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In this issue: Records of Painted Finch and status in South Australia
Breeding behaviour and prey of Black Falcons
Osprey nesting in mangroves in South Australia
Black-tailed Nativehen roosting behaviour
White-plumed Honeyeater; Spotted Dove, Eyre Peninsula

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The South Australian Ornithological Association Inc. (Birds SA)

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Birds SA is the trading name of The South Australian Ornithological Association Inc.

The principal aims of the Association are to promote the study and conservation of Australian birds, to disseminate the results of research into all aspects of bird life, and to encourage bird watching as a leisure activity.

The *South Australian Ornithologist* is supplied to all members and subscribers, and is published twice a year. In addition, a quarterly *Newsletter* reports on the activities of the Association, announces its programs and includes items of general interest.

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Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. 2003. *The new atlas of Australian birds*. Birds Australia, Melbourne.

Close, D. 1982. Birds of the Ninety Mile Desert. In *The Ninety Mile Desert of South Australia*. C.R. Harris, A.R. Reeves and D.C. Symon (eds). Nature Conservation Society of South Australia, Adelaide, pp 85–87.

Marchant, S. and Higgins, P.J. (eds). 1990. *Handbook of Australian, New Zealand and Antarctic birds. Volume 1B, Australian Pelican to ducks*. Oxford University Press, Melbourne.

SAOA. 1995. Bird Records. *South Australian Ornithological Association Newsletter* 155: 15.

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Revised February 2014

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Front cover photograph:

Painted Finch

Merilyn Browne



Early records of the Painted Finch, *Emblema pictum* Gould, 1842 and a review of its status in South Australia

ANDREW BLACK AND PHILIPPA HORTON

Abstract

Frank Gibson, a little known 19th century rural worker and collector, recorded the Painted Finch in 1868 from the Flinders Ranges near the southern limit of its distribution. In the following year he obtained the first ten specimens other than the holotype, four of which formed the basis of the British Museum's collection. He made the first recorded observations of its varied plumage, behaviour, habitat and diet, and inferred that it was a visitor rather than a resident. The species was thereafter almost unknown in South Australia until nearly a century later, but increasing numbers of observations since then, especially from the 1980s, have provided clarification of its status. There are resident populations in the Musgrave and other north-western ranges and the Davenport Range but at latitudes south of 30° S it is chiefly an irregular spring and summer visitor, with sporadic breeding in favourable seasons.

INTRODUCTION

Gould (1842) named the Painted Finch, *Emblema picta*, on the basis of a single male specimen obtained by Benjamin Bynoe, surgeon to H.M.S. *Beagle*, in June 1840 on Depuch Island east of Dampier, north-western Australia (21° 38' S, 117° 43' E) (Mathews 1925-1927, Whittell 1954). Gould's knowledge of the species was therefore limited and he could offer no further "account whatever of its habits or economy" in his subsequent *Handbook* (Gould 1865). Ramsay (1878) was likewise unaware of any subsequent record, but later described specimens collected in 1886

by T. H. Bowyer-Bower from near Derby in the Kimberley that he believed to be the first obtained since Gould's holotype (Ramsay 1886).

A little later Sharpe (1890) listed six specimens in the British Museum collection, not including the holotype, which Gould (1865) had reported was stolen in 1846, though it was actually stolen in September 1845 (Chisholm 1942). One of Sharpe's specimens was said to have come from Champion Bay (Geraldton, WA) and the other five were reported from the "Interior of Northern Australia".

North (1896, 1898) showed that G. A. Keartland collected seven Painted Finches in central Australia with the Horn Expedition in 1894 and five at Joanna Spring, northern Great Sandy Desert with the Calvert Expedition in 1897. Campbell (1905) provided two records from north-western Queensland, the earlier around 1900. Mathews (1925-1927) provided reports from 1895 (Roebuck Bay, WA) and 1898 (Northwest Cape Peninsula, WA) and listed specimens from central Australia, the Pilbara and the Kimberley.

Since those observations it has been understood that the Painted Finch generally occupies rocky ranges, gorges and gullies of the inland and arid and semi-arid coasts of the north-west, chiefly north of 25° S (Higgins, Peter and Cowling 2006). However Sharpe was mistaken about the locality of four of the five specimens listed from the "interior of northern Australia". He recorded that they had been obtained from F. Gibson, one apparently directly and three acquired from

Gould's collection. We have recently learnt a little about F. Gibson and are able to correct Sharpe's error. If he had known the true locality of those specimens, he would have provided a very different and somewhat enigmatic view of the natural distribution of the species.

Gibson's observations of the Painted Finch

The identity of F. Gibson, as named by Sharpe, became evident to us from an entry included by Datta (1997) in her monograph on Gould's Australian labours. Amongst summarised letters and other documents were "Notes on *Emblema picta* [by] F. Gibson. Ediwoii [sic], South Australia 1869". This confirms that the collector was Frank (or Francis) Gibson, who worked at Edeowie and other localities in the Flinders Ranges in the 1860s and collected a number of significant bird specimens from there, probably including the holotype of the Chestnut-breasted Whiteface, *Aphelocephala pectoralis* (Black 2013).

A. Black recently examined Gibson's notes in the Natural History Museum Library in London ("Gould, J. MSS. Letters and drawings re: Australian mammals and birds") and these were copied and subsequently transcribed (see Appendix). Gibson's records of the Painted Finch are summarised below and will be discussed in the context of the species' Australian distribution and a review of South Australian records.

1. A pair of Painted Finches (identified in retrospect) was seen near a well at "Saltia Station" in the Pichi Richi Pass southern Flinders Ranges in May 1868. This was not the railway station but evidently the pastoral property of Charles Simmons, who had built a hotel nearby in 1849 and laid out the town of Saltia ($32^{\circ} 28.5' S$, $137^{\circ} 57' E$) in the Hundred of Woolundunga in 1861 (Manning 1986). Construction of the northern railway from Port Augusta began later, in 1878 (Mincham 1964).

2. A small flock was positively identified in the unnamed gorge in which the Willochra

Creek passes through the ranges near the former localities of Marachowie and Warrakimbo ($31^{\circ} 56' S$, $138^{\circ} 05' E$) in October 1868.

3. A flock of twelve, six pairs, was observed closely over seven days at a waterhole in Bunyeroo Gorge ($31^{\circ} 25' S$, $138^{\circ} 32' E$), about 8 km north-east of Edeowie in October 1869 and ten specimens were obtained.

An historical and distributional review of other records of the Painted Finch in South Australia

Condon (1968/9) accepted South Australian records only from the Musgrave Ranges, Lake Frome [sic] and Oodnadatta. The list of localities is now considerably expanded with more recent records and also with some overlooked by or not known to Condon. Pertinent locality records are:

20 July 1914 - S.A. White (1915) saw the species in the Musgrave Ranges and took a specimen at Tietkens Birthday Creek (SAMA B54892).

23 March 1925 - McGilp (1925) reported five Painted Finches in the verandah of the house at Poontana, his only record for the "Lake Frome District". Poontana no longer exists but it was presumably situated near Poontana Creek which is c 15 km NE of North Mulga Outstation, North Flinders Ranges at $30^{\circ} 18' S$, $139^{\circ} 51' E$.

30 November 1940 - W.B. Greenwood collected a Painted Finch (SAMA B22286) on Arkaroola Station ($30^{\circ} 20' S$, $139^{\circ} 20' E$). This specimen has been missing from the collection for a long time, hence Condon (1968/9) not including it among his accepted records.

February 1956 - W.H. Lennon of Oodnadatta captured a small bird, presumably in or near Oodnadatta, and sent it to the SA Museum for identification. Condon identified it as a Painted Finch, but unfortunately did not keep the specimen as it was too decomposed for skinning and he did not routinely keep such specimens for skeletons.

23 November 1963 - a single bird was seen in a rocky gully near Woomera (Bell 1976).

8 September 1965 – G.O. Furness saw two on a rocky hillside on Plumbago Station, Olary Range near the Mount Victor boundary (unpublished SAOA record, B. Blaylock pers. comm.).

April-May 1967 - A pair was reported by C.N. Austin from the Everard Ranges (Glover 1968).

2 October 1973 - Brian Crisp saw two birds with a nest and five eggs on Mount Ward, Arkaroola, North Flinders Ranges ($30^{\circ} 12' S, 139^{\circ} 23' E$) (SAOA Newsletter 69, p. 13). This is the first breeding record for South Australia.

16 November 1973 - A single egg was collected on Mount Ward by Ian May (SAMA B35964).

31 December 1974 -12 January 1975 - Joseph (1975) reported up to five in Corunna Gorge, Baxter Hills, east of the Gawler Ranges proper.

September 1980 – Close and Jaensch (1984) reported 8-11 birds observed on Mount Woodroffe, Musgrave Ranges, by members of their party. P. Horton's field notes record the date as 2 September.

13 March 1983 – R.E. Read saw six at Kalka, Tomkinson Range, 20 km south-east of Surveyor General's Corner (unpublished SAOA record, B. Blaylock pers. comm.).

July 1985 - R. Jaensch saw a single bird at a waterhole near Amata, Musgrave Ranges (Jaensch and Jaensch 1987).

10-14 December 1985 - Hornsby (1987) observed a pair building a nest in the base of a *Triodia* tussock at Brindana Gorge above Hamilton Creek, Mt Fitton Station, North Flinders Ranges ($29^{\circ} 58' S, 139^{\circ} 25' E$).

24 October 1989 - Dennis and Dennis (1995) observed a single male drinking from the Alligator

Creek, Mt Remarkable National Park ($32^{\circ} 49' S, 138^{\circ} 04' E$) and noted extensive seeding *Triodia* and *Stipa* grasses in woodland burnt in January 1988.

July, August and October 1989 – 1993, and December 1994 – Gee, Gee and Read (1996) found the Painted Finch to be resident and numerous on every visit to the Davenport Range ($28^{\circ} 22'-32' S, 135^{\circ} 58'-136^{\circ} 10' E$), west of Lake Eyre. They reported nesting sites on steep *Triodia*-covered rocky slopes in September 1993.

April 1993 - Reid (2000) saw two birds at the Clayton Bore drain, Birdsville Track this being the first record from the north-east of the State.

1994 – 2003 - Kovac and Niejalke (2004) reported observations at Hermit Hill artesian springs and nearby Finniss Creek ($29^{\circ} 34' S, 137^{\circ} 25' E$) in May 1994 and December 1997 and breeding in September 2000 and September 2003, having failed to see them on earlier regular trips during the 1980s and early 1990s.

Discussion of Gibson's observations and notes in the context of more recent records

Sharpe's (1890) misunderstanding over the locality of Gibson's records requires an explanation. It is evident that at least three of the Painted Finch specimens as well as the "Notes on *Emblema picta*" (hereafter The Notes) were sent to Gould, because they were received in the British Museum from him.

