THE SUNBIRD

Journal of the
QUEENSLAND ORNITHOLOGICAL SOCIETY
Birds Queensland

Volume 42 Number 1 June 2012

SUNBIRD 42(1) JUNE 2012

CONTENTS

THE SUNBIRD

Editor
F. Dane Panetta
Biosecurity Queensland
Department of Agriculture, Fisheries and Forestry

Assistant Editor
Denise Elias
School of English, Media Studies and Art History
University of Queensland

Editorial Board

Richard Noske
Environmental Futures School, Griffith University

David Milton
CSIRO Division of Marine and Atmospheric Research

David Rounsevell (Past Editor)
Office for Research, Griffith University

The Sunbird is published by the Queensland Ornithological Society Incorporated (Birds Queensland). It is available online via the Informit e-Library (www.informit.com.au), RMIT Publishing (www.rmitpublishing.com.au), by agreement with Birds Queensland (full content provider).

The aims of Birds Queensland are to promote awareness and appreciation, as well as conservation and scientific study of birds, with particular emphasis on the birds of Queensland. The society holds a general meeting and several field excursions each month. All members receive a monthly newsletter and a copy of *The Sunbird*. For enquiries, including membership, *Sunbird* subscription rates or individual *Sunbird* copies, please visit **www.birdsqueensland.org.au** or write to:

The Secretary
PO Box 3784
South Brisbane BC Qld 4101

Front cover : A pair of Rufous Owls. Photograph by J. Matsui.

ISSN 1037-258X

© Queensland Ornithological Society Inc.

The Sunbird (2012) 42(1): 1-10

RUFOUS OWL (*NINOX RUFA*) DIET AND BREEDING IN AN URBAN FOREST REMNANT IN NORTH-EASTERN QUEENSLAND

WILLIAM GOULDING & BRIAN VENABLES

ABSTRACT

Information on the diet of the Rufous Owl (*Ninox rufa*) was gathered from the regurgitated pellets and prey remains from a pair that used the habitat surrounding Centenary Lakes, Cairns, north-east Queensland. Mammals comprised the largest portion of the diet during the 2010 breeding period, but passerine birds were also a major food source. Some new prey items are identified and the regular use of invertebrate prey, such as beetles, is further confirmed. Historical prey items recorded at the site and in adjoining suburbia are also mentioned. The results support the view that the diet of this species is likely determined by diverse foraging behaviours and differences in prey availability across the species' range.

INTRODUCTION

The Rufous Owl (*Ninox rufa*) has a disjunct tropical distribution that extends from New Guinea, through the Aru Islands and across northern Australia down to the central east coast of Queensland (Mason and Schodde 1980). Divergence has resulted in three subspecies being recognised within Australia (Mason and Schodde 1980), with the east coast subspecies *N. rufa queenslandica* using lowland habitat, such as rainforest and sclerophyll woodlands, up to highland forests ≥1200 m asl (Kanowski 1998, Higgins 1999). This occurrence within the more densely human-populated coastal strip has resulted in some unusual records from urban-influenced environments, such as riverside suburbs (Boyd 2009) and the Queen's Gardens in Townsville City (Wieneke 1995), as well as well-vegetated suburbs and areas of Cairns City, e.g. Centenary Lakes (this study). Despite this distribution, published information on the species is scarce, with aspects such as foraging behaviour still not well known (see Higgins 1999). Much of the published information on diet is from various locations through incidental or nesting observations (e.g. Winter 1993, Nielsen 1995, van Gessel 1999, Legge *et al.* 2003, Hollands 2008). Notable information has come from a study of regurgitated pellets of *N. rufa rufa* in the Northern

Territory (Estbergs and Braithwaite 1984) and J. Young's personal communications of observations in north Queensland (Schodde and Mason 1980, Wood 1988, Shaw 1996, Hollands 2008).

Not surprisingly, the range of habitats utilised across this species' entire tropical distribution has been reflected in prey variation and dietary flexibility. Prey has included large invertebrates, small to relatively large birds (e.g. Australian Brush-turkeys) and mammals up to Brushtail Possum size (reviews in Higgins 1999, Harrington and Debus 2000, Hollands 2008, Boyd 2009). Birds represented the most common prey remains found in a nest monitored in Iron Range National Park (Legge *et al.* 2003), and up to 90% of the diet in Ingham is thought to be waterbirds (Schodde and Mason 1980). Yet, possums are commonly-seen clutched prey of Rufous Owls in a riverside suburb of nearby Townsville (Boyd 2009), and elsewhere mammals are suggested to make up a greater proportion of the diet than birds (Schodde and Mason 1980). In support of this interpretation, the aforementioned pellet study in the Northern Territory (Estbergs and Braithwaite 1984) documented mostly mammalian prey, and the presence of Rufous Owls in the territory has also been associated with flying-fox abundance (van Gessel 1999). In the highland forests of north Queensland, it is thought Rufous Owls not only prey heavily on arboreal mammals but may have a distribution associated with Brushtail Possum abundance (Kanowski 1998, Harrington and Debus 2000).

Pellet analyses and prey remains offer a useful insight into the unseen feeding ecology and the dietary composition of nocturnal avian predators (Hollands 2008). In several cases this approach has highlighted prey species not known to exist in an area, historical distributions of prey, and owl foraging behaviour (e.g. Smith 1977, Estbergs and Braithwaite 1984, Hollands 2008). Rufous Owl foraging behaviour in the Northern Territory, as revealed from examination of pellets, centres upon the open woodlands that surround the more dense forests in which they often roost (Estbergs and Braithwaite 1984).

Here we report on pellet contents and prey remains from a pair of breeding Rufous Owls using north-east Queensland (NEQ) habitat relatively enclosed by suburbia and containing waterbirds. The objective is to add to the dietary information on this eastern subspecies from a different location and in a potentially more urban-influenced context. Historical observations of Rufous Owls using the Centenary Lakes area and surrounding suburban habitat are also presented.

METHODS

In August 2010 a pair of Rufous Owls was located at a nesting hollow in a weeping tea-tree (*Melaleuca leucadendron*). This (presumed) same pair had an unsuccessful nesting attempt nearby in 2009. The nesting tree was located in Centenary Lakes, adjoining the Flecker Botanical Gardens, Cairns (16°54'S, 145°45'E). This area covers approximately 38 ha and is contiguous with the lower slopes of Mt Whitfield Conservation Park (>300 ha). Habitat comprises lowland melaleuca swamp and rainforest remnants dissected by a mangrove community associated with Saltwater Creek. Other habitat types include open grassy areas and a small freshwater lake and saline lagoon that attract waterbirds.

The first suspected Rufous Owl pellets and prey remains found underneath the tree were subsequently confirmed through sighting the owl pair during the evening at the nesting tree. Pellets and prey remains were then sought beneath the tree, and nearby, on a daily basis during August–September 2010, with those found nearby assumed to be from this pair.

Pellets were teased apart dry and components split into fur/feathers, bones, invertebrates and other material (seeds, small stones). The total dry weight of pellets and their components were measured using a AND *EK–30000i* digital scale (precision 0.1 g). Bone and fur/feather fragments from each pellet were then compared with Queensland Museum skeletal material and study skins to search for matches. Potential matches were selected from a comprehensive species list compiled for the area (BV) and known distributions from the literature. Only confident identifications from remains are cited in this text.

RESULTS

Pre-2010 unpublished observations (BV) of the prey remains and the clutched prey of roosting Rufous Owls at this site and from surrounding nearby suburbia have included a Topknot Pigeon (*Lopholaimus antarcticus*), Pied Imperial-Pigeon (*Ducula bicolor*), Laughing Kookaburras (*Dacelo novaeguineae*) and friarbird (*Philemon* sp.). Mammals have included a White-tailed Rat (*Uromys caudimaculatus*), Striped Possum (*Dactilopsila trivirgata*) and Spectacled Flying-fox (*Pteropus conspicillatus*).

A pair of owls, presumably the same pair for which diet is reported on here, was observed nesting in a melaleuca hollow in Centenary Lakes in 2009 (Figure 1), but this breeding attempt failed on the night of 17 November 2009, with a fully-developed embryo still within the eggshell discovered beneath the tree the following morning (nest height = ~11 m). The cause of

Fig. 1. The Rufous Owl pair in 2009. The brood patch is discernable on the female on the right. Photo: J. Matsui.

failure was unknown, but the eggshell seemed thin and flexible (BV pers. obs.; Figure 2).

The 2010 breeding attempt was in another melaleuca within 100 m of the 2009 attempt (nest height = ~13 m). The first pellet was collected on 18

Fig. 2. The Rufous Owl embryo and egg found beneath the nesting tree in 2009. Photo: J. Matsui.

August 2010. Regurgitated pellets from this site had a mean weight of 3.2 ± 0.7 g (SE) and a conservative count of 2.0 ± 0.2 (SE) prey items per pellet ($n = 6$, Table 1). Prey remains present in the pellets were crushed and composed of fragmented skeletal material, exoskeleton fragments, fur and feathers. Mammalian remains were found in all six pellets and both avian and beetle remains in five of the six. The prey remains found in the field and the comparison of pellet fragments with museum specimens are shown in Table 2. Remains consisted of portions of the digestive tracts of small mammals and the heads, gizzards and hindquarters of avian prey. No waterbird species were recorded as prey. Eggshells (again thin and flexible) fitting those described for the species were found beneath the nesting tree (9 September 2010) before a decline in Rufous Owl activity.

DISCUSSION

The diet recorded for the Rufous Owls of Centenary Lakes during this short temporal window is further evidence of their versatility in prey use and supports the view that birds form an important part of their diet in NEQ.

Mammals still appear to comprise the bulk of the diet but, unlike observations from the highland forests of the nearby Atherton Tablelands, NEQ (Harrington and Debus 2000) and the findings from the Northern Territory (Estbergs and Braithwaite 1984), avian remains were a prominent part of the diet as well (*cf.* 3% of estimated live biomass in the Northern Territory). This significant use of avian prey was also observed for *N. rufa meesi* further north in Iron Range National Park (Legge *et al.* 2003). The high proportion of bird material in pellets and prey remains (Legge *et al.* 2003; this study) make it unlikely that a predominance of avian prey reported in NEQ resulted from any suspected observational bias of clutched prey toward birds (see Higgins 1999). As expected, the range of avian prey is broad and differs between locations, e.g. Iron Range (Legge *et al.* 2003), Ingham (Schodde and Mason 1980, Hollands 2008) and this study.

Table 1. The weights and contents of regurgitated Rufous Owl pellets, 2010.

Date	Weight (g)	Contents (g)	No. prey items
18/8/2010	5.1	Fur/feather (2.3), bone (2.5), invertebrate (0.3), other (<0.1)	2
24/8/2010*a*	5.6	Fur/feather (2.8), bone (2.5), invertebrate (0.2)	3–4
24/8/2010*b*	2.1	Fur/feather (1.3), bone (0.6), invertebrate (0.2)	3–4
30/8/2010	2.3	Fur/feather (1.4), bone (0.8), invertebrate (< 0.1), other (0.1)	2
3/9/2010*a*	2.2	Fur/feather (1.3), bone (0.9)	3
3/9/2010*b*	1.8	Fur/feather (0.9), bone (0.7), invertebrate (0.1), other (0.1)	2

Table 2. Rufous Owl prey items from pellet remains (P) and prey remains (PR), 2010.

Date	Sign	Mammalian	Avian	Invertebrate
18/8/2010	P	*Water Rat* (*Hydromys chrysogaster*)	-	-
		-	-	Beetle (F. Scarabaeidae)
20/8/2010	PR	Small unidentified mammal heart and intestines	-	-
24/8/2010	P*a*	*Rattus sordidus* or *R. fuscipes*	-	-
		-	-	Beetle (F. Scarabaeidae)
		-	1–2 passerine prey – Australasian Figbird (*Sphecotheres vieilloti*) and possibly Yellow Honeyeater (*Lichenostomus flavus*) feathers	-
″	P*b*	*Rattus sordidus* or *R. fuscipes* complementing parts from Pellet *a*	-	-
		-	-	Beetle (F. Scarabaeidae)
		-	Remainder of 1–2 passerine prey – Australasian Figbird and possibly Yellow Honeyeater from Pellet *a*	-
26/8/2010	PR	-	Yellow Honeyeater	-
29/8/2010	PR	Small carnivorous mammal stomach and intestines	-	-
30/8/2010	P	*Rattus* species similar to *R.. sordidus* or *R. fuscipes*	-	-
		-	Avian species similar in size to Pellet *a* remains	-
3/9/2010	P*a*	*Rattus* species similar to *R. sordidus* or *R. fuscipes*	-	-
		-	Unknown avian prey, solely some poor feather fragments	-
		-	-	Beetle (F. Scarabaeidae)
″	P*b*	*Rattus* species similar to *R. sordidus* or *R. fuscipes*	-	-
		-	Avian species – suspect F. Oriolidae or possibly larger member of F. Meliphagidae (did not match other families)	-
5/9/2010	PR	-	Rock Pigeon (*Columba livia*)	-
20/9/2010	PR	Spectacled Flying-fox (*Pteropus conspicillatus*)	-	-

Beetles have been reported as important nestling food for owls (Schodde and Mason 1980) and such large invertebrates are well-known Rufous Owl prey (White 1917, Schodde and Mason 1980, Hollands 2008). Their frequency in the pellets from this study indicates their dietary importance, and the regularity with which they are taken when available at this site (*cf.* 3/106 pellets containing insects in the Northern Territory; Estbergs and Braithwaite 1984). The pellet remains were thought to be from the Rhinoceros Beetle (*Xylotrupes* sp.), which in the area can range from scarce at certain times of the year to very common on exotic poinciana trees *Delonix regia*.

