzetta*		1
192	Nankeen Night Heron	*Nycticorax caledonicus*		1
179	Australian White Ibis	*Threskiornis molucca*	A	35
180	Straw-necked Ibis	*Threskiornis spinicollis*	2	
181	Royal Spoonbill	*Platalea regia*	1	
226	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1	
228	Whistling Kite	*Haliastur sphenurus*	2	1
221	Brown Goshawk	*Accipiter fasciatus*		1
220	Grey Goshawk	*Accipiter novaehollandiae*	1	
219	Swamp Harrier	*Circus approximans*	1	3
235	Australian Hobby	*Falco longipennis*	1	1
058	Purple Swamphen	*Porphyrio porphyrio*	C	B ffy
056	Dusky Moorhen	*Gallinula tenebrosa*	B	B
059	Eurasian Coot	*Fulica atra*	A	Heard
133	Masked Lapwing	*Vanellus miles*	A	2
168	Latham's Snipe	*Gallinago hardwickii*		18
271	Little Corella	*Cacatua sanguinea*		10+

PAMBALONG NATURE RESERVE.

269	Sulphur-crested Cockatoo	*Cacatua galerita*			A
281	Australian King-Parrot	*Alisterus scapularis*			2
288	Eastern Rosella	*Platycercus eximius*		A	20
349	Pheasant Coucal	*Centropus phasianinus*			1
348	Channel-billed Cuckoo	*Scythrops novaehollandiae*			2
337	Pallid Cuckoo	*Cacomantis pallidus*			1
338	Fan-tailed Cuckoo	*Cacomantis flabelliformis*			1
339	Brush Cuckoo	*Cacomantis variolosus*			1
319	Azure Kingfisher	*Ceyx azurius*			4
322	Laughing Kookaburra	*Dacelo novaeguineae*		2	A
326	Sacred Kingfisher	*Todiramphus sanctus*			4
318	Dollarbird	*Eurystomus orientalis*			2
679	Satin Bowerbird	*Ptilonorhy chus violaceus*			1
529	Superb Fairy-wren	*Malurus cyaneus*		B	B
536	Variegated Fairy-wren	*Malurus lamberti*		Heard	
453	White-throated Gerygone	*Gerygone olbogularis*			Heard
471	Yellow Thornbill	*Acanthizo nana*		B	B
565	Spotted Pardalote	*Pardalotus puctatus*			Heard
591	Eastern Spinebill	*Acanthorhynchus tenuirostris*		1	1
605	Lewin's Honeyeater	*Meliphaga lewinii*		3	Heard
614	Yellow-faced Honeyeater	*Lichenostomus chrysops*			B
633	Bell Miner	*Manorina melanophorys*			Heard
634	Noisy Miner	*Manorina melanocephala*		A	
645	Noisy Friarbird	*Philemon corniculatus*			20+
421	Eastern Whipbird	*Psophodes olivaceus*		Heard	
424	Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			3
398	Golden Whistler	*Pachycephala pectoralis*		Heard	
401	Rufous Whistler	*Pachycephala rufiventris*			A
432	Australasian Figbird	*Sphecotheres vieilloti*		Heard	
671	Olive-backed Oriole	*Oriolus sagittatus*			1
543	White-breasted Woodswallow	*Artamus leucorhynchus*			4
702	Grey Butcherbird	*Cracticus torquatus*		1	
700	Pied Butcherbird	*Cracticus nigrogularis*		1	
705	Australian Magpie	*Cracticus tibicen*			A

PAMBALONG NATURE RESERVE.

361	Grey Fantail	*Rhipidura albiscapa*	A	2
364	Willie Wagtail	*Rhipidura leucophrys*	A	B
930	Australian Raven	*Corvus coronoides*		1
415	Magpie-lark	*Grallina cyanoleuca*	A	2
525	Golden-headed Cisticola	*Cisticola exilis*	1	4
524	Australian Reed-Warbler	*Acrocephalus australis*	1	6
523	Tawny Grassbird	*Megalurus timoriensis*		2
522	Little Grassbird	*Megalurus gramineus*		1
574	Silvereye	*Zosterops lateralis*		B
357	Welcome Swallow	*Hirundo neoxena*	A	C
360	Fairy Martin	*Petrochelidon ariel*		2
359	Tree Martin	*Petrochelidon nigricans*		30+
999	Common Starling	*Sturnus vulgaris*		2
998	Common Myna	*Sturnus tristis*		2
564	Mistletoebird	*Dicaeum hirundinaceum*		4+
662	Red-browed Finch	*Neochmea temporalis*	C	B

Appendix 4 - Water body photographs

Plate 1: Slitched photograph of South Swamp taken in November 2009.

Plate 2: Slitched photograph of South Swamp taken in March 2010.

Plate 3: Stitched photograph of Main Swamp taken in November 2009.

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Plate 4: Stitched photograph of Main Swamp taken in March 2010.

Plate 5: Stitched photograph of North Swamp taken in November 2009.

Plate 6: Photograph of North Swamp taken in March 2010.

Appendix 5: Contributions and qualifications of ecobiological staff

Name	Qualification	Title	Contribution
Kristy Peters	B. ParkMgt. (Hons)	Ecologist (Ornithologist)	Bird surveys, fauna report writing, Anabat analysis review
Dan Pedersen	B. Sc.	Ecologist (Botanist)	Flora survey and ID, vegetation mapping, flora report writing
Adam Blundell	B. Env Sc. (Hons)	Senior Environmental Scientist	Fauna hair identification, trap layout and checks, nocturnal fieldwork, internal report review
David Paull	B. Sc. (Masters)	Senior Ecologist (Herpetologist)	Amphibian survey, Anabat analysis
Luke Foster	B. Env Sc. (Masters candidate)	Ecologist	Trap layout and checks, nocturnal fieldwork
Dianna Brettschneider	B. App Sc.	GIS Manager	Preparation of map layouts for report

Appendix 6: Licensing matters relating to the survey

ecobiological employees involved in the current study are licensed or approved under the *National Parks and Wildlife Act* 1974 (License Number: S12398, Expiry: 30 November 2010) and the *Animal Research Act* 1985 to harm/trap/release protected native fauna and to pick for identification purposes native flora and to undertake fauna surveys.

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