Historical documents in the South Australian Museum show that between 1865 and 1870 Gibson sent specimens of natural history to its Curator, Frederick George Waterhouse, from three or more localities in the Flinders Ranges, all designated "the Far North" in Waterhouse's records and reports (Black 2013, Horton, Black and Blaylock in prep.). The localities named in those documents, Woolundunga, Marachowie and Edeowie align closely with the sites of Gibson's three Painted Finch records, Saltia Station, the Willochra Creek gorge and Bunyeroo Gorge, showing that he was collecting in the general area on each occasion.

Waterhouse corresponded with Gould and used the term "Far North" in relation to material supplied by Gibson (Sutton 1929) and The Notes disclose that Gibson and Waterhouse were in close communication regarding the former's Painted Finch observations. Gibson wrote The Notes to redress a deficiency in Gould's publications and that of Mauder (1852), all of which recorded its occurrence only in north-western Australia, but they were not addressed to a particular person and it took two decades before they were directly cited by Sharpe (1890), who quoted Gibson's description of bill colour in the fresh specimen.

There is little doubt that Gibson sent both the specimens and The Notes to Waterhouse, who forwarded The Notes and some of the specimens to Gould. There is further evidence of the likely intermediary involvement of Waterhouse. Firstly, in the Museum Curator's report for October 1869, he reported that [the taxidermist] Mr Withers had mounted a specimen of "Painted Finch (*Emblema picta*) from the Far North". Secondly, in his list of bird species known to occur in South Australia and the Northern Territory (Waterhouse 1876), he included the Painted Finch for the former portion of the Colony but not for the latter. Gould would have known from earlier correspondence between the two what Waterhouse meant by "the Far North", but Sharpe would have assumed it referred to the north of Australia, whether he was aware that the Northern Territory was under South Australian jurisdiction at the time or not.

Gibson's records were only the second for the species and his specimens were the first following the theft of Gould's holotype. It is remarkable that they came from almost the southernmost limits of its distribution; indeed only the record of Dennis and Dennis (1995) is farther south in this State (by about 40 km) than Gibson's first sighting in Pichi Richi Pass (but see below for the most southerly report of all, from the Riverina, New South Wales). All three records preceded the next from the Flinders Ranges by nearly 60 years and most by over 100. His conclusions that the species

inhabited only the roughest mountain gorges and fed on the seeds of "Spinifex Sturtii" [= *Triodia* spp.] are generally supported by reports of the species although there are obvious exceptions, notably those of Kovac and Niejalke (2004) who found them in wetland vegetation associated with artesian springs in the absence of *Triodia*. Gibson also reasonably concluded that the species was rare ("scarce") and this is consistent with the years that passed before further sporadic reports emerged from the Flinders Ranges.

Throughout its continental range, the Painted Finch appears nowhere to be especially common, except perhaps in the Pilbara where breeding records are said to be widespread, though scattered elsewhere (Higgins, Peter and Cowling 2006). In South Australia reports have been relatively infrequent until recently, even from the far north-western ranges where the species is close to its centre of distribution. Only four records apart from Gibson's were documented in South Australia before 1960 and ten before 1980, but there have been nearly 100 in the last three decades (see discussion of its present status below).

Migratory or sedentary?

Gibson's final inference was that the species was migratory. Condon (1968/9), on the other hand, suggested that there were scattered resident populations in the Musgrave and Flinders Ranges; Joseph (1975) believed that long term studies would be needed to address that question. Higgins, Peter and Cowling (2006) found that movements of the Painted Finch were still poorly known, apparently largely sedentary, but "capable of wide dispersal and irruptive movements", with "scattered and irregular records in SA and WA, sometimes far outside usual range".

An irruption or rather an incursion was reported by Reid (1975) who observed between two and fifteen Painted Finches on four occasions between September 1973 and February 1974 near Menzies and Leonora in the north-eastern goldfields of Western Australia "south and west of the bird's

usual range" after widespread exceptional rainfall in the area. The scattered records in South Australia "outside usual range" included those in the Flinders and Gawler Ranges and near Woomera. More recently McAllan *et al.* (2010) reviewed records of the Painted Finch in New South Wales, only two accepted from the north-west of the State before an influx in 2007-2008, during which breeding was documented near Menindee and much farther south in the Riverina at 35° 09' S, 145° 46' E.

At issue therefore is the definition of usual range, which appears at least to include the Pilbara and northern Gascoyne Regions, north-eastern Great Sandy Desert and Kimberley in Western Australia, ranges in far western Queensland and those between 20° and 25° S in the Northern Territory, notably the MacDonnell Ranges, Uluru and Katajuta (Higgins, Peter and Cowling 2006).

Status of the Painted Finch in South Australia

We now consider the status of the species in South Australia on a regional basis and refer to records not already provided in the distributional review above, including the Birdlife Australia database (Andrew Silcocks pers. comm.) and the Atlas of Living Australia (ALA) website (www.ala.org.au accessed 23 July 2013).

In the far north-west, closest to the central Australian ranges, earlier observers found the Painted Finch to be rare or uncommon. White (1915) visited the Musgrave and Everard Ranges in drought conditions; he called it a very rare bird that he saw only once or twice in the deep gorges of the Musgrave Ranges. McGilp (1935) did not record it at all. Close and Jaensch (1984) and Jaensch and Jaensch (1987) each made only one observation and only the record from the Everard Range in 1967 and those from the Tomkinson Range in 1979 (Blakers, Davies and Reilly 1984) and 1983 (as above) were added before 1985.

The species has evidently become more common since the 1990s and particularly in the present century. Copley *et al.* (2003) recorded a total of

26 Painted Finches at 5 sites in the Musgrave, Everard and Mann Ranges during the biological survey of the region between 1994 and 2001, while David Hartland counted 30-50, 18, 14 and 100 on 4 occasions at Amata wastewater treatment plant from 16-24 February 2013 (ALA).

Between 2001 and 2013 John Read (pers. comm.) observed Painted Finches on 9 of 17 visits to Kalka and 6 of 22 visits to New Well in the Tomkinson and Musgrave Ranges respectively. He saw over 20 birds including fledglings at Ninuku Spring near Kalka in May 2011. This last record is the first documentation of breeding in the north-western ranges of South Australia.

Gee, Gee and Read (1996) reported what they considered to be the southern-most resident breeding population in the State in the Davenport Range, west of Lake Eyre. In fact, in the absence of continuous records in the far north-west, they were actually the first to document any resident population. Philip Gee (pers. comm.) has visited the Davenport Range in most years since and has confirmed their presence on each occasion.

To the south of Lake Eyre, Kovac and Niejalke (2004) inferred the recent establishment of a resident breeding population at Hermit Hill, birds first being observed in May 1994 and nesting recorded in September 2000 and September 2003. Bird observation in the area since then has been irregular and only one definite sighting has been reported (in 2008) and so its current status is uncertain (Kelli-Jo Kovac pers. comm.).

In the North Flinders Ranges, from where the majority of incidental observations have been reported, including breeding records, the species has not been shown to be a continuous resident in our view. In support of this we note that Hornsby (1997) recorded a pair of Painted Finches in only two months, December 1985 and May 1989, and considered it a rare visitor during more than a decade of observations at Brindana Gorge, Hamilton Creek in the period 1984-1994. Of interest, the species was recorded at the same

place in November 2001 (ALA) and P. Koch saw five birds there in May 2011 (SAOA Newsletter 219).

In July 1992, J. Ramsey observed 30 Painted Finches at Chambers Gorge, this being the first winter record for the Flinders Ranges (Carpenter *et al.* 2003). They were also recorded at Terrapinna Waterhole in June and July 2003 (ALA) and perhaps through the years 2006-2007 near Depot Creek, north-west of Quorn (a claim of up to 20 birds including juveniles; per P. Langdon, whose only personal observation in the Flinders Ranges, of 2 birds in Depot Creek, was on 9 January 1994).

All other records from the Flinders Ranges, including nine or more between 1982 and 2010 (Carpenter *et al.* 2003, Rogers 2008-2012, ALA), and from other southerly localities have been made between 25 September and the month of May. That pattern suggests that the Painted Finch is generally an irregular spring and summer visitor to latitudes south of 30° S, with breeding occurring opportunistically in favourable seasons and over-wintering the exception. While records from the Flinders Ranges have accumulated steadily since the 1970s it is uncertain whether the reporting rate has increased since the 1990s as it has further north. There were two reports from the Flinders during the conduct of the first national atlas (1977-1981) and only one in the second atlas (1998-2002); there have been another three in the "continuing atlas" since 2002 (Andrew Silcocks pers. comm.).

Recent records from other parts of the State include a sighting of three birds by R. Whatmough near Andamooka in September 1992 (Carpenter *et al.* 2003) and an observation north of Nilpena Homestead, east of Lake Torrens in August 2007 (ALA). A further seven reports have come from the north-west between The Painted Desert, Tallaringa Well and Algebuckina (Rogers 2008-2012, ALA). Twelve individuals were seen in April 2008 (E. Macilwain, ALA) and 11 in February 2010 (P. Barron and N. Doecke, Rogers 2008-2012) on Mount Ive Station, Gawler Ranges.

A number of reports have also come from the far north, north-east and Lake Eyre Basin, Witjira NP (two in June 1992, P. Copley), the Peake ruins (eight in November 1996, H. Owens), Cordillo Downs (May 2011), Muloorina (May 2009) and Kalamurina (October 2001) Stations and Montecollina Bore, Strzelecki Track (August 2000) (ALA). McAllan *et al.* (2010) included a nesting record from Cooper Creek SA on 9 April 2007, but this proved to be from outside the State: a pair at a nest in roadside litter (fallen branches) among low chenopods at the western margin of Cooper Creek channels, south of Ballera Gas Centre, south-west Queensland (Graham Turner and Matthew Stanton pers. comm.).

Records in north-western New South Wales (McAllan *et al.* 2010) were documented only in January 1977 and September 1992 before the reported influx in April 2007 and breeding near Menindee in September 2007, followed by the remarkable southern breeding observations in the Riverina between August and November 2008. That report is pertinent to this review in two respects. First, the authors suggested that there has been a southward and eastward extension of range of the Painted Finch in recent decades; second, they inferred that, as the Painted Finch "now regularly occurs" in South Australia from the Musgrave to the northern Flinders Range, the Flinders Ranges were the likely origin of birds observed in New South Wales.

To summarise our review of distributional records of the Painted Finch in South Australia, we find that it appears to be a breeding resident in the Musgrave and other north-western ranges and in the Davenport Range. These populations are likely to have been small until recently relative to that of the species as a whole, whose core distribution lies farther north. Farther south at Hermit Hill, while recent breeding has been recorded, its long term status is uncertain. In the Flinders Ranges the species appears to be an irregular visitor, chiefly from late spring to autumn, with sporadic breeding and occasional over-wintering.