The mammalian remains offer the first records of a Water Rat (*Hydromys chrysogaster*) as prey and highlight the importance of other rodents, likely *Rattus sordidus* or *R. fuscipes*, as prey at this site. These rodent records indicate some prey taken from the ground. Interestingly, many other potential and known mammalian prey species were regularly observed in 2010 at this site (BV pers. obs.), but there is no evidence of their being preyed upon in that year, e.g. Striped Possums (*Dactilopsila trivirgata*) (see Harrington and Debus 2000) and Northern Brown Bandicoots (*Isoodon macrourus*). The results do not indicate an association with flying-foxes or possums, which are thought to influence Rufous Owl distribution in other habitats (Kanowski 1998, van Gessel 1999, Harrington and Debus 2000). It must be kept in mind, however, that the short breeding period over which these results were collected may not be representative for this site at other times of the year. A switching in the frequency of different prey taken occurred with changes in prey availability for the Rufous Owl in the Northern Territory (Estbergs and Braithwaite 1984), so it would be expected to occur also at this site in NEQ. It is noteworthy that in Iron Range National Park, the remains of prey from a nest indicated a switch from invertebrates and birds to mammals as the nestling period progressed (Legge *et al.* 2003).

The prey identified from this study do not offer a conclusive insight into the specific foraging areas used. However, the Water Rat undoubtedly would have been captured near the nesting site amongst the wetland network, and most likely while foraging on a bank. The other items also seem to be from species more likely taken in the more open areas at the site or possibly in adjoining suburbia, rather than the well-vegetated rainforest areas that are known (BV) to harbour more forest-specific species such as the Prehensile-tailed Rat (*Pogonomys mollipilosus*), Noisy Pitta (*Pitta versicolor*) and Spotted Catbird (*Ailuroedus melanotis*). In the only other example from an urbanised context, a riverside suburb in Townsville (Boyd 2009), foraging areas used were mostly inconclusive. In this location, waterbird prey such as Comb-crested Jacanas (*Irediparra gallinacea*) provided interesting evidence of hunting very close to the water and the riparian zone but the commonly-seen clutched possums, other bird species and flying-foxes could also have been caught out in the well-vegetated suburbs.

The pellet weights and number of prey items per pellet are comparable to those found in the Northern Territory. Some of the species in the prey remains did not show up in the pellet remains, but analysis solely of pellet remains can misrepresent the proportions of some prey, due to differences in digestibility, plus prey-size and other factors that affect the handling or consumption of prey (Sharp *et al.* 2002). However, the observations of prey remains in this study do support the proportion of dietary taxa suspected from the pellets, i.e. mostly mammals (rodents) but with a considerable avian component.

These dietary observations, although few, offer further examples of the flexibility of the Rufous Owl in capturing and utilising diverse prey. It is assumed that this would allow the owls to take advantage of changes in prey abundance, which must be advantageous when maintaining territory. This capacity to adjust to prey variability might be of greater importance when at least two individuals (pair + fledgling/s for some period) might be using the same home range, given that pair bonds have been reported as being maintained throughout the year (Hollands 2008).

The eggshell record extends the known breeding period of this species in Queensland, appearing later in the year than previous records supporting a late June-July laying period (see Nielsen 1995, Higgins 1999). The 2009 failed nesting attempt would indicate laying occurred around 11 October of that year (incubation 37 days; Hollands 2008). This could have been a replacement clutch after a failed earlier attempt. However, observations also indicated a later start to breeding activity in 2010 (August). The apparent flimsiness of the eggshells may indicate an ongoing problem relating to exposure to chemicals, but this cannot be proven and requires further investigation.

ACKNOWLEDGMENTS

Thanks to Ota Yu and Jun Matsui (photographs) for contribution to the investigation, as well as Kieren Aland and Heather Janetzki of the Queensland Museum for information and access to the collection material.

REFERENCES

BOYD, I. 2009. A special area in Townsville. *Bird Observer* 862: 17.

ESTBERGS, J.A. & BRAITHWAITE, R.W. 1985. The diet of the Rufous Owl *Ninox rufa* near Cooinda in the Northern Territory. *Emu* 85: 202-205.

HARRINGTON, G.N. & DEBUS, S.J.S. 2000. Dietary items of the Rufous Owl *Ninox rufa* on the Atherton Tableland, north Queensland. *Australian Bird Watcher* 18: 251-252.

HIGGINS, P.J. (Ed.) 1999. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4. Parrots to Dollarbird.* Oxford University Press, Melbourne.

HOLLANDS, D. 2008. *Owls: Frogmouths and Nightjars of Australia.* Bloomings Books, Melbourne.

LEGGE, S., HEINSOHN, R., BLACKMAN, C. & MURPHY, S. 2003. Predation by Rufous Owls on Eclectus Parrots and other animals at Iron Range National Park, Cape York. *Corella* 27: 45-46.

MASON, I.J. & SCHODDE, R. 1980. Subspeciation in the Rufous Owl *Ninox rufa* (Gould). *Emu* 80: 141-144.

NIELSEN, L. 1995. Notes on the Rufous Owl in north Queensland. *Sunbird* 25: 71-72.

SCHODDE, R. & MASON, I.J. 1980. *Nocturnal Birds of Australia.* Lansdowne, Melbourne.

SHARP, A., GIBSON, L., NORTON, M., MARKS, A., RYAN, B. & SEMERARO, L. 2002. An evaluation of the use of regurgitated pellets and skeletal material to quantify the diet of Wedge-tailed Eagles, *Aquila audax*. *Emu* 102: 181-185.

SHAW, M. 1996. Some mammal observations from the McIlwraith Range including a new roost record for the Dusky Leafnosed Bat, *Hipposideros ater*. *Queensland Naturalist* 34: 35--40.

SMITH, M.J. 1977. Remains of mammals, including *Notomys longicaudatus* (Gould) (Rodentia : Muridae), in owl pellets from the Flinders Ranges, S. A. *Australian Wildlife Research* 4: 159-170.

van GESSEL, F.W.C. 1999. Noisy flight and other observations of the Rufous Owl *Ninox rufa* in the Northern Territory. *Australian Bird Watcher* 18: 121-123.

WHITE, H.L. 1917. North Australian birds. *Emu* 16: 205–231.

WIENEKE, J. 1995. *Where to Find Birds in North East Queensland*. Revised Edition, Townsville.

WINTER, J. 1993. Rufous Owl predation on a Herbert River Ringtail Possum. *North Queensland Naturalist* 195: 22-23.

WOOD, G.A. 1988. Further field observations of the Palm Cockatoo *Probosciger aterrimus* in the Cape York Peninsula, Queensland. *Corella* 12: 48-52.

WILLIAM GOULDING, 19 Victoria Street, Indooroopilly, Qld 4068*
BRIAN VENABLES, 527 McCormack Street, Cairns, Qld 4870
**Corresponding author: willgoulding@yahoo.com.au*

The Sunbird (2012) 42(1): 11-23

LONGEVITY AND MOVEMENTS IN THE WHITE-FACED ROBIN (*TREGELLESIA LEUCOPS ALBIGULARIS*) IN IRON RANGE NATIONAL PARK, CAPE YORK

J.T. COLEMAN, F.W. VAN GESSEL, & M. CLAYTON

ABSTRACT

The White-faced Robin (*Tregellesia leucops albigularis*) has been studied in Iron Range National Park since 1990, with regular visits to conduct banding studies in the area. This has provided an opportunity to provide data on survival and movements of this poorly studied species. Recaptures showed the species to be highly sedentary; almost all recaptures were either at the banding location or within 1 km of banding. Recaptures also suggested high longevity in the species, with birds recaptured up to 18 years after their initial banding date. Calculated survival for birds caught and banded in 1990 indicated a constant survival rate of 75.3% for these birds throughout the 18 -year study. The analysis also suggested that birds could potentially live beyond 18 years. Survival rates between visits were variable but did not differ significantly over the duration of the study. However, cohort survival rate and annual rainfall in the year of banding were correlated.

INTRODUCTION

The White-faced Robin (*Tregellesia leucops albigularis*) is a resident species ranging through New Guinea (Diamond 1985) and northern Australia, where it is restricted to the rainforests of northern Cape York (Beruldsen 1990). In Cape York, the species is confined to tropical rainforest with a thick understorey (Hardy and van Gessel 1992), but is commonly found in *Quercus* spp. and *Nothofagus* spp. forests in New Guinea (Bell 1971).

The species is considered common in suitable habitat in Iron Range National Park (Forshaw and Muller 1978) and is widespread in New Guinea (Diamond 1985). No population estimates have been attempted, but the species is believed to be stable and has an IUCN listing of 'Least Concern' (Birdlife International 2010).

Little is known of the White-faced Robin's breeding habits, but breeding is believed to occur between October and January (Beruldsen

2003). It moults during the same period, with records of birds in active moult recorded in November in Iron Range National Park (Higgins and Peter 2002). Examination of skins indicates that there is a partial post-juvenile moult and adults undergo a complete moult each year (Higgins and Peter 2002).

Males and females of the species are indistinguishable on plumage characteristics but are sexually dimorphic, with males being larger than females (Hardy and van Gessel 1992). Birds with wing lengths of 73 mm or less are female; those with wing lengths of greater than 76 mm are male (Higgins and Peter 2002).

Movements of the White-faced Robin are poorly understood, but in Australia it has been described as sedentary (Chisholm 1960). This is supported by recovery data from the Australian Bird and Bat Banding Scheme, with 93 recoveries of birds banded in Australia and Papua New Guinea having an average distance of movement of only 3 km (ABBBS 2010). The same source also indicates that the species can be long lived, with one bird banded in Cape York in November 1990 being recaptured at the same site in November 2005, an interval of 15 years and 11 months.

Cape York retains very close similarities to New Guinea, having large areas of tropical lowland (Mackey *et al.* 2001). A number of bird species are found only in New Guinea and Cape York and there is evidence of migratory links between both areas (Griffioen and Clarke 2002). Geographic isolation from the rest of Australia, including the Wet Tropics, has resulted in up to 40% of the passerines in Cape York being either endemic species or subspecies (Schodde and Mason 1999).

This paper presents data from White-faced Robins banded in Iron Range National Park between 1990 and 2008, and provides information on their longevity and movements. Furthermore, recapture data are used to establish survival rates for the species, as well as providing estimates of survival rates over many years for different cohorts within the species. The region is highly seasonal, and the White-faced Robin's breeding season corresponds with a well-demarcated wet season (Higgins and Peter 2002). Survival rates are therefore compared with rainfall totals, given the link between rainfall and breeding in this species. Since the White-faced Robin is considered to be an endemic, insectivorous resident, the data presented in this study can be compared with those collected for other endemic species occurring in other tropical and sub-tropical areas of Australia.

METHODS

Since 1990, visits have been made every two or three years to Iron Range National Park for the purposes of banding rainforest species within the park. Visits have been made mostly in November (Table 1). This is in an attempt to coincide with the arrival of migratory species from New Guinea, while also permitting completion of fieldwork before the wet season starts fully in late November/early December. Some exploratory banding was performed by S.G. Lane in 1988, prior to these regular field visits.

The study site encompasses the area of lowland rainforest existing within the park. Forshaw and Muller (1978) have described the range of vegetation and bird communities found in the region. They described the vegetation as a mixture of lowland tropical rainforest, with mesophyll and notophyll vine forest surrounded by more open woodland communities. This study was restricted to the areas of closed forest found in the park, primarily in the Claudie River flood plain, mainly at sites along the Portland Roads access road (Figure 1).

The study site was divided into 1 km grid squares (Figure 1), each numbered uniquely. As many grid sites as possible were visited, mist nets set and birds caught and banded. Site maps and GPS units were used to ensure the correct squares were being sampled. All birds captured were recorded, along with the grid square of capture. No attempts were made to standardise the number of nets set at each site or the duration of the visit to each square, so the level of effort between each visit could not be directly compared. Mist nets were 12 m or 18 m long and 2.6 m high, with (stretched) mesh sizes varying between 30–38 mm. Banding activities were normally conducted between dawn and midday each day.

Each bird caught was banded with an Australian Bird and Bat Banding Scheme metal band and a series of morphological measures were taken, as

Table 1: Dates and durations of visits to Iron Range National Park for bird banding between 1990 and 2008.

Year	Month	Dates	Duration (days)
1990	November	15–23	9
1994	November	19–24	6
1997	August	16–23	8
1999	November	14–19	6
2002	November	16–24	9
2005	November	19–25	7
2008	November	08–15	8

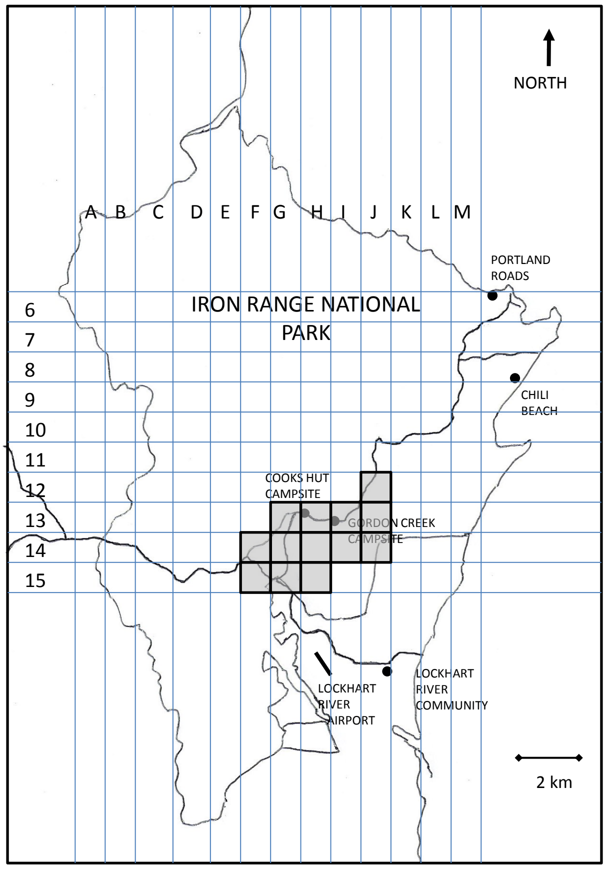


Figure 1. Banding locations used within Iron Range National Park between 1988 and 2008, (grid squares used in this study are shown in grey).

described in Lowe (1989). Measurements routinely recorded were wing and tail (measured to the nearest mm), tarsus and head-bill (to the nearest 0.1 mm) and body mass (to the nearest 0.1 g).

Estimated annual survival rates were calculated using MARK survival estimation software v2.1 (White and Burnham 1999) using the Recaptures Only Model (Seber 1970). The 1990 cohort was used for survival analysis as this represented the longest time span over which survival could be estimated. Four models were tested and the best-fit model selected to show survival rates over time in the population. The models tested were: Model 1 – survival rate time-dependent (St) and recapture probability time-dependent (Pt); Model 2 – survival rate time-dependent (St) and recapture probability constant (P); Model 3 – survival rate constant (S) and recapture probability time-dependent (Pt); and Model 4 – both parameters constant (S P).

The best-fit models were selected initially on the basis of Aikaike's Information Criterion (AIC), where the lowest value, combined with the lowest number of parameters used in the model, usually indicates the model that best represents the observed data.

For all models tested, time intervals were corrected to account for the differing time periods between visits, with gaps of two, three and four years recorded between visits to the site. Once the best-fit model had been identified using the 1990 cohort, this model was then used to estimate survival rates for each subsequent banding cohort, calculating the survival rate of new birds between each banding visit and the next field visit to the site, to establish whether survival rates changed over time. Since it was not possible to age many birds (see below), the data were analysed as a single group for each cohort.

Annual rainfall totals for each survey year were obtained from the Bureau of Meteorology website (www.bom.gov.au) and an ANOVA conducted to establish whether the survival rate for each cohort was linked to rainfall totals in the year of banding.

RESULTS

Between 15 November 1990 and 15 November 2008, a total of 596 White-faced Robins were banded, with 68 recaptures of 52 individuals banded within that period and from an earlier banding visit in 1988, yielding a total of 664 encounters. Table 2 shows the number of birds banded in each visit-year and the number of recaptures of those birds in subsequent visits. The 596 birds caught comprised 53 juveniles and 71 adult birds, with the remaining birds (472) recorded as fully grown, age not determined.

Longevity and survival

Of the 68 recaptured birds, 10 (15.4%) were recaptured at 10 years or older (Table 2). Birds were caught 12 years (n=3), 14 years (n=1) and 15 years after banding (n=1). The oldest bird, with an elapsed time between banding and

Table 2. Numbers of White-faced Robins banded and total number of recaptures in each visit to Iron Range National Park (nine same-year recaptures are not included).

Year of banding	Number banded	1988	1990	1994	1997	1999	2002	2005	2008
1990	186	1							
1994	60	1	3	0					
1997	59	1	7	6	0				
1999	34	0	3	2	1	0			
2002	65	1	3	1	3	5	0		
2005	103	0	1	2	2	5	4	0	
2008	92	0	1	0	1	2	0	12	0

Table 3. Oldest recapture age for White-faced Robins recaptured at Iron Range National Park for males, females and individuals for which the sex was unknown (data from all years combined).

Sex	Years after banding													
	3	4	5	6	7	8	9	10	11	12	13	14	15	18
Male	14	1	2	6	3	1	3	0	3	2	0	1	1	1
Female	6	1	3	0	2	1	0	0	0	0	0	0	0	0
Unknown	1	0	0	1	0	1	0	0	0	0	0	0	0	0

recapture of 18 years, was caught in 2008. Of the eight individuals recaptured at 10 years or more after banding, all were males (Table 3). The oldest females recaptured were seven years (*n*=2) and eight years (*n*=1) after banding. However, this apparent difference in longevity was not statistically significant (X^2=15.9, DF=13, P>0.05).

Our survival analysis using the birds banded in 1990 (the oldest cohort available from this study) further demonstrated the longevity of the species. Results from the four tested models are shown in Table 4. Models 1, 2 and 4 were discounted due to their higher AIC values and variances, indicating that these models had the poorest fit to the field data collected. Model 3 had the lowest AIC and lowest variance, demonstrating it was the best fit model for the data provided. This model (S Pt) suggested that although the probability of recapture varied over the period of the study, the survival rate remained constant, with the model predicting a constant survival rate of 75.3% per annum for the 1990 cohort over the duration of the project.

Of the birds used in the survival analysis for the 1990 cohort, 100 individuals were identified as males, of which 11 (11%) were recaptured in subsequent visits, and 59 were female, of which two (3.4%) were recaptured in subsequent visits. The remaining individuals (*n*=27) could not be allocated to either sex. Using the same survival analysis techniques, the survival rate for males in the 1990 cohort was 77.5% (SE ± 0.04). Insufficient data were available for an accurate calculation of female survival rates.

Table 4. Statistical results for the selected models used to analyse survival rates of White-faced Robins banded in 1990 at Iron Range National Park.

Model no.	Criteria	AIC	Delta AIC	AIC weight	Model likelihood	No. parameters	Deviation
1	St Pt	181.9	9.5	0.01	0.01	11	19.2
2	St P	176.4	4.0	0.1	0.1	7	22.4
3	S Pt	172.4	0.0	0.6	0.1	6	20.7
4	S P	174.2	1.7	0.3	0.2	2	30.8

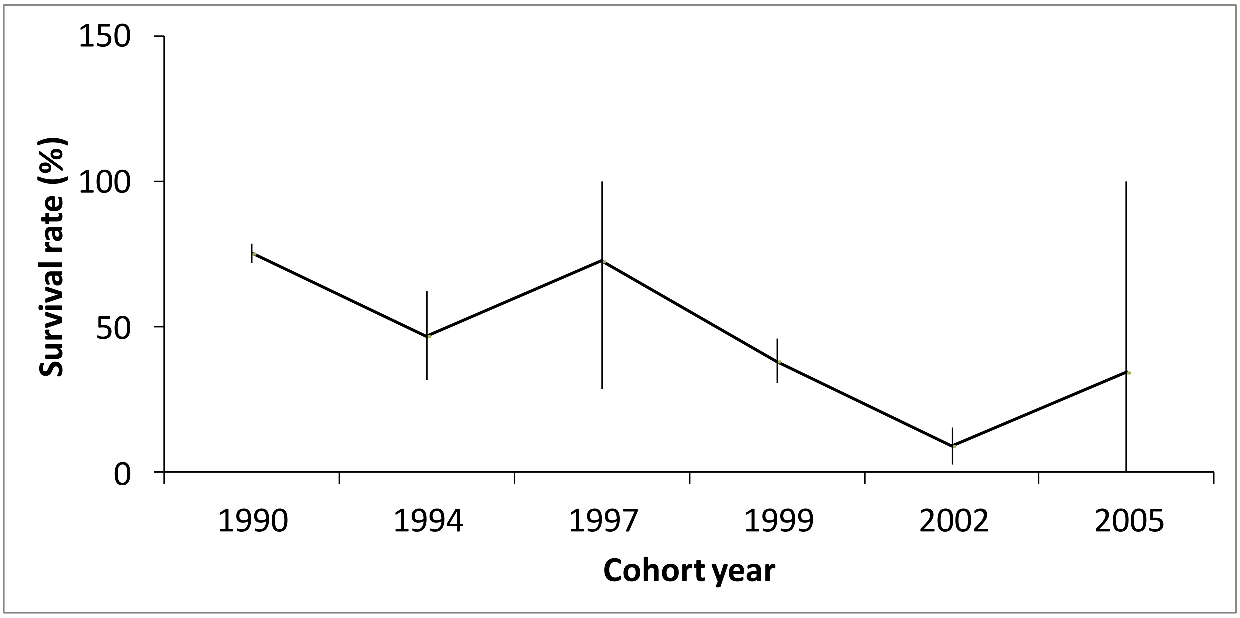


Figure 2. Survival rates of White-faced Robins in Iron Range National Park between visits using a Live Recaptures Only Model in Program MARK. Bars indicate SE values.

Survival rates between visits for each banding cohort were also analysed to see whether survival changed over the period of the study (Figure 2). Survival rate ranged between 75.3% for the 1990 cohort and 9.1% for the 2002 cohort, with rates of 72.6, 46.9, 38.2 and 34.4% for birds banded in 1997, 1994, 1999 and 2005 respectively (Figure 2). Despite this variation between cohorts, the survival rate for cohorts did not show a clear trend over time (R^2= 0.57, DF=5, P=0.08), although the 2002 cohort was notable for its low survival rate.

Rainfall totals for each survey year are shown in Table 5. A significant correlation was detected between annual rainfall and cohort survival (Figure 2), with lower cohort survival rates in years with lower rainfall (ANOVA F=48.0, DF=11, P<0.001).

Table 5. Rainfall totals for Lockhart River monitoring station for the calendar year encompassing each survey at Iron Range National Park.

Year	Annual rainfall (mm)
1990	1534
1994	1590
1997	2099
1999	3161
2002	1284
2005	1979
2008	1442

Movements

The 52 individuals that were banded and recaptured also provided an opportunity to examine movements of this species between the monitored grid squares in the forest. Of the birds recaptured, 36 were male, 13 female and three of indeterminate sex (Table 6). For 10 birds the original-capture grid square was not recorded so these were excluded from the analysis. Of the remaining 42, 9 (21.4%) were recaptured in the same grid square in which they were banded, one after 18 years. This comprised 19.4% of the males in the sample and 7.7% of the females.

Twenty-nine birds (55.8%) were recaptured in a grid square adjacent to where they were banded, comprising 52.7% of the males recaptured and 61.5% of the females. Only four (5.6%) birds moved further than this during the 18 years of the study (Table 6), of which three were males, and one was female, with the longest recorded movement being no more than 4 km from the original banding site.

DISCUSSION

Longevity in tropical passerines is well documented (e.g. Johnston *et al.* 1997; Murray 1985), with the tradeoffs between fecundity and survival cited as the reasons for the differences between tropical and temperate species. Despite recent challenges to this paradigm (Karr *et al.* 1990), continuing studies support this general observation (McGregor *et al.* 2007; Francis *et al.* 1999). The high survival rate and longevity demonstrated in the White-faced Robin is therefore not surprising, but with little published work on the species, is nonetheless important to document.

Table 6. Movements of White-faced Robins between grid squares at Iron Range National Park as a result of recaptures of individuals (figures in brackets are numbers of male, female and unsexed individuals respectively).