Evidence presented here allows an inference that the species has become more prevalent in the far north-west and is expanding its range in the north, north-west and Lake Eyre Basin, perhaps in a sequence of vagrant movements, followed by the establishment of breeding resident populations, such as shown by Eckert (2006) to be the pattern of expansion of the Pied Butcherbird, *Cracticus nigrogularis*, in South Australia. Such a conclusion must be treated with some caution, since increasing reports in recent decades will be influenced by the greater scrutiny of arid zone fauna during this time, as a result of the State's biological survey program, the greater mobility of bird observers and ongoing professional appraisal of the environmental impacts of recent or proposed land use changes. Whether South Australian populations spilled over into New South Wales in 2007 or whether the irregular more southerly occurrences in South Australia and in New South Wales reflect periodic expansion of central Australian populations and subsequent dispersals remains a matter of conjecture.

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APPENDIX: NOTES BY F. GIBSON

Notes on *Emblema picta*

The first time that I saw this bird was in May 1868, the day following a very violent thunderstorm, when I saw a pair near a well at the Saltia Station (10 miles East of Port Augusta). I happened, unfortunately, to be without a gun with me that day and although I kept a close watch for several days after I never saw anything more of them so I concluded that they were driven out of their latitude by the storm.

I did not on this occasion recognize the birds as *Emblema picta*, as at the distance I was from them the entire of the head and neck appeared to be covered with brilliant scaly scarlet feathers, but thought they were some hitherto unknown species. I was much struck by their peculiar cry, totally unlike that of any other bird with which I am acquainted, & which is indescribable in words, the only English word which would convey any idea of it is 'jerking'.

In October 1868, as I was crossing Flinders' Range by the gorge thro' which the Willochra Creek runs [p. 2] and which is about 60 miles North of Port Augusta, my attention was attracted by hearing

the same cry and on looking in the direction from which it proceeded I saw a small flock of birds which allowed me to get sufficiently close to identify them as *Emblema picta* from the description of that bird in Mauder's "Treasury of Nat: His:" [Mauder 1852]. When I got within about 30 yards of them they all flew up to some pines growing about 80 yds up on the side of precipitous hills which line the gorge and altho' I waited for some time to have a closer look at them they did not come down. I was again on this occasion without a gun with me, but about six weeks afterwards (I was unable to go sooner) I went with a gun right thro' the same gorge stopping, during the heat of the day, at the place where I had seen the birds, but could not see one. I wrote to Mr Waterhouse of the Adelaide Museum announcing my having seen so rare a bird & stating that I believed it to be an inhabitant of the most rugged of our mountains gorges which has turned out to be correct.

[p. 3] In October 1869 I again saw a flock of twelve (six pairs) of this bird in the gorge thro' which the Bunyeroo Creek runs thro' the Flinders' range, which is about ninety miles North of Port

Augusta and after perseveringly watching the hole they watered at for seven days succeeded in shooting all the males and four of the females.

Mr Waterhouse kindly sent me a copy of the portion of "Gould's Manual" [Gould 1865] relating to this bird & as I see by it that the only specimen obtained when that was written was unaccompanied by any account of its habits, food &c I am happy to be able to supply those omissions.

Habits – Gregarious but not sociable as the individuals composing the flock feed & perch some distance apart. Excessively shy which is remarkable in a bird of this family (Fringillidae): they feed on the most inaccessible parts of the hills in the vicinity of their watering place & do not come often to the water – they utter the peculiar cry I have alluded to while flying & are very restless.

[p. 4] I carefully dissected all the specimens I shot to ascertain sex & food & in all found the food to be solely the seeds of "Spinifex Sturtii".

The plumage of the upper surface of the female is similar to the male that of the under surface black or brownish black thickly spotted with white or buffy white all over & having three or four of the central breast feathers tipped with red.
Irides – pale straw color.

Mr Gould, doubtless from having only a dried skin before him, has incorrectly described the tarsi & beak: all my specimens were thus colored –

Tarsi – dirty brown getting very light on the hinder side.

Beak – upper mandible, black tipped with scarlet – under mandible, scarlet with a triangular patch of livid blue (same shade as that on beak of Artamus melanops) at the base.

Females vary greatly in color, some being jet black spotted with white & others brownish black spotted with buff on the under surface.

F Gibson

Ediowie. S. A. 1869 (over)

[p. 5] I forgot to state, that the fact of my not seeing this bird on my second visit to the Willochra gorge (there being no ostensible cause for its departure) & that altho I took a flock of sheep to water in the Bunyeroo gorge from the latter end of August to the second week in October on every alternate day I did not see one till the latter period when they arrived as described, warrants me in pronouncing them, as inhabiting the roughest only of the mountain gorges, as being very migratory & very scarce.
FG

Breeding behaviour and prey of Black Falcons, *Falco subniger*, including food-caching

D. CHARLEY, H. LUTTER AND S.J.S. DEBUS

Abstract

The breeding behaviour and diet of a pair of Black Falcons, *Falco subniger*, and offspring were studied by 110 hours' observation from incubation to the end of the post-fledging period, and by analysis of pellets, on a wooded floodplain in northern coastal New South Wales in 2013. The sexes shared incubation and feeding of chicks, and delivery of food to the fledglings. Delivered prey was entirely birds in the nestling period ($n = 38$), and almost half mammals (41%) by number in the post-fledging period ($n = 34$; rats ~50% of prey biomass in that phase). The adults cached prey, mostly in tree hollows. Parental feeding rates were 0.7 prey item/h (~70 g of prey biomass/h) delivered in the nestling period, and 0.4 item/h (~80 g of prey biomass/h) in the post-fledging period (initially 0.5–0.6 item/h, declining to 0.2/h in the final weeks). Adult behaviour and vocalisations, and growth and development of nestlings and fledglings, are described. The nestling period lasted 42–43 days, and the post-fledging period lasted two months for two surviving juveniles (of four fledged); fledglings died during a storm and from vehicle strike. Supplementary observations of displays, vocalisations, hunting behaviour and prey are provided for a site in northern inland NSW.

INTRODUCTION

The Black Falcon, *Falco subniger*, remains poorly known, especially in one of its stronghold states, South Australia (e.g. Debus and Olsen 2011; Debus and Zuccon 2013). Previous attempts to document its life cycle in the sheep–wheat belt mainly covered the pre-laying phase and later

stages of the nestling period, less so the incubation phase, early nestling phase and post-fledging dependence period (Debus *et al.* 2005; Debus and Tsang 2011; Barnes and Debus 2012; Debus and Zuccon 2013). There are few details on aerial courtship manoeuvres between the sexes (e.g. Marchant and Higgins 1993; Whelan 2013a). Food-caching is well known and apparently universal in *Falco* (Cade 1982; Anderson and Squires 1997). Among Australian species, caching has been studied in the Peregrine Falcon, *F. peregrinus* (Sherrod 1983; Cameron and Olsen 1993; Turner, Lawrence and Czechura 1993) and Brown Falcon, *F. berigora* (McDonald 2004), and briefly mentioned for a pair of wintering Black Falcons (Olsen 1994).

Here we describe a breeding event of the Black Falcon in New South Wales (NSW), discovered late in the incubation phase, including novel observations on male incubation, prey, food-caching, and a long post-fledging dependence period. We also describe little-reported aspects of the falcon's pre-breeding and defensive behaviour, vocalisations and hunting behaviour. Now that the Black Falcon is declining in the Murray–Darling Basin, and is state-listed as Vulnerable in Victoria and NSW, comprehensive ecological information is needed in order to manage its habitat requirements, threats and prey base in the agricultural zone (e.g. Debus and Zuccon 2013).

STUDY AREAS

The active nest studied by DC and HL in northern coastal NSW in 2013 was located ~15 km south of

Lismore ($28^{\circ}49' S$, $153^{\circ}16' E$), on the subtropical lower Richmond River floodplain. The habitat was remnant Forest Red Gum, *Eucalyptus tereticornis*, woodland amid agricultural and pastoral (cattle-grazing) fields, with the river and lagoons nearby, sugarcane fields within 1 km, several farm building complexes within 2 km, and a sealed road within 80 m of the nest.

Observations by SD on Black Falcons in northern inland NSW in autumn to spring 2013 were conducted near Tamworth ($31^{\circ}05' S$, $150^{\circ}55' E$) in the sheep-wheat belt. Habitat and other context details are provided elsewhere (Debus *et al.* 2005; Debus and Tsang 2011; Debus and Zuccon 2013). However, a hailstorm in autumn 2013 destroyed a focal pair's previous nests of 2010 and 2011–12 and some other corvid-type stick nests in the wider area (including one reportedly used in previous years by unidentified falcons), and no active Black Falcon nest was located in the vicinity of three former territories and nests.

METHODS

At Lismore, the nest was watched from late in the incubation period (22 July, 10 days before hatching) until the end of the post-fledging period (8 November), in timed observation sessions from an unconcealed position outside the falcons' alert distance (~110 m from the nest). The nest was watched opportunistically at various times of day, for 1–5 hours per day, using binoculars, telescope and digital camera. In the incubation period, the nest was watched for 30 minutes over the midday period (1200–1250 h) on two days. In the nestling period, the nest was watched for one hour on one day early in week 1 (day 2, afternoon), 2.7 hours on one day in week 3 (day 19, midday), and 38.3 hours over 12 days in weeks 4–6 (four afternoons and one morning in weeks 4–5), mostly in week 6 (25.5 hours over seven days; mornings and afternoons). In the post-fledging period, the nest area was watched for ~68 hours on 31 days over eight weeks: intensively in weeks 1–4 (8–16 h/week over 4–6 days/week), less so in weeks 5–8 (2.5–8 h/week over 2–3 days/week). Watches were spread

throughout the day in weeks 1–4, but concentrated on late afternoon to dusk in weeks 5–8, as that was the best time to await the juveniles' arrival. From late in week 3, watches included reconnaissance of the wider area to locate the juveniles, and the nest site was checked a final time for an hour at sunset in week 9 (day 57). The adult falcons and fully grown juveniles were sexed by the females' relatively larger size in this sexually size-dimorphic species (e.g. Debus *et al.* 2005; Debus and Olsen 2011; Debus and Tsang 2011).

Pellets and prey remains (orts) collected under the nest and nearby feeding perch in the post-fledging period (week 1: two pellets; week 7: 10 pellets + ~14 g of broken pellets and three orts) were analysed by SD, using a microscope and reference material from the Zoology Museum, University of England. The calculated minimum number of prey individuals took into account items observed delivered or cached, those additionally found only as orts, and those in pellets only where they added species to the other two categories. Parental delivery rates of prey biomass were estimated from applicable prey weights in raptor dietary studies cited by Marchant and Higgins (1993) or Debus (2012a) and, for comparison, recalculated from prey data in Debus *et al.* (2005) and supporting field notes.

At Tamworth, the search timetable and protocol followed that of Debus and Zuccon (2013). Observations on Black Falcon pairs or individuals encountered were conducted using binoculars or telescope from outside their alert distance, for as long as the bird(s) could be kept in view.