Distance moved (km)	Age (yrs)											
	3	4	5	6	7	8	9	11	12	15	18	Total
<1	4 (3,0,1)	1 (0,1,0)	0	1 (1,0,0)	0	0	0	1 (1,0,0)	1 (1,0,0)	0	1 (1,0,0)	**9 (7,1,1)**
<2	15 (10,5,0)	0	3 (1,2,0)	2 (1,0,1)	1 (1,0,0)	3 (1,1,1)	2 (2,0,0)	1 (1,0,0)	1 (1,0,0)	1 (1,0,0)	0	**29 (19,8,2)**
1-3	1 (0,1,0)	0	1 (1,0,0)	1 (1,0,0)	0	0	0	0	0	0	0	**3 (2,1,0)**
2-4	1 (1,0,0)	0	0	0	0	0	0	0	0	0	0	**1 (1,0,0)**
Not known	0	1 (1,0,0)	1 (0,1,0)	1 (1,0,0)	4 (2,2,0)	0	1 (1,0,0)	0	2 (2,0,0)	0	0	**10 (7,3, 0)**

Despite confinement of the White-faced Robin to Cape York, there were similarities with other robin species elsewhere in Australia, with high survival rates of 71% recorded for the Eastern Yellow Robin (*Eopsaltria australis*) in New South Wales (Debus 2006), and 86% (males) and 79% (females) recorded for the White-breasted Robin (*Eopsaltria georgiana*) in south-west Australia (Russell *et al.* 2004). No sex-specific differences in survival were recorded in this study, which differed to the findings of Russell *et al.* (2004).

Estimating survival rates is acknowledged as a vital component in understanding the ecology of bird species (Parker *et al.* 2006) and is becoming increasingly important as a tool to help underpin the rationale behind conservation initiatives (Conway *et al.* 1995). However, some caution is needed, as dispersal patterns in an individual species can cause significant differences between estimated and actual survival rates, with highly sedentary species generally considered to be better species for modelling (Lebreton *et al.* 1992). Movement data from this study suggest that the White -faced Robin is highly sedentary, supporting observations made previously (Chisholm 1960) and making the species a good candidate for survival modelling.

Age is also known to influence survival rates significantly (Ricklefs 2000), with juveniles having lower survival rates than adults; this needs consideration when selecting data sets for analysis. The majority of birds in this study were marked as Age Code One Plus, meaning fully grown, but age not determined. The White-faced Robin breeds from late October onwards (Beruldsen 2003) so the youngest birds caught during the November visits would have been sub-adults from the previous breeding season, either having moulted into adult plumage before capture, or with plumage heavily worn (juvenile features abraded) and thus difficult to age. It was therefore assumed that that any high juvenile mortality would not be represented in the data, as this would have occurred prior to sampling. As a result, all birds were included in the analysis, and selecting a model that did not demonstrate time (age) dependent mortality was considered appropriate in this study.

The constant adult survival rate for the 1990 cohort over the duration of the study, combined with recaptures up to 18 years of age, suggest that the White-faced Robin is long-lived and has the ability to live even longer than 18 years. Although no trend in survival rates over time was evident, the 2002 cohort demonstrated a particularly low survival rate. The reasons for this are unclear and need more investigation. Low survival could be a result of a wide range of local environmental factors. However, a positive correlation between annual rainfall and survival was evident. It is known that rainfall levels influence insect abundance (e.g. Pinheiro *et al.* 2002), with insects from many genera increasing during the wet season. As insects are the primary food source for this species (Higgins and Peter 2002), reduced insect abundance during drier years could influence its survival.

Only 7.6% of female and 8.3% of male White-faced Robins were recorded more than 2 km from their point of banding, indicating that the species is highly sedentary, with limited dispersal by both sexes. Previous studies have found a bias toward female dispersal in both the White-breasted Robin (Russell *et al.* 2004) and Eastern Yellow Robin (Debus 2006). Most robin species demonstrate a sex-biased dispersal pattern (Greenwood 1980, Pusey 1987). The reasons for the results obtained in this study are unclear, warranting a more detailed investigation using colour marking.

The sedentary nature of the White-faced Robin, and the isolation of the location and its habitat, makes the species potentially vulnerable to local change. For sedentary species, environmental changes, in association with habitat fragmentation, have been demonstrated as being capable of having large-scale impacts on local populations (Cagan 2007). Our analysis of recapture data demonstrates that, from a survival perspective, the population appears to be relatively stable. This type of monitoring and analysis of recaptures may provide an effective means of monitoring aspects of the health of similar populations.

ACKNOWLEDGMENTS

The authors would like to acknowledge the Queensland Department of Environment and Resource Management for its support of this research through the issue of scientific permits over the years, as well as the support of the local rangers at Iron Range National Park.

Many banders have contributed to the data set that has been collected since 1988. Banders who contributed data for this paper are R. Allen, G. Cam, B. Chaffey, M. Clayton, J. Coleman, R. Donaghey, C. Elliott, P. Ewin, W. Filewood, K. Fisher, G. Fry, F.V. Gessel, S. Gould, W. Goulding, N. Hermes, J. Hardy, W. Klau, S.G. Lane, A. Leavesley, A. Leishman, A. Ley, P. Mahoney, D. Pepper-Edwards, W. Martin, S. Newbery, J. Nicholls, A. Overs, B. Pascoe, S. Pell, S. Rae, J. Rawsthorne, C. Rich, N. Schrader, R. Sonnenburg, S. Tiedeman, S. Williams and K. Wood (with apologies for any accidental omissions).

REFERENCES

AUSTRALIAN BIRD AND BAT BANDING SCHEME (ABBBS) 2010. Search the database: *Tregellesia leucops*. http://www.environment.gov.au/cgi-bin/biodiversity/abbbs/abbbs-search.pl Accessed on 18 November 2010.

BELL, H.L. 1971. Field notes on birds of Mt Albert Edward, Papua. *Emu* 71: 13-19.

BERULDSEN, G.R. 1990. Cape York in the wet. *Australian Birdwatcher* 13: 209-217.

BERULDSEN, G. 2003. *Australian Birds: Their Nests and Eggs*. Brisbane: G. Beruldsen.

BIRDLIFE INTERNATIONAL 2010. Species factsheet: *Tregellasia leucops*. www.birdlife.org/datazone/speciesfactsheet.php?id=5485 Accessed on 18 November 2010.

CAGAN, H.S. 2007. Conservation ecology: Area trumps mobility in fragment bird extinctions. *Current Biology* 17: R283-R286.

CHISHOLM, A.H. 1960. Remarks on robins. *Emu* 60: 221-236.

COURTNEY, J., CONWAY, C.J., POWELL, G.V.N. & NICHOLS, J.D. 1995. Overwinter survival of neotropical migratory birds in early-successional and mature tropical forests. *Conservation Biology* 9: 855-864.

DIAMOND, J.M. 1985. New distributional records and taxa from the outlying mountain ranges of New Guinea. *Emu* 85: 65-91.

DEBUS, S.J.S. 2006. Breeding and population parameters of robins in a woodland remnant in northern New South Wales, Australia. *Emu* 106: 147-156.

FORSHAW, J.M. & MULLER, K.A. 1978. Annotated list of birds observed at Iron Range, Cape York Peninsula, Queensland, during October, 1974. *Australian Birdwatcher* 7: 171-194.

FRANCIS, C.M., TERBORGH, J.S. & FITZPATRICK, J.W. 1999. Survival rates of understorey forest birds in Peru. Proceedings of the 22nd International Ornithological Congress, pp. 326-335.

GREENWOOD, P.J. 1980. Mating systems, philopatry and optimal dispersal in birds and mammals. *Animal Behaviour* 28: 1140-1162.

GRIFFIOEN, P.A. & CLARKE, M.F. 2002. Large-scale bird-movement patterns evident in eastern Australian atlas data. *Emu* 102: 99-125.

HARDY, J.W. & VAN GESSEL, F.W. 1992. Morphometrics of the White-faced Robin. *Corella* 16: 94.

HIGGINS, P.J. & PETER, J.M. (Eds). 2002. *Handbook of Australian, New Zealand and Antarctic birds. Volume 6: Pardalotes to Shrike-thrushes*. Melbourne: Oxford University Press.

JOHNSTON, J.P., PEACH, W.J., GREGORY, R.D. & WHITE, S.A. 1997. Survival rates of tropical and temperate passerines: A Trininean perspective. *The American Naturalist* 150: 771-789.

KARR, J.R., NICHOLS, J.D., KLIMKIEWICZ, M.K. & BRAWN, J.D. 1990. Survival rates of birds of tropical and temperate forests – will the dogma survive? *The American Naturalist* 136: 277-291.

LEBRETON, J.D., BURNHAM, K.P., CLOBERT, J. & ANDERSON, D.R. 1992. Modeling survival and testing biological hypotheses using marked animals – a unified approach with case studies. *Ecological Monographs* 62: 67-118.

LOWE, K.M. 1989. *The Australian Bird Banders Manual.* Australian Bird and Bat Banding Scheme, Canberra.

MACKEY, B.G., NIX, H., HITCHCOCK, P. 2001. The Natural Heritage Significance of Cape York Peninsula. Report to Queensland Government. Canberra: www.derm.qld.gov.au/register/p00582aj.pdf

MCGREGOR, R., WHITTINGHAM, M.J. & CRESSWELL, W. 2007. Survival rates of tropical birds in Nigeria, West Africa. *Ibis* 149: 615-618.

MURRAY, B.G. 1985. Evolution of clutch size in tropical species of birds. *Ornithological Monographs* 36: 505-519.

PARKER, T.H., BECKER, C.D., SANDERCOCK, B.K. & AGREDA, A.E. 2006. Apparent survival estimates for five species of tropical birds in an endangered forest habitat in western Ecuador. *Biotropica* 38: 764-769.

PINHEIRO, F., DINIZ, I.R., COELHO, D. & BANDEIRA, M.P.S. 2002. Seasonal pattern of insect abundance in the Brazilian cerrado. *Austral Ecology* 27: 132-136.

PUSEY, A. 1987. Sex-biased dispersal and inbreeding avoidance in birds and mammals. *Trends in Ecology and Evolution* 2: 295-299.

RICKLEFS, R.E. 2000. Density dependence, evolutionary optimization, and the diversification of avian life histories. *Condor* 102: 9-22.

RUSSELL, E.M., BROWN, R.J. & BROWN, M.N. (2004). Life history of the white-breasted robin, *Eopsaltria georgiana* (Petroicidae), in south-western Australia. *Australian Journal of Zoology* 52: 111-145.

SCHODDE, R. & MASON, I.J. 1999. *The Directory of Australian Birds: Passerines*. Melbourne: CSIRO.

SEBER, G.A.F. 1970. Estimating time specific survival and reporting rates for adult birds from band returns. *Biometrika* 57: 313-318.

WHITE, G.C. & BURNHAM, K.P. 1999. Program MARK: survival estimation from populations of marked animals. *Bird Study* 46: 120-139.

J.T. COLEMAN, 22 Parker Street, Shailer Park, Qld, 4128*
F.W. VAN GESSEL, 64 Dorothy Avenue, Woy Woy, NSW 2256
M. CLAYTON, 81 Maribyrnong Ave, Kaleen, ACT, 2617

**Corresponding author: janetandjon@hotmail.com*

The Sunbird (2012) 42(1): 24-38

BIRD SURVEYS OF GOLD COAST CITY CONSERVATION AREAS

JASON SEARLE, SHEREE MADEN, BLAIR PRINCE & TERRY DILLON

ABSTRACT

Gold Coast City Council officers, together with local naturalists, undertook weekly bird surveys in 12 conservation reserves over a four-year period (2006 to 2010). Sixteen visits were made to each reserve. A total of 160 species was observed, representing approximately 60% of the avifauna of the City. Species richness was high, with over 60 species recorded in each reserve. The highest species richness (109 species) was recorded at Pimpama River, reflecting the diversity of habitat present at this site. Seasonal trends in species richness were evident in each reserve, with the highest values recorded from spring to early summer. Seasonal patterns were also evident for several species. In addition to surveys, individual bird counts were undertaken in three of the reserves, with results reflecting survey effort and being similar across each reserve.

INTRODUCTION

Employing the ratepayer-funded Open Space Preservation Levy, the Gold Coast City Council acquired 12 conservation reserves throughout the hinterland of the Gold Coast prior to 2006. The total cost was approximately $21 million. These reserves, classified as Conservation Areas, range in size from 13 ha (Elanora) to 895 ha (Clagiraba), and comprise a total area of 4,240 ha of native bushland (approximately 0.7% of all bushland remaining in the City). They include Austinville, Bonogin Ridge, Clagiraba, Eagle Heights, Elanora, Upper Mudgeeraba, Numinbah, Pimpama River, Springbrook, Tallebudgera, Tugun Hill and Wongawallan. Locations are shown in Figure 1.

Several earlier studies have provided 'snapshot' inventories of the avifauna of the Gold Coast hinterland (Dawson *et al.*, 1991; Sewell and Catterall, 1998; Debus, 2007), whilst the Gold Coast City Council flora and fauna database and Queensland government's Wildnet databases contain a large body of bird observations for the local government area (in the order of 35-45,000 records). The City has compiled an official list based on all of

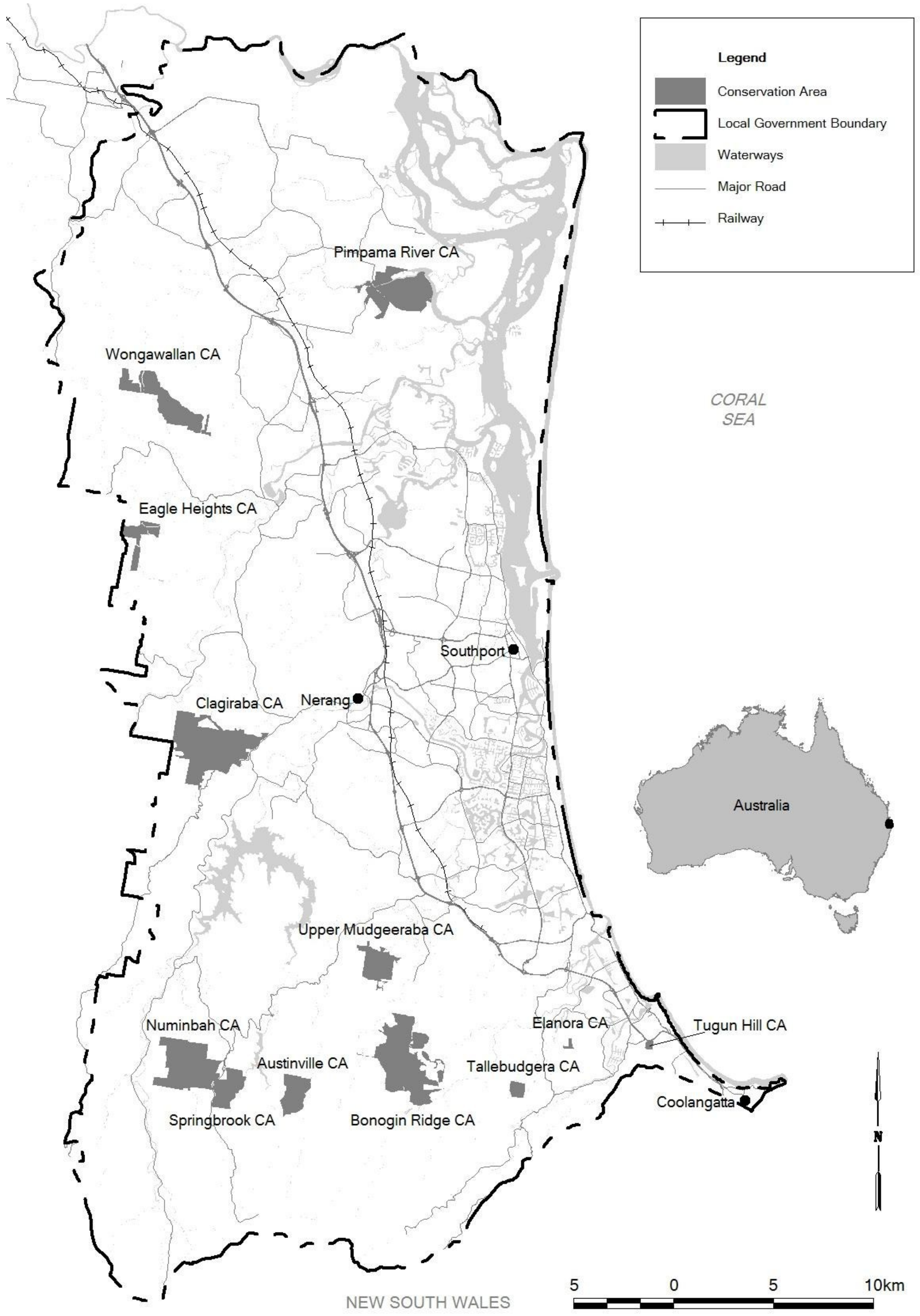


Figure 1. The 12 Conservation Areas monitored during this study.

these sightings, which in 2010 included a total of 272 species confirmed as resident or regular visitors. An additional 85 bird species, recorded from fewer than five observations overall, are considered outside their normal range, and have been termed rare visitors or vagrants.

A major question facing conservation planners and managers within the City is how well the avifauna of the City is represented in the Conservation Areas. In an attempt to address this question, the current project aimed to determine how many of the resident or regularly visiting species (previously recorded for the City) utilised the areas. This involved collection of presence/absence and count data at each site over time, with the overall objective of identifying trends between seasons and any indications of environmental change.

METHODS

Together with local naturalists, local government officers conducted a 60–90 minute bird census weekly within one of the Conservation Areas between July 2006 and June 2010. Each Area was surveyed quarterly according to a rotating alphabetical roster, such that it was surveyed four times during each season over the four-year period, giving a total of 12 survey days per season. Over four years, a total of 192 surveys was conducted.

Each census was undertaken along a set route within each Conservation Area, ranging from 600 m to 1500 m in length, depending on location. A group of two to five recorders attended each survey, and recorded only those birds confirmed by sight (aided with the use of binoculars) or identified by characteristic calls by at least two recorders. Each survey commenced at a standardised start time (ranging from 0600 h in summer to 0730 h in winter) when birds were most active, and transects were walked at a consistent pace to reduce variability. Surveys were not conducted in the rain but completed as soon as the weather permitted (typically within two days).

In addition to collecting presence/absence data, the abundance of each species was recorded for Clagiraba, Pimpama River and Tugun Hill Conservation Areas.

RESULTS AND DISCUSSION

A total of 160 species was observed in this study (see Appendix 1). Based on a review of all the historical records for Gold Coast City area to date (GCCC 2004), 357 species have been recorded for the entire City area, of which 85 species have been recorded fewer than five times overall and are

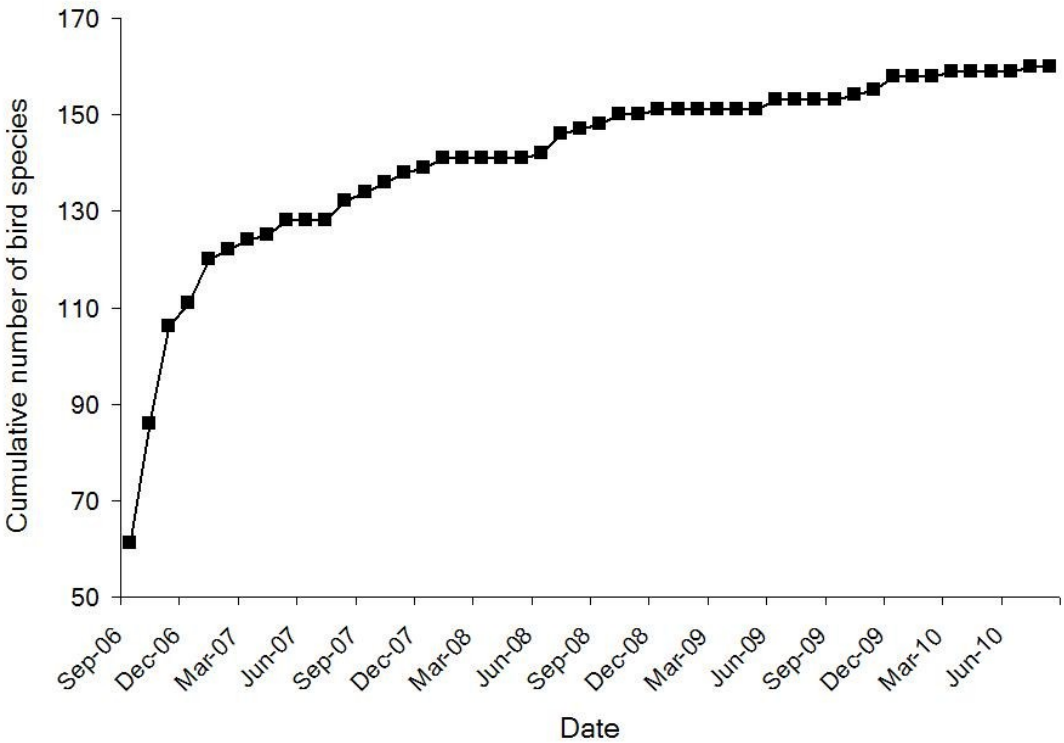


Figure 2. Cumulative number of species recorded over the four-year survey period (September 2006 to August 2010).

considered to be rare visitors or vagrants. This means that, apart from vagrants, approximately 60% of the City's species were recorded as utilising the Conservation Areas.

The cumulative number of species recorded in the Conservation Areas over time is shown in Figure 2. New species were observed consistently up until the eighteenth month, after which additional species were recorded less frequently. However, new species continued to be observed sporadically over the entire four-year period of the study, suggesting that further surveys would gradually reveal more species.

Among the birds recorded, four species subject to special provisions under the Queensland *Nature Conservation Act 1992* were recorded. These were the vulnerable Powerful Owl (*Ninox strenua*) at Mudgeeraba in spring 2007, the vulnerable Glossy Black-Cockatoo (*Calyptorhynchus lathami*) at Clagiraba in spring 2008, the near-threatened Albert's Lyrebird (*Menura alberti*) at Eagle Heights in autumn 2008-2010, spring and winter of 2009 and the near-threatened Grey Goshawk (*Accipiter novaehollandiae*) at Numinbah in summer 2008, autumn 2006 and 2010, and once at Wongawallan during winter 2010.

Only two introduced species were observed. The Common Myna (*Sturnus tristis*) was recorded in four Conservation Areas: Bonogin Ridge, Elanora, Numinbah and Tugun Hill. The Spotted Dove (*Streptopelia chinensis*) is widespread and was observed in five Conservation Areas, including Bonogin Ridge, Elanora, Upper Mudgeeraba, Tugun Hill and Wongawallan.

Figure 3 shows the number of species recorded within each of the 12 reserves. The Pimpama River Conservation Area supported the highest species richness, with 109 species recorded over the four years. This reserve is the only property to contain a wide variety of coastal habitat types, including mangrove wetlands, saltmarsh and marine flats, coastal sedgelands, open grasslands, swamp oak (*Casuarina glauca*) and broad-leaved paperbark (*Melaleuca quinquenervia*) open forest and eucalypt (*Eucalyptus tereticornis, Corymbia intermedia, Lophostemon confertus*) coastal woodlands, while the remaining 11 properties are generally terrestrial bushland habitat reserves. In addition, the Pimpama River Conservation Area has two freshwater dams that provide habitat for waterbirds and is the only reserve with marine flats known to support wading shorebirds.

Clagiraba Conservation Area also exhibited a relatively high species richness, with 100 species recorded. This is at least partially a reflection of the diverse range of habitats present in this reserve, including open grassland, acacia regrowth, dry open forest communities, tall moist open forests and riparian rainforest. Clagiraba Conservation Area also has a freshwater dam that provides additional freshwater habitat for waterbirds.

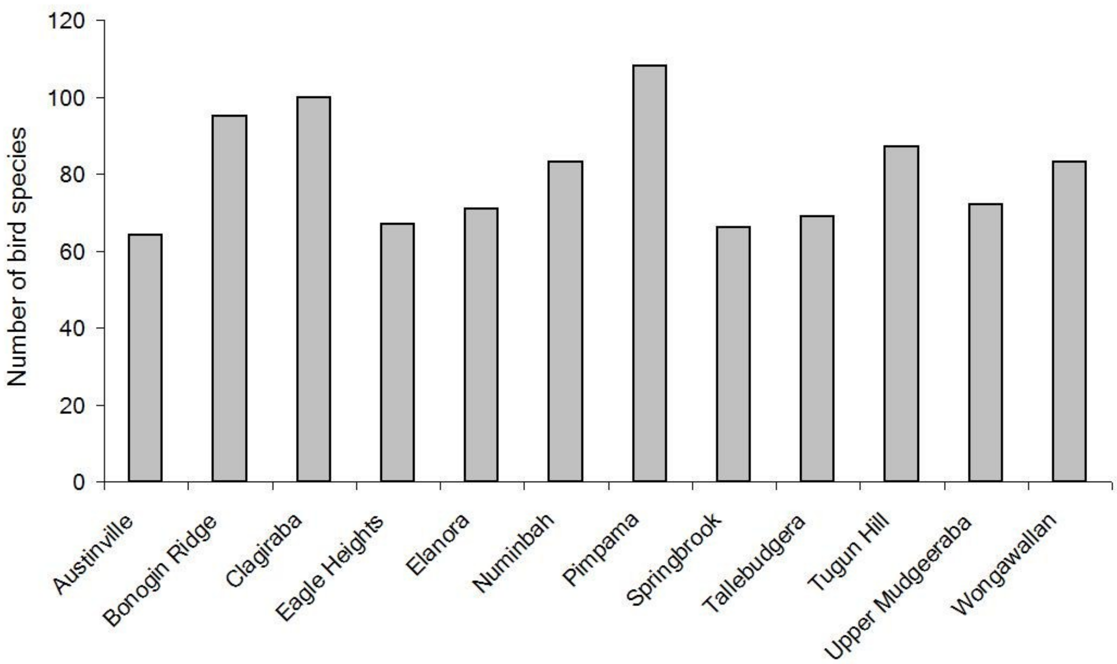


Figure 3. Total number of species recorded in each Conservation Area (September 2006 to August 2010).