RESULTS

Aerial displays

At Tamworth in mid-May a pair of falcons soared together, high over the woodland patch that contained an active Black Falcon nest in previous years. The male briefly stooped with several rapid wing-beats obliquely away from the female (i.e. descending to the side), then rose and made a series of gentle mock stoops or passes over her; she

responded with slight evasive action and lowered feet, then both briefly circled in tandem, the male just above and behind the female. A. Zucco (pers. comm.) reported that elsewhere in late April 2013 a pair soared high over a previous (2012) nest site, and in similar 'play dives' the male stooped at the female which rolled in response.

Territorial defence

In a probable territorial action at Tamworth in mid-September 2013, a female falcon in flight was approached by a male, which stooped at her; she rolled and thrust her feet upwards, then continued her path on a long, low glide to the horizon while the male soared away in the opposite direction (whence he had come).

Near Lismore, during the nestling period, both adults chased a third Black Falcon (male by relative size) past the nest tree, initially from 400–600 m away. One grappled with the intruder, talons locked, and both spiralled to within 10 m of the ground before they separated and resumed the chase, the male continuing to swoop at the intruder, before the pair returned to the nest tree. A second pair of Black Falcons was known to have a territory 5–6 km away for the previous ~5 years.

Interspecific interactions

Near Tamworth, single Black Falcons occasionally swooped at or briefly chased a perched Brown Falcon or flying Australian Raven, *Corvus coronoides* (once each), without displacing or visibly distressing the target, but were more frequently harassed by a Brown Falcon (twice) or raven(s) (four times). Perched Black Falcons seemed distressed by an attacking raven (once in apparent attempted robbery as the falcon ate prey), but in flight a Black Falcon easily evaded two mobbing ravens. A perched Black Falcon eating prey was flushed by a Brown Falcon that briefly continued to swoop, but the Black Falcon retained the prey.

Near Lismore, during the incubation phase, the adult Black Falcons (female on nest, male in nest tree) did not visibly react to an Australian Hobby,

Falco longipennis, flying past the tree. During the second half of the nestling phase, the adult falcons (when present in the nest area) usually showed no visible reaction to Torresian Crows, *Corvus orru*, or small to medium-sized raptors flying past or over the nest tree (Pacific Baza, *Aviceda subcristata*; Nankeen Kestrels, *Falco cenchroides*; Australian Hobby), or circling in the general area (Black Kites, *Milvus migrans*). However, the female, after caching prey in a tree, once repeatedly swooped a crow on the nearby road until it left. The female also vigorously climbed, pursued and swooped a high-soaring Wedge-tailed Eagle, *Aquila audax*, >200 m from the nest, and juvenile White-bellied Sea-Eagle, *Haliaeetus leucogaster*, 300 m from the nest, cackling as she did so (and causing the latter eagle to roll and parry with its feet). She also remained perched but cackled and watched, as an adult sea-eagle flew directly high over the nest. Otherwise, from week 5 (day 33) onwards, a Square-tailed Kite, *Lophoictinia isura*, flying over the nest tree, Black Kites and a Whistling Kite, *Haliastur sphenurus*, foraging within 400 m, a Collared Sparrowhawk, *Accipiter cirrocephalus*, soaring 300 m away, two kestrels pausing on the top of the nest tree, and crows inspecting the nest tree, did not cause the absent (and possibly unaware) adults to return and defend the nest and large nestlings.

In the post-fledging period (week 1, day 3), both adult falcons flew ~1 km to swoop a Wedge-tailed Eagle and drive it into a low tree, where it sheltered against the trunk under the canopy. The male continued to dive at the eagle, while the female returned to the top of the nest tree. Later (week 3, day 15), one adult chased a Wedge-tailed Eagle at 300 m from the nest, then both attacked three soaring eagles, calling as they did so, and causing the eagles to dodge or roll as they were driven from the area. In week 3 (day 18) one adult falcon also chased a crow near the falcons' ground cache.

On 28 October a pair of Brown Falcons had a nest with chicks ~two weeks old (i.e. hatched in mid-October) ~400 m from the Black Falcons' nest

(K. Fisher pers. comm.). Allowing five weeks' incubation (Marchant and Higgins 1993), the former's eggs were laid in early September, just before the young Black Falcons fledged (see below), although no conflict between the two falcon species was observed.

Vocalisations

At Tamworth in mid-July, as a male falcon arrived with a full crop (but no prey) on a dead tree next to the female, he gave a soft chittering trill, barely audible from ~50 m: three trill phrases of three pulses each, one phrase per second. The call was more musical ('chirruping') than the rattle of a Brown Falcon or the guttural rattle (though identical rhythm) of a displaying male Black Falcon (see Debus *et al.* 2005). A perched female Black Falcon startled by an attacking raven gave a brief cackle, deeper than that of a Peregrine Falcon.

At Lismore, the breeding pair gave a variety of calls in various contexts, the calls here categorised according to standard terminology (e.g. Carlier 1995; Leonardi *et al.* 2013):

1. a typical falcon cackle, soft or guttural/grating ('ka-ka...' or 'chuck-chuck...') to very loud and 'churring' according to the level of agitation, e.g. when pursuing an eagle. Usually heard from the female, occasionally from the male, typically around the nest when either arrived (sometimes together) with or without prey, or when the female appeared to be inciting the male to hunt or transfer prey. A repeated 'chuckling' call from the male as he arrived with prey may have been a faster, 'rattle' version (see Debus *et al.* 2005). Single 'chuck' notes were occasionally given by either sex, and a 'yuck' call by the female in apparent alarm before she left to attack an eagle.
2. a wailing call (noted as 'mewing'), given by the female to the male as a food-begging call in the nestling period. Also given by the male when flying around the nest tree during the incubation period (just before he retrieved food from a cache after the female had relieved him), and during

the nestling period as the female fed the chicks on prey collected from him.

3. a 'chip-chip' or 'chick-chick' call, usually given by the male (e.g. to the incubating female after she relieved him), or once during a pause as he fed the large nestlings, but also between the adults when perched in the nest tree during the nestling period, and by the perched female as the male arrived at the roost during the post-fledging period. The female gave a 'cluck-cluck' version, amid bouts of cackling calls, when departing to pursue an eagle; a 'yak-yak' version and cackling when arriving in the nest tree; and a loud, double 'yuk-yuk' or 'chuck-chuck' when perched there, surrounded by begging fledglings. Both also gave 'yuck-yuck' calls when attacking a Wedge-tailed Eagle. At least some of these (specifically noted as double calls, above) were probably the disyllabic 'creaking call' or 'ee-chip' typical of large falcons (see Cade 1982), and known for the Black Falcon (e.g. Debus and Tsang 2011). Observations on Black Falcons elsewhere agree, e.g. noisy around the nest with deep cackles at avian intruders, other chuckles (J. Olsen pers. comm.).

Nest site and breeding chronology

The nest near Lismore appeared to be the old stick nest of Torresian Crows in a large, dead-topped old-growth Forest Red Gum in woodland of this species in a cattle paddock, on an open floodplain. From a fledging date of 13 September, an estimated hatching date of 1 August (see below) and allowing five weeks for incubation (Marchant and Higgins 1993), egg-laying occurred in late June (i.e. ~six weeks ahead of the neighbouring Brown Falcons).

Incubation

On 22 July, between 1200 and 1230 h, the female was incubating for 20 minutes while the male perched high in the nest tree, on a dead limb, until the female left the nest and flew out of sight, whereupon the male went to the nest and settled to incubate (shuffling down on eggs) for the remaining 10 minutes of observation. On 31 July, between 1220 and 1250 h, there were two

changeovers of incubation. Initially, the male was incubating for the first nine minutes, arising as the female arrived, and they both landed in the nest tree together for a noisy greeting. The female then incubated for 17 minutes (interrupted once by returning to her original perch for one minute), while the male retrieved and prepared prey from a food cache. He took prey to the nest, then resumed incubation for the remainder (three minutes) while the female perched beside the nest and ate the prey.

Nestling period

The presence of hatchlings on 2 August was indicated by the female's posture as she settled down onto chicks, sitting high or tall in the nest bowl, with much shuffling. Thus, hatching probably occurred on 1 August (half the interval since the previous observation day, i.e. 31 July, when incubation was still in progress).

Parental behaviour

On one day early in week 1 (2 August, day 2), during an hour in early afternoon (1435–1535 h), the female fed the chicks for 27 minutes, perched at a food cache (feeding) for 5 minutes, was

absent collecting prey from the male (which accompanied her back to the tree) for four minutes, and otherwise brooded for the balance (24 minutes). The male was absent for 24 minutes, perched in the tree (including at the cache) for 23 minutes, and at the nest for 13 minutes (12 minutes while the female fed the chicks, one minute while she was at the cache). The nest was unattended for five minutes. While the female was feeding at the cache, the male waited there and when she had finished eating, she gave him the remains. There were three chicks, white downy heads just visible, and able to hold their heads up fairly well (i.e. probably hatched on the previous day); the female fed them small pieces of meat. A fourth chick hatched, probably later that day or on the next, but was not discerned until later (next visit, day 19). We could not determine whether the male brooded.

On one day late in week 3 (day 19), in 2.2 hours over midday (1055–1305 h), the female fed the chicks for two minutes, stood on the nest for five minutes and perched in the nest tree for three minutes, but did not brood; she was absent for the balance (2 h, 92%), though she was in the wider

Table 1. Parental time-budgets of a pair of Black Falcons near Lismore, NSW, in the nestling period, August–September 2013: % observation time (total 38.3 h) spent in each activity.
Stand = adult stand on or beside nest; in tree = perched in nest tree; absent = away from nest tree; unattended = neither adult at nest. Numbers in parentheses = n hrs observation in each week.
Week 1 = first week after hatching (see text for details of weeks 1 and 3).

Sex/activity	Week		
	4 (6.3)	5 (6.5)	6 (25.5)
Female			
Stand	1	3	1
Feed chick	1	1	5
In tree	32	4	29
Absent	66	92	65
Male			
Stand	0	1	0
Feed chick	7	1	0
In tree	18	23	9
Absent	75	75	91
Unattended	87	60	90
Both at nest	<1	0	0

Table 2. Growth and development of nestling Black Falcons near Lismore, NSW, August–September 2013.