The lowest species richness was recorded in the Austinville Conservation Area, with 64 species seen over four years. This is at least partially a reflection of the relatively low detectability of birds in the very tall and dense vegetation along the survey transect. In summer this site is renowned for substantial insect (cicada) activity, hence bird calls are often not heard.

Generally, lower species richness was observed in Conservation Areas that constitute more isolated remnants of habitat and act as localised wildlife refuges (e.g. Elanora, Tallebudgera, Tugun Hill and Upper Mudgeeraba) than Areas that adjoin other larger parks and reserves. A summary of the species richness for each Conservation Area surveyed is provided in Appendix 2, together with other location and habitat details.

The current survey program has a number of practical constraints that may have influenced the results, including: bias towards accessibility (e.g. surveys along tracks and roadsides), survey areas of different sizes, transects of different lengths, and transects not being proportionally representative of all habitat types present at each reserve.

Seasonal bird population trends

Seasonally, the greatest number of species was observed during spring (i.e. September to November), with a total of 107 species confirmed for the 12 Conservation Areas. One hundred and four species were recorded in summer, 97 species in winter and 89 species in autumn.

Figure 4 shows the total number of times particular species were recorded in each season. Some of the seasonal patterns evident were:

Common Koel (*Eudynamys scolopacea*), Brush Cuckoo (*Cacomantis variolosus*) and Dollarbird (*Eurystomus orientalis*) were all recorded in spring/summer;

Channel-billed Cuckoo (*Scythrops novaehollandiae*), Sacred Kingfisher (*Todiramphus sanctus*) and White-throated Needletail (*Hirundapus caudacutus*) were recorded in spring/summer, but also once in early autumn;

Leaden Flycatcher (*Myiagra rubecula*), Spectacled Monarch (*Monarcha trivirgatus*) and Olive-backed Oriole (*Oriolus sagittatus*) were all recorded in spring/summer with occasional sightings in the cooler months;

Pheasant Coucal (*Centropus phasianinus*) was mostly recorded in summer, frequently in spring and only occasionally during autumn/winter;

Rose Robin (*Petroica rosea*) was only recorded in autumn/winter;

Rufous Fantail (*Rhipidura rufifrons*) was mostly recorded in autumn with

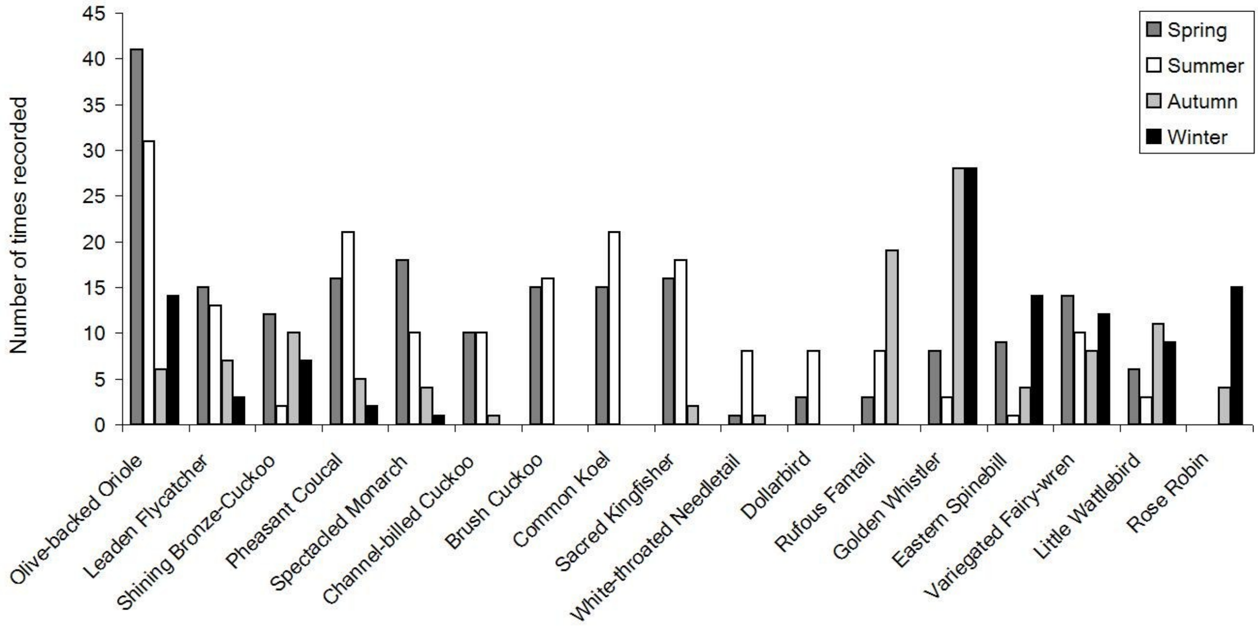


Figure 4. Total number of times each species was recorded in each season over the four-year period (spring 2006 to winter 2010).

occasional sightings in the warmer months;

Golden Whistler (*Pachycephala pectoralis*) was mostly recorded in the cooler months and only occasionally in the warmer months;

Shining Bronze-Cuckoo (*Chrysococcyx lucidus*), Eastern Spinebill (*Acanthorhynchus tenuirostris*) and Little Wattlebird (*Anthochaera chrysoptera*) were rarely recorded in summer;

Variegated Fairy-wren (*Malurus lamberti*) sightings were consistent throughout all seasons.

Seasonal occurrences were generally as expected for species that are spring-summer breeding migrants or autumn-winter migrants to the Gold Coast region. The Conservation Area estate provides habitat for a large number of common resident bird species, including Lewin's Honeyeater (*Meliphaga lewinii*), Rainbow Lorikeet (*Trichoglossus haematodus*), Torresian Crow (*Corvus orru*), Eastern Whipbird (*Psophodes olivaceus*), Pied Currawong (*Strepera graculina*), Laughing Kookaburra (*Dacelo novaeguineae*), Australian Magpie (*Gymnorhina tibicen*), Eastern Yellow Robin (*Eopsaltria australis*), Brown Thornbill (*Acanthiza pusilla*), White-throated Treecreeper (*Cormobates leucophaeus*), Sulphur-crested Cockatoo (*Cacatua galerita*), Spotted Pardalote (*Pardalotus punctatus*), Silvereye (*Zosterops lateralis*), Grey Fantail (*Rhipidura fuliginosa*) and many more. Each of these species has been recorded within all 12 Conservation Areas at least once each season over the survey period.

Further monitoring is required to determine seasonal trends of species that have been recorded only occasionally. These species include waterbirds and waders present only in those areas where aquatic habitats are present, and other groups such as raptors and rails, which were only recorded sporadically in the surveys undertaken.

Count surveys

The bird counts taken for the Clagiraba, Pimpama River and Tugun Hill Conservation Areas during the survey program constituted a pilot project to examine possible population trends at these three sites over time. The results of this count data are presented in Figure 5.

Figure 5 shows that the total number of birds recorded per visit varied temporally to a similar degree at each of the three sites. Counts of over 200 were made at each site at least once during the four-year survey period. There were periodic low counts of approximately 80 birds at two sites, and a more extreme low count (66 birds) for the Clagiraba Conservation Area during autumn 2010.

These numbers are of a similar magnitude despite the vastly different overall size of the three reserves, and appear to be a reflection of the similar area of habitat surveyed, and similar survey effort (time taken and distance

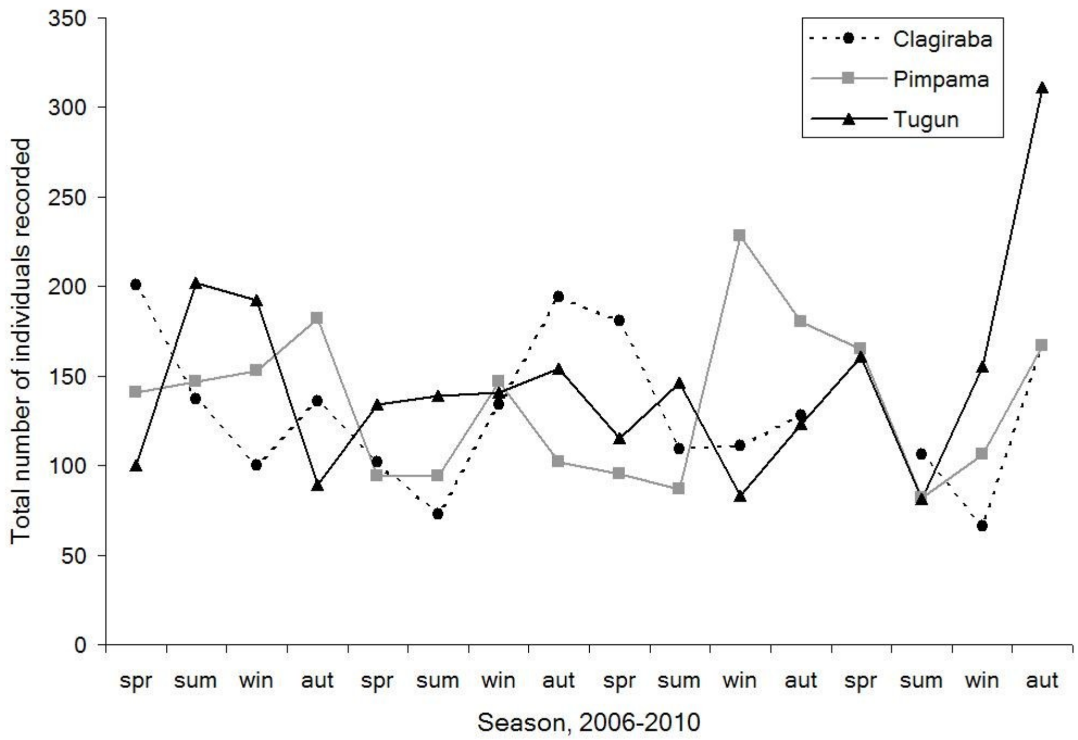


Figure 5. Total number of birds (individual counts) recorded in each reserve each month during the four-year period (spring 2006 to winter 2010).

walked) at each site. Despite these similarities, there appeared to be no consistent seasonal pattern in the total number of birds counted across the three reserves.

Figure 6 shows the total number of species recorded at each of the three sites during each season over the survey period. As with the total number of birds counted, there appeared to be no consistent seasonal pattern in species richness across the three reserves. However, species richness did appear to follow the expected trend of increasing with the overall area of habitat available. The highest species richness (60 species during spring 2008) was recorded at Clagiraba, which was the largest reserve (860 ha). The lowest species richness for a season (25 species in autumn 2007 and winter 2010) was recorded at Tugun Hill, which was the smallest reserve (14 ha).

Other trends in count data were difficult to identify from this four-year survey. Many species were observed only a few times. Additional data collected over a longer period may help to minimise variability (based on randomness and daily weather conditions) and confirm suggested trends in bird numbers and distribution.

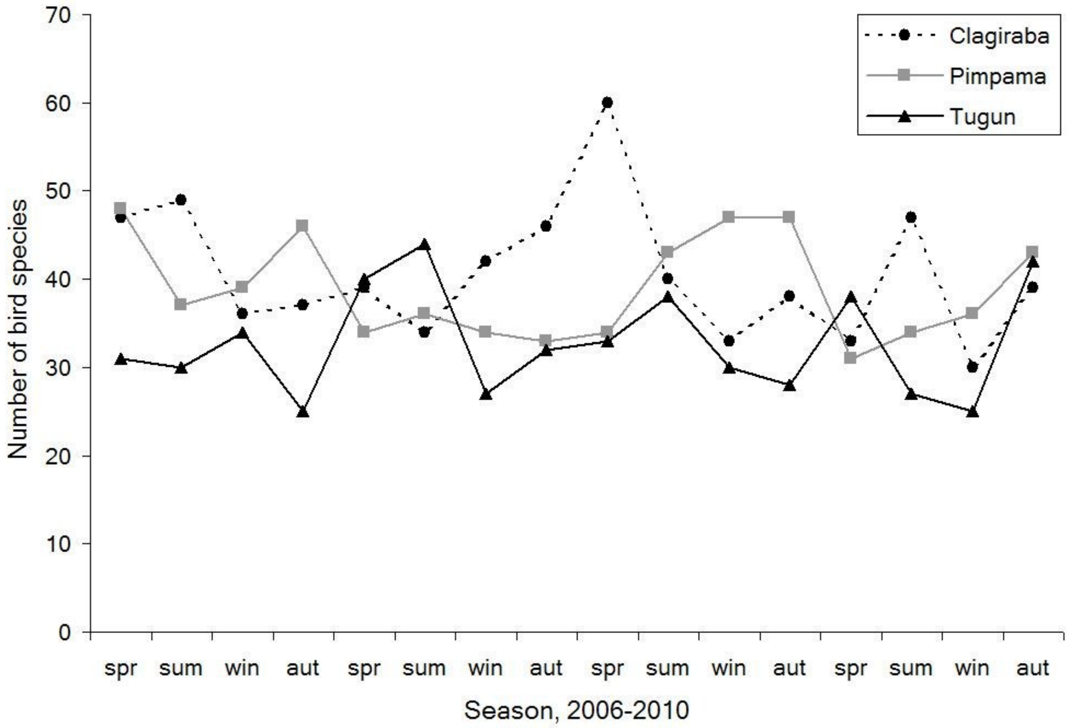


Figure 6. Number of species recorded at Clagiraba, Pimpama and Tugun Hill Conservation Areas each month during the four-year period (spring 2006 to winter 2010).

CONCLUSION

One of the major planning and management issues this survey aimed to address was how well the City's bird fauna was represented in the 12 reserves. One hundred and sixty species were observed in these reserves over the survey period, representing approximately 60% of the resident or regularly visiting avifauna. Although most species were recorded during the first 12 months of monitoring, additional species continued to be recorded throughout the study, suggesting that ongoing survey effort would return a fuller inventory at each reserve.

Species richness was high at each reserve, with at least 60 species recorded in each over the survey period. The highest species richness was recorded at Pimpama River (109 species), and reflected the diversity of habitats present. Many of the other reserves support terrestrial bushland which is widespread and representative of more common vegetation communities within the Gold Coast area. In order to best conserve the full range of bird fauna occurring in the region, future acquisitions of land for conservation purposes might best target areas of known habitat for species with restricted distributions or specialist habitat requirements.

The data collected in this survey set a valuable benchmark against which any temporal changes in the bird communities of these reserves can be monitored and assessed. In addition, many species were observed only a few times during the survey period; additional data collected over a longer period would assist in more accurate determination of presence and abundance. Finally, continued monitoring would help minimise variability and confirm seasonal trends.

ACKNOWLEDGMENTS

We would like to thank all the community volunteers and local government officers who participated in this bird survey program over the four-year monitoring period.

REFERENCES

AUSTRALIAN MUSEUM. 2007. *Birds in Backyards*, February 2007, available via http://www.birdsinbackyards.net (accessed April 2008).

BARRETT, G., SILCOCKS, A., BARRY, S., CUNNINGHAM, R. & POULTER, R. 2003. *The New Atlas of Australian Birds*. Royal Australasian Ornithologists Union, Victoria.

DAWSON, P., DAWSON, D., REYNOLDS, I. & REYNOLDS, S 1991. Notes on the birds of Logan Reserve, Southeast Queensland, 1967-1990. *Sunbird* 21: 93-111.

DEBUS, S.J.S. 2007. Avifauna of remnant bushland in Southeast Queensland II: The Gold Coast Hinterland. *Sunbird* 37(2): 25-32.

GOLD COAST CITY COUNCIL. 2004. Vertebrate Fauna of the Gold Coast Local Government Area, List Version April 2010. http://www.goldcoastflorafauna.com.au/

HIGGINS, P. & DAVIES, S. 1996. *Handbook of Australian, New Zealand & Antarctica Birds*. Oxford University Press, Melbourne.

SEWELL, S.R. & CATTERALL, C.P. 1998. Bushland modification and styles of urban development: their effects on birds in Southeast Queensland. *Wildlife Research* 25: 41-63.

SLATER, P., SLATER, P. & SLATER, R. 2003. *The Slater Field Guide to Australian Birds*. New Holland Publishers, Sydney.

J. SEARLE, S. MADEN, & B. PRINCE, Environmental Planning and Conservation Section, Gold Coast City Council, GCMC 9729*
T. DILLON, 4 Harbord Court, Robina, QLD 4156

**Corresponding author: jsearle@goldcoast.qld.gov.au*

APPENDIX 1

Species recorded in each of 12 Conservation Areas in Gold Coast City for the 2006-2010 bird survey program.

No.	Genus	Species	Common name	Austinville	Bonogin Ridge	Clagiraba	Eagle Heights	Elanora	Numinbah	Pimpama River	Springbrook	Tallebudgera	Tugun Hill	Upper Mudgeeraba	Wongawallan
1	*Alectura*	*lathami*	Australian Brush-turkey		x			x				x	x	x	
2	*Coturnix*	*ypsilophora*	Brown Quail		x	x	x	x	x	x		x		x	x
3	*Dendrocygna*	*eytoni*	Plumed Whistling-Duck			x									
4	*Dendrocygna*	*arcuata*	Wandering Whistling-Duck							x					
5	*Chenonetta*	*jubata*	Australian Wood Duck		x			x	x	x		x	x		
6	*Anas*	*gracilis*	Grey Teal							x					
7	*Anas*	*castanea*	Chestnut Teal							x					
8	*Anas*	*superciliosa*	Pacific Black Duck	x	x	x		x	x	x			x	x	
9	*Aythya*	*australis*	Hardhead			x									
10	*Tachybaptus*	*novaehollandiae*	Australasian Grebe			x				x					
11	*Columba*	*leucomela*	White-headed Pigeon	x	x		x			x	x			x	x
12	*Streptopelia*	*chinensis*	Spotted Dove		x			x					x	x	x
13	*Macropygia*	*amboinensis*	Brown Cuckoo-Dove	x	x	x	x	x	x	x	x	x		x	x
14	*Chalcophaps*	*indica*	Emerald Dove	x								x			x
15	*Phaps*	*chalcoptera*	Common Bronzewing		x	x							x	x	
16	*Ocyphaps*	*lophotes*	Crested Pigeon		x	x				x			x	x	x
17	*Geopelia*	*striata*	Peaceful Dove			x		x		x		x		x	
18	*Geopelia*	*humeralis*	Bar-shouldered Dove		x	x		x	x	x	x	x	x	x	x
19	*Leucosarcia*	*melanoleuca*	Wonga Pigeon	x	x	x	x	x	x		x	x	x		x
20	*Ptilinopus*	*magnificus*	Wompoo Fruit-Dove	x		x	x		x						x
21	*Ptilinopus*	*regina*	Rose-crowned Fruit-Dove	x		x	x								
22	*Lopholaimus*	*antarcticus*	Topknot Pigeon	x		x	x	x	x		x	x			x
23	*Podargus*	*strigoides*	Tawny Frogmouth											x	
24	*Hirundapus*	*caudacutus*	White-throated Needletail				x	x		x			x		
25	*Anhinga*	*melanogaster*	Darter							x					
26	*Phalacrocorax*	*melanoleucos*	Little Pied Cormorant			x				x					
27	*Phalacrocorax*	*carbo*	Great Cormorant			x									
28	*Phalacrocorax*	*sulcirostris*	Little Black Cormorant							x					
29	*Phalacrocorax*	*varius*	Pied Cormorant		x					x			x		
30	*Pelecanus*	*conspicillatus*	Australian Pelican							x			x		
31	*Ardea*	*pacifica*	Pacific Heron			x			x	x					
32	*Ardea*	*alba*	Great Egret			x				x			x		
33	*Ardea*	*intermedia*	Intermediate Egret										x		
34	*Ardea*	*ibis*	Cattle Egret			x				x			x		
35	*Egretta*	*novaehollandiae*	White-faced Heron	x	x	x			x	x			x		
36	*Egretta*	*garzetta*	Little Egret		x										x
37	*Threskiornis*	*molucca*	Australian White Ibis		x			x		x			x		
38	*Threskiornis*	*spinicollis*	Straw-necked Ibis		x					x					
39	*Elanus*	*axillaris*	Black-shouldered Kite			x				x					
40	*Aviceda*	*subcristata*	Pacific Baza			x		x	x	x			x		x
41	*Haliaeetus*	*leucogaster*	White-bellied Sea-Eagle							x					
42	*Haliastur*	*sphenurus*	Whistling Kite							x					
43	*Haliastur*	*indus*	Brahminy Kite							x			x		
44	*Accipiter*	*fasciatus*	Brown Goshawk		x	x			x	x					x
45	*Accipiter*	*cirrhocephalus*	Collared Sparrowhawk		x										

No.	Genus	Species	Common name	Austinville	Bonogin Ridge	Clagiraba	Eagle Heights	Elanora	Numinbah	Pimpama River	Springbrook	Tallebudgera	Tugun Hill	Upper Mudgeeraba	Wongawallan
46	*Accipiter*	*novaehollandiae*	Grey Goshawk						x						x
47	*Aquila*	*audax*	Wedge-tailed Eagle		x	x				x					
48	*Falco*	*cenchroides*	Nankeen Kestrel							x					
49	*Falco*	*berigora*	Brown Falcon							x					
50	*Falco*	*longipennis*	Australian Hobby							x					
51	*Gallirallus*	*philippensis*	Buff-banded Rail							x					
52	*Amaurorrnis*	*olivaceus*	Bush-hen												x
53	*Gallinula*	*tenebrosa*	Dusky Moorhen			x				x					
54	*Vanellus*	*miles*	Masked Lapwing		x	x		x	x	x					
55	*Gallinago*	*hardwickii*	Latham's Snipe		x										
56	*Larus*	*novaehollandiae*	Silver Gull										x		
57	*Calyptorhynchus*	*lathami*	Glossy Black-Cockatoo			x									
58	*Calyptorhynchus*	*funereus*	Yellow-tailed Black-Cockatoo	x	x	x	x		x		x	x	x	x	x
59	*Elophus*	*roseicapilla*	Galah		x	x		x				x	x	x	x
60	*Cacatua*	*sanguinea*	Little Corella		x			x		x	x		x		
61	*Cacatua*	*galerita*	Sulphur-crested Cockatoo	x	x	x	x	x	x	x	x	x	x	x	x
62	*Trichoglossus*	*haematodus*	Rainbow Lorikeet	x	x	x	x	x	x	x	x	x	x	x	x
63	*Trichoglossus*	*chlorolepidotus*	Scaly-breasted Lorikeet		x		x	x	x	x	x		x	x	x
64	*Alisterus*	*scapularis*	Australian King-Parrot	x	x		x	x	x		x	x	x	x	x
65	*Platycercus*	*elegans*	Crimson Rosella	x		x	x		x		x				x
66	*Platycercus*	*eximius*	Eastern Rosella		x	x		x					x	x	
67	*Platycercus*	*adscitus*	Pale-headed Rosella		x	x	x	x	x	x		x	x	x	x
68	*Centropus*	*phasianinus*	Pheasant Coucal		x	x		x	x	x		x	x	x	x
69	*Eudynamys*	*scolopacea*	Common Koel	x	x	x		x	x	x	x	x	x	x	x
70	*Scythrops*	*novaehollandiae*	Channel-billed Cuckoo		x	x	x		x	x		x		x	x
71	*Chrysococcyx*	*lucidus*	Shining Bronze-Cuckoo	x	x	x	x	x	x		x	x		x	x
72	*Cacomantis*	*flabelliformis*	Fan-tailed Cuckoo	x	x	x	x	x	x	x	x	x		x	x
73	*Cacomantis*	*variolosus*	Brush Cuckoo	x	x	x	x	x	x	x	x	x	x		x
74	*Ninox*	*strenua*	Powerful Owl											x	
75	*Ceyx*	*azurea*	Azure Kingfisher	x		x			x	x					
76	*Dacelo*	*novaeguineae*	Laughing Kookaburra	x	x	x	x	x	x	x	x	x	x	x	x
77	*Todiramphus*	*macleayii*	Forest Kingfisher			x		x		x	x			x	
78	*Todiramphus*	*sanctus*	Sacred Kingfisher	x	x	x		x	x	x		x	x	x	x
79	*Todiramphus*	*chloris*	Collared Kingfisher							x					
80	*Merops*	*ornatus*	Rainbow Bee-eater			x	x	x	x	x		x	x		x
81	*Eurystomus*	*orientalis*	Dollarbird			x				x		x	x		
82	*Pitta*	*versicolor*	Noisy Pitta											x	x
83	*Menura*	*alberti*	Albert's Lyrebird				x								
84	*Cormobates*	*leucophaeus*	White-throated Treecreeper	x	x	x	x	x	x	x	x	x	x	x	x
85	*Ailuroedus*	*crassirostris*	Green Catbird	x					x		x				
86	*Ptilonorhynchus*	*violaceus*	Satin Bowerbird	x	x		x		x		x				
87	*Malurus*	*cyaneus*	Superb Fairy-wren		x				x	x			x		
88	*Malurus*	*melanocephalus*	Red-backed Fairy-wren		x	x			x	x		x	x		x
89	*Malurus*	*lamberti*	Variegated Fairy-wren		x	x	x	x	x	x	x	x	x		x
90	*Sericornis*	*frontalis*	White-browed Scrubwren	x	x	x	x		x	x	x	x	x	x	x
91	*Sericornis*	*magnirostris*	Large-billed Scrubwren	x	x	x	x		x		x	x	x	x	x
92	*Smicrornis*	*brevirostris*	Weebill								x				
93	*Gerygone*	*mouki*	Brown Gerygone	x	x	x			x		x			x	x
94	*Gerygone*	*olivacea*	White-throated Gerygone	x	x	x	x	x	x	x	x	x	x	x	x
95	*Acanthiza*	*lineata*	Striated Thornbill	x	x	x	x		x		x	x		x	x
96	*Acanthiza*	*reguloides*	Buff-rumped Thornbill								x				