Week	Day	Comments
1	2	Small, white, downy.
3	19	Large, downy (body, wings and head); primary pinfeathers emerged. Chicks filled nest bowl; appeared almost as large as adult male in body size. Standing, being fed in turn.
4	23	Large, downy; primaries lengthening (~10 cm), scapulars emerged. Active, moved around nest. One fed on prey.
	28	Feathers emerging on crown, body and wing coverts (patchy on back, dark collar); primaries and secondaries well developed. Active, ate food scraps. Flapped and stretched wings.
5	30	Face much darker, back mostly feathered, tail ~½ adult length. Milled and pulled at freshly delivered prey; no aggression.
	31	Well feathered on body, back, wings and thighs.
	33	Well feathered, though downy patches on body (crown, chest, sides and vent) and wings, much down under wings. Chicks fed by parent in turn, though one (downiest) missed out.
6	36	Well feathered, little down remaining on body (small patches on neck, flanks and belly); wings appeared nearly full size. Some had more down than others (neck, upper chest and rump); one almost had white collar remaining. One chick walked 0.3 m along nest branch, returned to nest within one minute. Fed on prey dropped in nest, but no fighting.
	37	Little down (armpit, flanks, sides, legs); appeared as large as adult female in body size. Flapped strongly, lifting body off nest, retained grip with feet. Fought over prey, one or two dominant, other submissive (head-low bow).
	38	Fully feathered, almost no down; exercised vigorously. Three fought over prey, one passive. One 'branched' on nest limb for two minutes. Fledging appeared imminent.
	39	One 'branched' repeatedly in and out of nest to 1 m along nest limb. Aggressively crowded and pushed female at feeding time.
	40	Little down remaining (armpit and flanks). Two 'branched', 0.5 and 3 m along nest limb, flapping, then one 5 m from nest. Then hopped/flapped up vertical branch above nest, flapping but wobbly, returned unsteadily. One tore into whole small prey (duckling) in nest; one took prey from other. Gave adult-like 'chip' call and cackle when Australian Hobby circled over nest tree.
	41	'Branching'; one jumped to perch 0.5 m above nest. One chick appeared larger than others, one submissive (hunched) towards others. Took food from one another, one chick mantled over food.
	42	Aggressive towards female with food, trying to seize it with feet. Two 'branched' above nest.
7	43	Three fledged (fourth fledged two days later); see text.

nest area for almost half of this (52 min., 40%). The male fed the chicks for 18 minutes, perched in the nest tree for 58 minutes (45%, mostly in the female's absence), and was absent for the balance (54 minutes, 42%), though in the wider nest area for most of this (39 minutes, 30%). The nest was unattended for 103 minutes (79%), in periods of up to 42–57 minutes, although either adult was perched elsewhere in the nest tree for about half this time.

By weeks 4–6, the parents only visited the nest to drop prey and feed the chicks, and otherwise perched in the nest tree or were absent (Table 1), although 'absent' included either adult present in the wider nest area, or flying or soaring within view of the nest. The nest was unattended for periods of 8–111 minutes (mean 47 minutes) in week 4, 3–64 minutes (mean 52 minutes) in week 5, and 10–170 minutes (mean 83 minutes) in week 6. In week 5, the male's presence in the nest

tree compensated to some extent for the female's extended absence. The male was not seen to feed the chicks bill to bill after week 5 (day 33), but the female sometimes did so until they fledged. Despite the skew in the observation schedule (see Methods and Table 1), there was a trend of decreasing parental nest attendance (brooding, feeding chicks, perching at the nest or in the nest tree) with chick age. The male was once seen drinking from a pool of water on the road, before arriving to roost.

Development of young

The nestlings' stages of physical and behavioural maturation are shown in Table 2. At fledging, the juveniles were much darker (being a uniform dark chocolate-brown) than the adults in worn brown plumage, and had buff-edged feathers and a pale-tipped tail; their 'stepped' tails (short outermost rectrices) were evident. They also had a brown cere and blue-grey orbital skin (Figure 1).



Figure 1. Juvenile Black Falcon on fledging day (13/9/13)

Photo: David Charley

Three young fledged on 13 September, giving an estimated nestling period of 42–43 days per chick if (as inferred) hatching occurred on 1–2 August, and the last chick fledged two days later on 15 September. On the morning of the fledging day, three juveniles jumped and fluttered to different branches in the nest tree, then two flew to a tree 40 m away while the third flew to the opposite side of the nest tree. Two (one from the nearby tree) then returned to the nest to be fed. The fourth (youngest) juvenile's first flight was a clumsy, sprawled landing on the outer foliage of a tree where it remained for at least 22 minutes, but all four then returned to the nest.

Post-fledging period

Parental behaviour

Owing to the unbalanced watch schedule (biased towards weeks 1–4) and the skew in watch times (biased towards late afternoon/evening in weeks 5–8), there is no discernible pattern to adult nest-tree attendance, other than the female was present more than the male (Table 3). There were four fledglings in week 1 but only two thereafter (see below), thus changing the brood's total food demands and possibly the parents' hunting effort and nest-area attendance. On one morning, local

residents observed both adult falcons on the road, possibly drinking from roadside pools.

In week 1, the adults gave prey to the juvenile(s) at the nest (male parent, on day 3 before the last juvenile had fledged); to a juvenile on a branch of the nest tree (female parent twice, male once) or a dead tree 50 m away (female once, male twice); or the female fed a juvenile piecemeal on a branch of the nest tree (twice). In week 2, the adults initially behaved similarly, giving prey to a juvenile on a branch of the nest tree (female parent twice, male once), or on a fence post (unsexed adult once).

On day 13, an adult brought prey to the nest area and surrendered it to a juvenile after an aerial chase, and the female brought prey to the nest area and, after the juveniles chased her around the nest tree, she fed them piecemeal on the tree. During a tussle for the prey, it was dropped but the female retrieved it from the ground. Early in week 3 the pattern continued, with either parent giving prey to a juvenile on the nest tree, the dead tree, or feeding a juvenile piecemeal on the nest tree (female parent) or dead tree (male parent). From late in week 4, food passes to the juveniles were aerial.

Table 3. Parental time-budgets of a pair of Black Falcons near Lismore, NSW, in the post-fledging period, September–November 2013: % observation time (total 68.4 h) spent in each activity.

In tree = perched in nest tree (includes roosting at sunset/dusk); feed young = feed fledgling(s) bill to bill; absent = away from nest tree. Numbers in parentheses = n hrs observation in each week.
Week 1 = first week after fledging (see text for details of week 9); from week 5, watch schedule skewed towards last hour(s) to sunset/dusk roosting time.

Sex/activity	week							
	1 (15.8)	2 (10.3)	3 (13.7)	4 (8.3)	5 (8)	6 (2.6)	7 (5.6)	8 (4.1)
Female								
In tree	35	11	34	16	34	30	11	54
Feed young	5	3	<1	0	0	0	0	0
Absent	60	86	66	84	66	70	89	46
Male								
In tree	8	0	22	4	50	14	8	9
Feed young	0	0	<1	0	0	0	0	0
Absent	92	100	78	96	50	86	91	91

Until the end of observations (week 9, day 57), the adult(s) attended the nest tree and roosted there. The adults were often absent through the day (mornings to late afternoons) as the post-fledging period progressed. From week 1, the female's absences were commonly 30–90 minutes (once the entire watch, i.e. >2.5 h), progressing to frequently absent all watch, other than towards dusk (up to >2 h in week 2, >2.5 h in weeks 3 and 4, and >3 h in week 5).

Development of young

One of the juveniles (the weakest, possibly last fledged) had disappeared, presumed dead, on the morning of day 5 following a severe electrical storm with strong winds and heavy rain overnight, and rain on day 4. It could not be found during a search of the trees and paddock around the nest tree. Another (fledged on day 1) was found freshly road-killed late on day 7, 110 m from the nest (see below). Thereafter, only two of the four (a male and female) survived until independence. At 8–10 days out of the nest, one of these survivors still had incompletely emerged primaries and rectrices (Figure 2).

Behavioural development of the juveniles is shown in Table 4. They rapidly progressed to fast, agile chasing and aerial play-fighting within their first week, although until week 2 (day 10) such flights typically lasted only 1–2 minutes. One possibly made a tentative chase of Scaly-breasted Lorikeets, *Trichoglossus chlorolepidotus*, on day 3. Late in week 1, when chasing each other, one juvenile carried a food scrap from the nest, picked at it in flight then dropped it as the other followed. One juvenile flew low over the road near passing cars, and in week 2 one narrowly avoided a collision by rising over a passing car. The juveniles ranged 600 m from the nest by the end of week 1 to 800 m late in week 2, but were still found within 2 km of the nest towards the end of the study (week 8). From week 3 (day 21), the family group appeared to disperse during the day and became increasingly difficult to locate, although the juveniles still associated and interacted until week 7 (day 46).



Figure 2. Juvenile Black Falcon 8–10 days after fledging (note short wings and tail)

Photo: David Charley

In week 1 (until day 3, after the fourth had fledged) the juveniles returned to the nest to feed or beg to the adults. Late in week 4 (day 28) a juvenile chased the food-bearing male and rolled to take the prey aerially from his foot. Late in week 7, during an aerial food pass, the prey was dropped in the tussle, but the juvenile dived and caught it in the air. Early in week 4 and again late in week 5, the female and an unsexed adult brought prey to the nest tree, but no juvenile collected it. However, parental food provision continued until at least week 7 (day 48), and the juveniles directed food-begging calls at the adults until at least week 8 (day 52). They appeared to practise hunting behaviour from day 20, harassed large birds from week 4, and accompanied the hunting adult(s) on forays from week 6 (day 37) (Table 4). One juvenile had a full crop when it arrived at the roost in week 8 (day 52), begging to the female parent, but it is not known whether it had caught prey or obtained it from an adult. The juveniles were thus fully dependent until week 3 or 4, and partly dependent until at least week 8.

Except for day 30 when only one juvenile roosted at the nest with the adults, and day 33 when no falcons roosted in the nest tree, the juveniles roosted on or beside the nest with the adult(s) until week 7 (day 43). Thereafter, in week 8, on day 50 one falcon (apparently a juvenile) roosted alone at the nest; on day 52 a single juvenile (female) roosted beside the nest with the adult female; and

Table 4. Development of fledgling Black Falcons near Lismore, NSW, September–November 2013.

Week	Day	Comments
1	1	Three fledged; two flew competently in circuitous flight to 40 m from nest, but landings clumsy (stumbling). Exercised wings (flapping) when perched. Fed competently on prey in nest or on branches.
	2	Two ranged 150 m from nest, chasing each other. Competent landing (swoop and upward stall to perch).
	3	Two allopreened; one young followed adult female ~250 m. Young aggressive to female with food. Fourth young fledged.
	5	One juvenile missing after overnight storm. Others (1 m, 2 f) active, chased one another in low (<2 m above ground), fast, agile flight with twists and turns. One soared, one practised low swoops over grassy paddock. Adult-like cackle calls when not begging.
	7	One juvenile (f) found road-killed; brood now two, becoming aggressive to each other over food (mantling, gaping, pecking, bill-jousting, upright stance when sparring). Still exercised wings on perches; one ranged 600 m over paddocks.
2	8	Fed themselves on carcass at cache. Adult-like creaking and cackle calls when chasing.
	10	Both circled over paddocks to 300 m from nest.
	11	Avoided attacking Nankeen Kestrel by roll and half-roll in flight.
	12	One followed female 800 m on hunting flight.
	13	One chased food-bearing male and took prey from him. Juveniles then tussled over prey at perch.
3	17	Both sat on gravel road; chased low (<1.5 m) above ground, flew across main road out of sight.
	18	Juveniles initially not located within 600+ m of nest. Both tussled at evening roost by lunging and flapping.
	20	Both sunned on dead tree 500 m from nest. Swooping and fast direct flight low over grass, possibly hunting. One flew 1 m above grass then pounced in grass; other followed Magpie-lark briefly.
	21	One flew through trees as if hunting, fast and direct with occasional glides. Roosting juveniles begged when female arrived.
4	22	Juveniles not located during morning; female brought prey to nest tree but not collected by young.
	23	One chased Straw-necked Ibis, <i>Threskiornis spinicollis</i> , briefly. Still begged to adult(s).
	28	Aerial food pass by male to pursuing juvenile in low chase, juvenile rolled to take prey from male's feet.
5	30	Only one juvenile roosted beside nest with adults.
	33	In evening, adult (male?) brought and ate prey at nest tree, young did not collect prey or arrive to roost with adults.
6	37	Both followed hunting adult, harassing ibis, corellas, Galahs, crows gathering to roost.
	40	Juveniles flew low (<2 m) over grass, swooped and dived over lagoon and paddocks (possibly hunting practice). Joined adult to harass crows and Little Corellas going to roost, chasing and flying at roosting birds.
7	46	Four falcons (pair and two juveniles) hunted together over lagoons, circling slowly and sideslipping (i.e. maintaining height), searching along the reeds (K. Fisher pers. comm.).
	48	Aerial food passes by adult(s): (i) prey dropped, but juvenile caught it in air after 5 m dive; (ii) juveniles competed to roll and take prey from male's foot.

on day 53 three falcons (i.e. at least one juvenile) were present, but only one (unknown age/sex) roosted in the nest tree. The juveniles were not seen during an hour in week 9 (day 57), when one adult brought prey to the nest tree at sunset, ate the food and roosted there alone.

Hunting and prey

Tamworth

Hunting episodes and prey items are summarised in Table 5 (which gives scientific names). In the case of apparently co-operative hunts by members of a pair (or attempts to initiate such):

1. Two falcons were perched on a dead tree; the female, closely followed by the male, left together on a tandem, fast, contour-hugging flight.
2. The pair of falcons was perched in the same dead tree, the male resting with a full crop. The female twice in five minutes appeared to try to initiate a tandem hunt, by making a flight-intention movement (slowly opening her wings) and leaving, then (i) swinging back around the closest tree and returning to her perch beside the male, and (ii) pausing on a paddock tree ~300 m away and looking back at the male, before departing alone.

In the lizard episode (Table 5), a soaring falcon made a long, shallow dive from 50 m in the air and 100 m away to snatch the lizard from open ground beside a paddock fenceline, without landing. The falcon tried to land on a dead tree, but was displaced by an Australian Raven; the falcon ate the prey in soaring flight. From local habitat and survey data (SD), and its size in the falcon's foot, the lizard was probably a Boulenger's Skink, *Morethia boulengeri*.

In the co-operative hunt of Musk Lorikeets (Table 5), one falcon waited in the air above, ready to stoop, while the other flew through the trees, flushing the parrots (A. Ashworth pers. comm.). In the starling episode (Table 5), a falcon was hunting a low swirling flock over an open paddock. The falcon made a shallow power-stoop at the tight flock, then a series of direct flying attacks that became shallow stoops at single

starlings that broke away. The targeted starling either dodged the strike at the last moment, or suddenly closed its wings and dropped vertically 2–3 m into the grass as the falcon closed horizontally with it, thus avoiding capture. (See also Ross and Olsen 1988.)

Lismore

Hunting episodes and prey items are summarised in Table 5. The adult female falcon appeared to initiate at least three of seven low, fast tandem hunts: once departing first, closely followed by the male; once together after she wailed and cackled at him; and once when she left alone towards a known prey source (farm buildings), then he followed. She twice also went to join him as he was hunting or circling alone within sight of the nest, in what became a tandem hunt. Some of these co-operative hunts went for at least 700 m, and one resulted in a capture: the pair arrived at a canefield being harvested and alternately stooped repeatedly at an item on the ground, until the male caught a quail and took it to the nest.

The advanced juveniles joined an adult in harassment of roosting birds, and in quartering the margin of a lagoon (Table 4; scientific names of prey in Table 6). On another such occasion, just before sunset, two falcons (at least one adult) came out of the sun through a melee of corellas and other birds, outcome unseen (K. Fisher pers. comm.; Figure 3).



Figure 3. Parent Black Falcon in heavy moult, post-fledging period, week 7 (28/10/13)

Photo: Keith D. Fisher

The adult falcons' hunting areas included farm buildings <2 km from the nest and several lagoons, the closest of which was <250 m from the nest. Hunting flights occurred at all times of day, from early morning (e.g. when fog lifted) until the last hour of daylight. The male also

repeatedly hawked small bats (Microchiroptera, unsuccessfully) in four short sallies over 10 minutes around his roost tree on one evening at dusk (~30 min. after sunset). The female flew easily and strongly while carrying a seemingly large (partly eaten) Cattle Egret, although at

Table 5. Observed hunting episodes of adult Black Falcons at Tamworth (May–October) and Lismore (nestling and post-fledging periods, August–November), NSW, 2013.

Tandem = male and female of pair co-operating (alternating stoops or direct flying attacks). M = male, F = female. For juveniles associating with hunting parents, see Table 4.

Search method	Attack type	Target	Outcome
<i>Tamworth</i>			
? (pair)	Tandem	Galahs, <i>Eolophus roseicapillus</i> in paddock tree crown	Fail
M perch-hunt	Stoop to flush prey off ground	Australian Magpie, <i>Gymnorhina tibicen</i>	Fail
Pair perch-hunt	Tandem	Bird sp. in paddock tree crown	Fail
Pair soaring	M opportunistic tail-chase	Passing Feral Pigeon, <i>Columba livia</i>	Fail
Pair fast contour-hugging flight	Tandem?	—	—
F fast contour	—	—	—
High quartering	?	Budgerigar, <i>Melopsittacus undulatus</i>	Success
Quartering	Shallow dive to ground	Small lizard sp. (skink?)	Success
? (pair)	Tandem	Musk Lorikeets, <i>Glossopsitta concinna</i> , in woodland canopy (A. Ashworth pers. comm.)	Fail
?	Direct flying attacks/ stoops	Swirling flock of Common Starlings, <i>Sturnus vulgaris</i>	Fail
?	Tail-chase	Flock of Budgerigars (M. Eden pers. comm.)	?
M quartering	Stoop ×5	Grasshoppers (Orthoptera) flushed by tractor mower	Success ×3, fail ×2
High transect	Stoop	Bird sp.?	Fail
<i>Lismore</i>			
Fast contour ×11 (M ×8, F ×2)	M: (i) flush prey from tree canopy; (ii) tail-chase (other attacks unseen)	M: (i) roosting Galahs and Little Corellas, <i>Cacatua sanguinea</i> ; (ii) flying Grey Teal, <i>Anas gracilis</i>	M: fail / fail
Pair fast contour ×7	Tandem ×1 (other attacks unobserved)	Brown Quail, <i>Coturnix ypsilophora</i>	Success
M quartering	Dive to ground	?	Fail
F low quartering	—	—	—
F perch-hunt	Flew 250 m, dropped to ground	?	Fail
M perch-hunt	Short sally-strike ×4	Bats (Microchiroptera) at dusk	Fail ×4

~350 g it was ~40% of her body weight (female Black Falcons average 833 g: Debus and Olsen 2011).

Diet

The Lismore pair's observed breeding diet (prey deliveries, and other items visible in the nest and caches or found as orts, n = 72 identified) consisted entirely of birds during the incubation and nestling periods, and almost half mammals (41%, rats 38%) by number during the post-fledging period, or 81% birds overall (Table 6, which gives scientific names). No pellets and only three orts were found under the nest during the nestling period, along with fox scats (suggesting that a fox had scavenged most of the evidence). Only one ort was found under the nest early in the post-fledging period, along with two fresh pellets and one ort under a nearby feeding perch (week 1). A sample of pellets (n = 10, plus fragments) and orts (n = 3) found under the nest late in the post-fledging period (day 46) probably represented prey from fledgling weeks 2–7 (Table 6). The pellets measured 24–69 × 15–23 mm (mean 39 × 19 mm) and weighed 0.7–3.4 g (mean 1.9 g). All 12 intact pellets (100%) contained mostly feathers (by volume) and traces of other bird remains (bill and bone fragments), five (42%) also contained mammal fur and remains (foot, rat jaw), and three (25%) contained beetle remains. The pellet fragments, representing about seven pellets, contained the same prey profile as the intact pellets (i.e. feathers, fur and beetle). No reptile scales were found in pellets, despite searching. The pellet material contained no vertebrate prey species that were not otherwise observed as delivered or cached prey, or as orts (Table 6).

The cached items in the incubation and nestling periods (Table 6, all before the female started hunting) were probably caught by the male parent. However, the magpie orts (one a fledgling) appeared after the female started hunting, and she delivered one magpie. Otherwise, the male and female falcon took similar prey (Table 6). Rats started appearing in

the diet from late in week 1 of the post-fledging period, but by week 3 the pair had switched almost entirely to rats. At that time there was apparently a glut of rats, possibly exposed during cane-harvesting operations, and many were cached (Table 6). From a crude estimate of prey body weights (from SD's prior raptor studies cited by Marchant and Higgins 1993 or Debus 2012a), rats contributed ~50% of observed vertebrate prey biomass in the post-fledging period. The beetles (three small individuals in the final pellet sample, negligible by biomass) were likely to have been caught by the juvenile falcons. The road-killed juvenile's gut was empty (L. Tsang pers. comm.).

Caching

The falcons had three cache sites in the nest tree (horizontal hollow limbs of various sizes, e.g. an open spout ~20 cm in diameter, below the nest, 6 m above the ground), into which they pushed prey; one on the ground at the base of a Forest Red Gum 50 m from the nest tree; and (in the post-fledging period) a hollow in a dead tree 50 m from the nest. Both sexes retrieved food from the caches: the male either to feed himself or to give food to the female, and the female to feed the chicks during lulls in the male's deliveries. They used the cache sites to store excess fresh prey (e.g. when the female was already feeding the chicks on another item), and to store leftovers after feeding the chicks. Cached avian prey was often, but not restricted to, large species (e.g. Cattle Egrets, Little Corellas), and the adults sometimes moved prey between the ground and tree caches. They continued to use the caches during the post-fledging period, to feed themselves and the fledglings.