No.	Genus	Species	Common name	Austinville	Bonogin Ridge	Clagiraba	Eagle Heights	Elanora	Numinbah	Pimpama River	Springbrook	Tallebudgera	Tugun Hill	Upper Mudgeeraba	Wongawallan
97	*Acanthiza*	*pusilla*	Brown Thornbill	x	x	x	x	x	x	x	x	x	x	x	x
98	*Pardalotus*	*punctatus*	Spotted Pardalote	x	x	x	x	x	x	x	x	x	x	x	x
99	*Pardalotus*	*striatus*	Striated Pardalote	x	x	x	x	x	x	x	x	x	x	x	x
100	*Acanthorhynchus*	*tenuirostris*	Eastern Spinebill	x	x	x	x	x	x	x	x	x	x	x	
101	*Meliphaga*	*lewinii*	Lewin's Honeyeater	x	x	x	x	x	x	x	x	x	x	x	x
102	*Lichenostomus*	*chrysops*	Yellow-faced Honeyeater	x	x	x	x	x	x	x	x	x	x	x	x
103	*Manorina*	*melanocephala*	Noisy Miner		x	x		x	x	x		x	x	x	x
104	*Anthochaera*	*chrysoptera*	Little Wattlebird		x	x		x		x			x		
105	*Myzomela*	*sanguinolenta*	Scarlet Honeyeater	x	x	x	x	x	x	x	x	x	x	x	x
106	*Lichmera*	*indistincta*	Brown Honeyeater	x	x	x	x	x	x	x	x	x	x	x	x
107	*Phylidonyris*	*nigra*	White-cheeked Honeyeater		x					x					
108	*Melithreptus*	*albogularis*	White-throated Honeyeater			x	x	x	x	x	x	x	x	x	x
109	*Melithreptus*	*lunatus*	White-naped Honeyeater								x				x
110	*Entomyzon*	*cyanotis*	Blue-faced Honeyeater		x			x		x	x		x		x
111	*Philemon*	*corniculatus*	Noisy Friarbird		x	x	x	x	x	x	x	x	x	x	x
112	*Philemon*	*citreogularis*	Little Friarbird			x		x		x	x				
113	*Plectorhyncha*	*lanceolata*	Striped Honeyeater		x					x			x		
114	*Pomatostomus*	*temporalis*	Grey-crowned Babbler										x		
115	*Orthonyx*	*temminckii*	Logrunner	x		x	x		x		x	x		x	
116	*Psophodes*	*olivaceus*	Eastern Whipbird	x	x	x	x	x	x	x	x	x	x	x	x
117	*Daphoe-*	*chrysoptera*	Varied Sittella			x	x	x	x		x	x			x
118	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-Shrike	x	x	x	x	x	x	x	x	x	x	x	x
119	*Coracina*	*papuensis*	White-bellied Cuckoo-Shrike			x						x			
120	*Coracina*	*tenuirostris*	Cicadabird	x	x	x	x	x	x	x	x	x	x	x	x
121	*Lalage*	*sueurii*	White-winged Triller							x					
122	*Lalage*	*leucomela*	Varied Triller			x				x		x	x		
123	*Pachycephala*	*pectoralis*	Golden Whistler	x	x	x	x	x	x	x	x	x	x	x	x
124	*Pachycephala*	*rufiventris*	Rufous Whistler	x	x	x	x	x	x	x		x	x	x	x
125	*Colluricincla*	*megarhyncha*	Little Shrike-thrush	x	x	x	x	x	x	x	x	x		x	x
126	*Colluricincla*	*harmonica*	Grey Shrike-thrush	x	x	x	x	x	x	x	x	x	x	x	x
127	*Sphecotheres*	*viridis*	Figbird	x	x	x	x	x	x	x	x	x	x	x	x
128	*Oriolus*	*sagittatus*	Olive-backed Oriole	x	x	x	x	x	x	x	x	x	x	x	x
129	*Artamus*	*leucorhynchus*	White-breasted Woodswallow							x			x		
130	*Cracticus*	*nigrogularis*	Pied Butcherbird	x	x	x	x	x	x	x		x	x	x	x
131	*Cracticus*	*torquatus*	Grey Butcherbird		x	x	x	x	x	x			x	x	x
132	*Gymnorhina*	*tibicen*	Australian Magpie	x	x	x	x	x	x	x	x	x	x	x	x
133	*Strepera*	*graculina*	Pied Currawong	x	x	x	x	x	x	x	x	x	x	x	x
134	*Dicrurus*	*bracteatus*	Spangled Drongo	x	x	x	x	x	x	x	x	x	x	x	x
135	*Rhipidura*	*rufifrons*	Rufous Fantail	x	x	x	x		x	x	x	x	x	x	x
136	*Rhipidura*	*fuliginosa*	Grey Fantail	x	x	x	x	x	x	x	x	x	x	x	x
137	*Rhipidura*	*leucophrys*	Willie Wagtail		x	x			x	x			x		x
138	*Corvus*	*orru*	Torresian Crow	x	x	x	x	x	x	x	x	x	x	x	x
139	*Myiagra*	*rubecula*	Leaden Flycatcher	x		x	x	x	x	x	x	x	x	x	x
140	*Monarcha*	*leucotis*	White-eared Monarch	x											
141	*Monarcha*	*melanopsis*	Black-faced Monarch	x	x	x	x		x	x	x	x	x	x	x
142	*Monarcha*	*trivirgatus*	Spectacled Monarch	x	x	x	x		x				x	x	x
143	*Grallina*	*cyanoleuca*	Magpie-lark		x	x		x	x	x			x	x	x
144	*Ptiloris*	*paradiseus*	Paradise Riflebird	x											
145	*Petroica*	*rosea*	Rose Robin		x	x	x				x	x	x	x	x
146	*Tregellasia*	*capito*	Pale-yellow Robin	x		x	x								x
147	*Eopsaltria*	*australis*	Eastern Yellow Robin	x	x	x	x	x	x	x	x	x		x	x

No.	Genus	Species	Common name	Austinville	Bonogin Ridge	Clagiraba	Eagle Heights	Elanora	Numinbah	Pimpama River	Springbrook	Tallebudgera	Tugun Hill	Upper Mudgeeraba	Wongawallan
148	*Cisticola*	*exilis*	Golden-headed Cisticola		x					x					
149	*Acrocephalus*	*stentoreus*	Clamorous Reed-Warbler		x										
150	*Megalurus*	*timoriensis*	Tawny Grassbird		x					x					
151	*Zosterops*	*lateralis*	Silvereye	x	x	x	x	x	x	x	x	x	x	x	x
152	*Hirundo*	*neoxena*	Welcome Swallow		x	x			x	x			x		x
153	*Hirundo*	*ariel*	Fairy Martin							x					
154	*Hirundo*	*nigricans*	Tree Martin		x					x					x
155	*Zoothera*	*heinei*	Russet-tailed Thrush								x				
156	*Sturnus*	*tristis*	Common Myna		x			x	x				x		
157	*Dicaeum*	*hirundinaceum*	Mistletoebird	x	x	x	x	x	x		x		x		x
158	*Taeniopygia*	*bichenovii*	Double-barred Finch		x								x		
159	*Neochmia*	*temporalis*	Red-browed Finch	x	x	x	x		x	x	x	x	x	x	x
160	*Anthus*	*novaeseelandiae*	Richard's Pipit							x					

APPENDIX 2

Comparison of site location, survey area and species richness for the 2006-2010 bird survey.

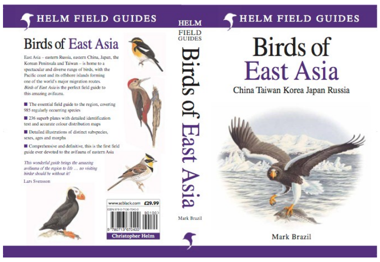
Conservation Area	Area (ha)	Number of species	Location and surroundings
Austinville	212	64	Austinville Road, part of Springbrook Conservation Area (1054 ha in total).
Bonogin Ridge	828	95	Davenport Park and Smith Road Property, adjoins Austinville Forest Reserve, Golden Valley Park, Dalton Park and Bonogin Valley Bushland Park.
Clagiraba	895	100	Belliss Road, wildlife corridor between extensive tracts of bushland at Canungra eastwards to Clagiraba Forest Reserve and extending north-east into Mount Nathan and Nerang Forest.
Eagle Heights	162	67	Consolidates a large area of public-owned open space and provides a wildlife corridor linkage to Tamborine National Park.
Elanora	13	71	Westminster Boulevard, wildlife refuge area in rural residential area.
Numinbah	493	83	Chesters Road, part of Springbrook Conservation Area (818 ha in total).
Pimpama River	550	109	Green Meadows Road, borders Southern Moreton Bay Marine Park and RAMSAR wetland site.
Springbrook	325	66	Apple Tree Park – Springbrook Road, part of Springbrook Conservation Area (818 ha in total).
Tallebudgera	53	69	Trees Road, wildlife refuge area in rural residential area.
Tugun Hill	14	87	Murray Street, Wildlife refuge area in urban residential area.
Upper Mudgeeraba	247	72	Orange Court or Saunders Road, wildlife refuge area in rural residential area.
Wongawallan	448	84	Wilke's Scrub – Lanes Road, adjacent to Mount Wongawallan.

BOOK REVIEW

Birds of East Asia

By Mark Brazil

Colour illustrations and line drawings by Dave Nurney *et al.*



Published by Christopher Helm, London, 2009, Paperback, 527 pages

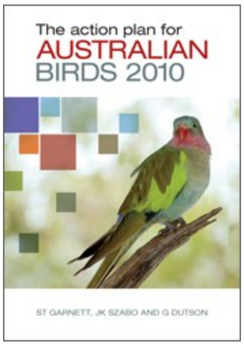
When travelling to Japan, one soon notices that there are not many field guides at hand. If you find out about one, it might not be in English or it is out of print. *Birds of East Asia* is a field guide not only of Japan, but also of eastern China, Taiwan, Korea and eastern Russia. The field guide describes 985 species and uses exquisite colour plates, with up to six species per plate. Illustrations of birds in flight are on the same plate as the same birds at rest. In some cases winter/eclipse plumage is also illustrated in the plates, but sometimes only described in the text. The text is up to date, packed full of concise and relevant information, but is still easy to understand, as can be expected since the author, formerly a professor of Biodiversity and Conservation at Rakuno Gakuen University, Hokkaido, now lectures in ornithology and is also the author of *A Birdwatcher's Guide to Japan* (1987), *The Birds of Japan* (1991) *and The Whooper Swan* (2003). The field guide has a 15-page index to the families, assisting with initial identification of birds. The only disadvantage might be the very small distribution map for each species (2.2 cm^2). However, the distribution information is also in the text, as well as in a table in an appendix, showing the status (resident, breeds, migrant, winters, abundance) of the birds in five distinct areas (Chinese coastal Provinces/Taiwan/Korea/Japan/Russian Far East). Compared to other field guides of Japan, this book's beautiful illustration sets it apart. It is a book of great quality and I can only recommend it.

Marianne D. Keller

BOOK REVIEW

The Action Plan for Australian Birds 2010

By S.T. Garnett, J.K. Szabo and G. Dutson



Published by CSIRO Publishing, 2010, Paperback, 456 pages, AU $49.95
http://www.publish.csiro.au

This book is the third in a 10-yearly series that commenced in 1990. As such, one of its strengths is that the reader can track changes over 20 years in the conservation status of species and subspecies of Australian birds, including those of offshore territories. Many of the changes in categorisation since 2000 have arisen from either refinement of the IUCN Red List criteria or the acquisition of additional information, but others can be attributed to on-ground conservation efforts. Accounts of taxa that are (or are likely to be) extinct are also presented. Methods used to categorise taxa are well described. I was particularly impressed by the indication of the degree of reliability in the IUCN Red List assessment data, since uncertainty is a core feature in assessments involving observations of highly mobile organisms over time and space. Each account includes descriptions of range, abundance, ecology and threats, as well as identification of conservation objectives and required information and management actions. Colour-coded maps show, among other things, core records for the taxon, non-core records (vagrant occurrences outside the usual range, or historical observations at a location where the taxon is known to be extinct) and records of other subspecies of the same species as the focal taxon. An up-to-date bibliography will be useful for those wanting to learn more about any particular taxon. As a reference tool, the book represents good value for money, but apart from this I would recommend it to anybody with more than a passing interest in the conservation of Australian birds.

F. Dane Panetta