Feeding rates

During the nestling period, the adults brought prey to the nest at a combined rate of 30 items in 41.5 hours (0.72 item/h): the male 0.43 item/h (two of these from a cache), the female 0.29 item/h (two of these from a cache, one or two possibly collected from the male away from the nest, as he accompanied her return). These represented ~70 g of prey biomass delivered per hour. The female

Table 6. Prey of a breeding pair of Black Falcons near Lismore, NSW, incubation to post-fledging period, July–November 2013: n items seen delivered by the adults to the nest or fledglings, or otherwise observed (? = uncertain identification). M = male, F = female; C = observed in or retrieved from cache (probably caught by male); ^I = incubation period; ? = adult falcon unsexed, or item observed in or retrieved from cache, or was an ort in or under the nest; ^O = ort (prey remains); ^P = in pellets; T = total. Care was taken not to double-count items.

Species	Inc./nestling				Post-fledging				T
	M	F	C	T	M	F	?	T	
Brown Quail, <i>Coturnix ypsilophora</i>	3		1 ^I	4	2			2	6
Maned Duck, <i>Chenonetta jubata</i> duckling					1	1		2	2
Grey Teal, <i>Anas gracilis</i> ?			1 ^I	1					1
Pacific Black Duck, <i>Anas superciliosa</i> duckling			1	1	1	1		2	3
Unidentified duckling		1		1					1
Bar-shouldered Dove, <i>Geopelia humeralis</i>			1	1	1	1		2	3
Crested Pigeon, <i>Ocyphaps lophotes</i>	1	2		3					3
Cattle Egret, <i>Ardea ibis</i>				1	1		1	2	3
Purple Swamphen, <i>Porphyrio porphyrio</i>	1			1					1
runner ?									
Masked Lapwing, <i>Vanellus miles</i> ?							1 ^O	1	1
Galah, <i>Eolophus roseicapillus</i>				1 ^O	1				1
Little Corella, <i>Cacatua sanguinea</i>	1		2	3					3
Rainbow Lorikeet, <i>Trichoglossus haematodus</i>							1 ^O	1	1
fledgling									
Scaly-breasted Lorikeet, <i>Trichoglossus chlorolepidotus</i>							1 ^O	1	1
Noisy Miner, <i>Manorina melanocephala</i>	1	1		2					2
Honeyeater sp. (Meliphagidae)			1	1					1
Honeyeater?	1			1					1
Australian Magpie, <i>Gymnorhina tibicen</i>			1	1 ^O	2				2
Magpie fledgling							1 ^O	1	1
Magpie?				1 ^O	1				1
Magpie-lark, <i>Grallina cyanoleuca</i>							1 ^O	1	1
Common Myna, <i>Acridotheres tristis</i>	3	2	1	6			2	2	8
Passerine				1	1		1 ^P	1	2
Medium bird			1	1					1
Small bird	4			4			1 ^P	1	5
Unidentified bird		1	1	2			1	1	3
Total birds				38				20	58
Brown Antechinus, <i>Antechinus stuartii</i> ?					1			1	1
Black Rat, <i>Rattus rattus</i>					2	1	6	9	9
Rat sp.					1	2	1 ^O	4	4
Total mammals								14	14
Beetle (Coleoptera)							3 ^P	3	3
Unidentified							2	2	2
Total				38			39	77	

was first seen to bring her own captured prey late in week 4 (day 28), while the male was feeding the chicks. The male took one item to a cache while the female was feeding the chicks. There were several short intervals between departures and next deliveries of avian prey (excluding from caches), e.g. male six intervals of 3–17 minutes (four of 7–9 min.), female one of six minutes. Both adults occasionally arrived (separately) with a full crop but no prey, or (the female, once) also brought the remnant and finished it without going to the nest, showing that they ate additional kills away from the nest.

In the post-fledging period until week 7, the adults brought prey to the juveniles in the nest area at a combined rate of 27 items in 68.4 hours (0.39 item/h): the male 0.19 item/h (three of these from a cache, all in week 3), the female 0.13 item/h (two of these from a cache, in weeks 3–4), and five by an unsexed adult (0.07 item/h). These represented ~80 g of prey biomass delivered per hour. The combined rate was 0.51 item/h in week 1 (brood of four), 0.58/h in week 2 (after brood reduction) and 0.51/h in week 3, declining to 0.36/h in week 4 and 0.19/h in weeks 5–7 combined (no witnessed deliveries in week 6; total observation time given in Table 3). The female was last confirmed to deliver prey in week 4, and there were no observed deliveries in week 8 (although the juveniles could have obtained prey from the adults away from the nest area in weeks 5–8). In week 3 the male once departed and returned with a fresh rat in two minutes. In weeks 3 (day 18) and 5 (day 32) the female arrived at the roost with a full crop, i.e. had fed away from the nest without bringing the prey, and in week 4 (day 26) she ate prey from a cache without sharing it with the juveniles that had also arrived to roost.

Roosting

Near Tamworth, from early July to early August a probably male Black Falcon was seen three times going to roost in the canopy of a live paddock eucalypt in the same stand of trees in a drainage line, around 1730 h. Each time, the falcon flew in

at low level, more than 10 minutes after sunset. On one of these, the falcon had gone by sunrise the next morning.

Near Lismore, during the second half of the nestling period, the female roosted at dusk on the nest branch, beside the nest (week 5, day 31 and week 6, days 38 and 40), and the male roosted away from the nest tree. However, on one evening in week 5 (day 30) when the female had not returned at dusk, the male roosted beside the nest. Throughout the post-fledging period, both adults roosted either on a branch beside the nest (female) or in the nest tree within a few metres of the nest (male), as did the juvenile(s), up to at least week 8 (day 52).

Reaction to disturbance

The focal pair of falcons at Tamworth had a favourite prominent perch (a dead tree) overhanging a rural sealed road. They remained perched, usually showing no visible reaction to passing vehicles of all sizes, but the female was once briefly startled by a truck gearing down directly below her. This female, and some other Black Falcons, readily perched on dead trees in or near (within ~50 m) farmstead backyards.

The Lismore nest was ~80 m from a busy main road with many car and truck movements, to which the adult falcons showed no visible reaction. Nor did the adults or fledglings visibly react to the observers, sometimes flying low over the parked vehicle as if inspecting us; once a juvenile landed in a tree 15 m away to eat a rat. There was a fire 300 m from the nest during the chick phase, but the falcons showed no reaction, other than watching the fire, as dense smoke enveloped the nest tree (without causing chick death).

Juvenile specimens

A known-age juvenile male reference specimen, road-killed near Tamworth (Debus and Zuccon 2013), is now registered as Australian Museum O.74636 (L. Tsang pers. comm.). The road-killed fledgling from the Lismore nest was a female, weighed 730 grams (possibly dehydrated: see

Schoenjahn 2011), and is also now registered in the AM, O.74912 (L. Tsang pers. comm.). At six days out of the nest, its primaries and rectrices were not fully emerged, their bases still ensheathed ('blood quills').

DISCUSSION

Displays and vocalisations

The aerial courtship displays supplement descriptions of high aerial male-female interactions (e.g. in Marchant and Higgins 1993), and the pre-laying and nest-selection behaviour described by Debus and Tsang (2011). Some of the male hunting behaviour at Tamworth in May (e.g. magpie episode, Table 5) may have been in display to the female. As in solitary aerial displays (Whelan 2013a), the male's manoeuvres during courtship appear to be demonstrations of speed and agility. The Black Falcon's aerial courtship manoeuvres are similar to those of other 'great falcons', subgenus *Hierofalco* (see Cade 1982; Ferguson-Lees and Christie 2001).

The Black Falcon's greeting trill may be similar to the trill illustrated for this species by Jurisevic (1998, Figure 2e). It is difficult to match our other call descriptions to Jurisevic's spectrograms, but the various cackles may match his Figure 2a,b. The Black Falcon's varied vocal repertoire is evidently similar to that of the Lanner Falcon, *Falco biarmicus*, and other 'great' falcons (e.g. Ferguson-Lees and Christie 2001). The Black Falcon's frequent and sometimes loud vocalising around the nest contrasts with prior perceptions (e.g. Marchant and Higgins 1993) that it is silent or subdued, at least away from the nest (although nest defence against humans is silent, e.g. Olsen and Olsen 1980). The male's frequent vocalising accords well with the pair's high fledging success, and contrasts with a male's infrequent vocalising at a nest with lower success (Debus *et al.* 2005). However, statistical correlation of male vocal signalling with breeding success (Leonardi *et al.* 2013) awaits proper investigation among multiple pairs.

Territorial defence

The intraspecific territorial interactions enlarge on previous information (e.g. in Marchant and Higgins 1993), and illustrate typical falcon aerial agonistic behaviour. Interspecific nest defence, and tolerance of most other raptors, accord with prior experience (e.g. Debus *et al.* 2005; Debus and Zuccon 2013), and suggest that nesting Black Falcons are mainly concerned with large eagles or conspecifics unless other species intrude too closely. Initiation of breeding (nest selection, laying) more than two months ahead of Brown Falcons may have minimised conflict with them over nest sites.

The Black Falcon, like other 'great' falcons, appears prone to interspecific conflict with corvids over stick nests, e.g. the Gyrfalcon, *Falco rusticolus*, and the Northern Raven, *Corvus corax* (Potapov and Sale 2005). Similarly, it appears to usually lose such contests with large corvids, which may be a factor in its decline in the sheep-wheat belt in the face of increasing, superabundant ravens and apparently increasingly severe storms which destroy stick nests (Debus and Tsang 2011; Debus and Zuccon 2013; SD pers. obs.). There may be a case for experimenting with artificial stick nests, high in tall trees in low, flat (e.g. riparian) parts of the agricultural landscape, for Black Falcons.

Breeding biology

As elsewhere, the Black Falcons at Lismore were early breeders (see Debus *et al.* 2005; Debus and Tsang 2011; Debus and Zuccon 2013). Our brief observations establish that at least some male Black Falcons share incubation while the female is absent or eating the male's catch, although further details and quantification of male and female roles are required. Shared incubation is common in *Falco* generally (e.g. Cade 1982).

Previous Black Falcon nestling periods were 38–42 days (Baker-Gabb 1984), i.e. ~6 weeks, as at Lismore. Marchant and Higgins (1993, '42–49 days') misquoted Cupper and Cupper (1981), who estimated 'between 6 and 7 weeks' (p. 88)

and '42 days' (p. 92), i.e. 49 days is too long. In the equivalent Peregrine Falcon it is 38–45 days (Marchant and Higgins 1993). As previously (Debus *et al.* 2005), advanced nestlings could feed themselves on delivered prey (*contra* Cupper and Cupper 1981).

The brief observations of parental behaviour in the chicks' first week accord with those of Hollands (1984) for downy chicks. Based on his photographs, and comparison with known-age Peregrine Falcon chicks (in Olsen 1995, p. 157) and Black Falcon chicks (in Cupper and Cupper 1981, p. 90), Hollands' Black Falcon chicks were about two weeks old. Available data (including Debus *et al.* 2005; Debus and Zuccon 2013) suggest that up to ~two weeks old, chicks are mostly brooded and fed by the female. Otherwise, parental behaviour and development of older nestlings agree well with the study of Debus *et al.* (2005) and, overall, aspects of the Black Falcon's breeding cycle resemble those of the Peregrine Falcon (see Marchant and Higgins 1993; Turner *et al.* 1993; Olsen 1995). However, quantification of the Black Falcon's full breeding cycle (sex roles, parental time-budgets) from pre-laying to independence remains to be done.

The juveniles' morphological characters at fledging age agree with recent studies (Debus *et al.* 2005; Debus and Zuccon 2013). The post-fledging dependence period at Lismore was long (two months, cf. three weeks recorded by Debus *et al.* 2005), but is as expected for juveniles of large bird-eating falcons, which presumably take many weeks if not months to hone bird-catching skills (e.g. Peregrine Falcon: Marchant and Higgins 1993; Turner *et al.* 1993). The fate of two fledglings at Lismore (a) suggests that the juveniles in a prior study (Debus *et al.* 2005), which disappeared early, may have perished before independence; and (b) reinforces the role of human hazards in Black Falcon mortality (see Debus and Olsen 2011; Debus and Zuccon 2013). The behavioural development of fledglings resembled that described by Debus *et al.* (2005) and Barnes and Debus (2012) for comparable

stages, and was generally similar to that described for the Peregrine Falcon (see Turner *et al.* 1993). Further study of this aspect will require radio- or satellite telemetry.

Foraging and prey

Hunting behaviour

The hunting observations at Tamworth and Lismore (Debus *et al.* 2005; Debus and Tsang 2011; Debus 2012b; Debus and Zuccon 2013; this study), together with recent anecdotal reports elsewhere (Debus 2013; Gemmell 2013; Whelan 2013b), confirm that Black Falcons search for prey by perch-hunting, fast contour hunting, high quartering, or soaring and prospecting, and attack in a direct flying attack, stoop (at aerial prey), tail-chase, or dive to the ground, and that co-operative hunting of avian prey by the male and female of a pair is common. Co-operative hunting flights appear to be frequently initiated by the female. For video examples of hunting behaviour, including tandem hunts, see D. Gemmell's website <www.raptorcapture.com>.

Prey

The prey items at Tamworth are consistent with previous data from there and elsewhere in southern Australia, i.e. mainly birds (Marchant and Higgins 1993; Debus *et al.* 2005; Debus and Olsen 2011; Debus and Tsang 2011; Debus and Zuccon 2013). However, there are few previous records of reptiles as prey. One early claim cited by Marchant and Higgins (1993) is doubtfully referable to the Black Falcon (given likely confusion with the Brown Falcon); the other (a lizard: Hollands 1984, p. 140) was overlooked. Small lizards may be taken frequently, at least in the inland, but would not appear in pellets other than as tiny scales among fur, feathers or insect fragments.

The diet of the breeding pair at Lismore is noteworthy for its frequency of Common Mynas, more the fare of agile raptors near cover than of fast falcons of open habitats (cf. Australian Hobby and Peregrine: Olsen 1994; Olsen *et al.* 2008). Much the same applies to the terrestrial mammals,

requiring agility near the ground during fast, low-level attacks. In such a comparison with the Peregrine, the Black Falcon parallels the Lanner Falcon (e.g., see discussion by Debus and Olsen 2011).

Dietary flexibility, in response to seasonal or geographical availability of prey classes, is well known in the Black Falcon (e.g. Marchant and Higgins 1993). However, the switch from birds to mammals within the one breeding event (at Lismore) seems noteworthy. In its ready alternation between birds and abundant mammals, and inclusion of bats, reptiles and insects, the Black Falcon resembles the Lanner Falcon and the Laggar Falcon, *Falco jugger* (see Ferguson-Lees and Christie 2001).

Feeding rates

The parental feeding rate was higher at Lismore than at Tamworth, both in the nestling period (0.7 vs 0.3 item/h; 70 vs 50 g of prey biomass/h) and, week for week, in the post-fledging period (0.5–0.6 vs 0.3 item/h; 80 vs 70 g of prey biomass/h in weeks 1–3) (cf. Debus *et al.* 2005). Although the difference in the nestling period may relate to brood size (four vs three then two), brood size was equal post-fledging, so the difference may relate to greater food supply at Lismore (especially given the use of caching; see below). In both studies, the increased biomass delivered in the post-fledging period reflected the increase in mammal captures (rats/rabbit kittens) and, at Tamworth, the capture of fledgling Galahs.

Caching

The Black Falcons at Lismore used tree hollows as cache sites, unlike a pre-breeding pair that was said to cache excess prey in the 'wall' (presumably the earth bank) of a farm dam (unsourced in Olsen 1995, p. 101). At Lismore, caching probably enabled the falcons to take advantage of abundant and easily caught prey in a high-rainfall zone, may have acted as a buffer against wet weather (when hunting might be difficult), and may have facilitated the successful brood of four fledglings by ensuring a constant

food supply to the chicks (e.g., see Cade 1982; Sherrod 1983; Cameron and Olsen 1993; Olsen 1995; McDonald 2004). Caching was not recorded at the nest studied by Debus *et al.* (2005), from which only two young fledged after a third chick (underweight and sick) fell from the nest.

Implications for research and conservation

The endemic Black Falcon is arguably of greater conservation concern than the cosmopolitan Peregrine Falcon. The latter is not threatened in any Australian State, is increasing, and is adapting to nesting on city buildings and other human infrastructure (e.g. Debus 2012a). Conversely, the Black Falcon is limited to pre-built stick nests in trees (Debus and Olsen 2011; Olsen 2014), and is of concern in the Murray-Darling Basin; two occupied nests in central Victoria, one in northern Victoria, and one in southern inland NSW (the only ones known to be monitored) all failed in 2013 (D. Gemmell, A. Zuccon pers. comm.).

There is little published on the biology or ecology of the Black Falcon in South Australia (Fraser 1985; Falkenberg, Hurley and Stevenson 2000; Debus and Olsen 2011). It has not been the focus of a detailed ecological and population study there or elsewhere in the sheep-wheat belt, although a Black Falcon breeding population is readily accessible from Adelaide (e.g. Debus and Olsen 2011).

In particular, the role of human hazards and unnatural mortality (e.g. vehicle strike, especially in the post-fledging months), and of corvids in nest-site availability, deserve investigation (see Debus and Olsen 2011; Debus and Tsang 2011; Debus and Zuccon 2013).

In contrast with dark Brown Falcons, the Black Falcon is more like a long-tailed, all-dark Peregrine Falcon in flight style and habits, and indeed the Black Falcon's genetic, morphological and ecological counterpart, the Lanner Falcon, has been extensively compared with the Peregrine in ecology, morphology and aerodynamics (e.g.

see studies cited by Debus and Olsen 2011). A similar comparison between Black and Peregrine Falcons in Australia would greatly enhance understanding of the Black Falcon's biology (e.g. see Olsen 1994, Debus and Olsen 2011 for preliminary remarks), with satellite telemetry also needed to understand its complex ecology and elucidate its movements (both daily and seasonal).

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Bird Notes

A recent record of Osprey nesting in mangroves in South Australia

T.E. DENNIS AND A.V. BROOKS

Although there is a dearth of coastal or near-coastal forests in South Australia, extensive areas of Grey Mangrove, *Avicennia marina*, occur in the intertidal areas of Spencer Gulf and Gulf St Vincent, and in sheltered bays on western Eyre Peninsula in the Great Australian Bight region. These commonly form a continuous low woodland formation extending inland as far as the limit of regular flooding, with individual trees to 3.5-5 m in height (Specht 1972). The furthestmost westerly occurrence of mangrove woodland in South Australia is at Tourville Bay, ~25 km west of Ceduna, where it covers an area >10 km² interspersed with tidal creeks, including Davenport Creek, a popular camping and aquatic recreation area for residents of the region.

The mangrove complex within Tourville Bay provides sheltered habitat for large cormorant rookeries and the intertidal area incorporates salt-marsh habitats with extensive sand and mudflats exposed at low tide, providing foraging habitat for significant numbers of threatened migratory bird species. These habitats are recognised internationally as occurring within the Tourville and Murat Bay IBA (Important Bird Area), which extends over an area of 11,689 ha (Birdlife International 2014).

In November 2011, a substantial nest structure was found by one of us (AB) in mangroves

overhanging an isolated tidal creek channel in Tourville Bay. The nest was unoccupied and therefore the species involved was not determined. When the location was revisited in October 2012 this nest had disappeared, but further searching revealed another similarly constructed nest 500 m distant, again unoccupied.

The species involved remained a tantalizing mystery until a return visit in December 2013 revealed the later nest to be occupied by Ospreys, *Pandion haliaetus*, and active, with at least one advanced nestling present (see Figure 1). This is the first confirmed nest placement in mangroves by Ospreys in South Australia since the 1960s, when young were banded at a nest near Murninnie Beach on the western shore of upper Spencer Gulf (Table 1). The nearest (known) occupied Osprey territory to the Tourville Bay site is ~15 km NE in Murat Bay. This was also active in 2013.

Throughout its range in Australasia, Osprey nest sites are most often found in trees (Marchant and Higgins 1993; Dennis and Clancy 2014) and although there are several historical records of tree nests occurring in South Australia, recent examples are rare and therefore exceptional (Table 1). For example, among the 58 occupied territories identified during Statewide surveys conducted between 2008 and 2010 only one pair was found using a tree-nest (Dennis *et al.* 2011), and that nest was <3m above ground level constructed on the nearly horizontal trunk section of a fallen dead tree situated on a small islet. The majority of other nests were constructed on broken sections of coastal cliff and near-shore rock-stacks, with a small number on man-made structures (Dennis 2007; Dennis *et al.* 2011).

Both tropical and subtropical mangrove habitats are recognised worldwide as important nursery habitats for juvenile and sub-adult fish (Laegdsgaard and Johnson 2001), and large schools of Mullet, *Myxus elongatus*, and Garfish, *Hemiramphus melanochir*, are seen regularly by fisherman in tidal creeks among mangroves and adjacent open waters of Tourville and Smoky Bays (AB) and upper St Vincent Gulf (P. Dennis pers. comm.). From this apparent abundance of prey and relatively isolated nest site availability, any expansion of the Osprey population in South Australia, as has occurred in New South Wales in recent decades (Rose 2000; Clancy 2006; Dennis and Clancy 2014), may become evident by re-occupation of former mangrove woodland habitats.

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Figure 1. Nest constructed ~3.5m above high-tide level, shown here with the female present and feeding a large pre-fledged nestling in late-December 2013
Photo: Andrew Brooks

Table 1: Records of Osprey tree-nest placements in South Australia

Region	Location	Date/period	Source
Eyre Peninsula	in dead tree at Lake Wangary	last active <i>ca</i> 1991	Dennis 2007
Spencer Gulf - west	'nest in mangroves' near Murninnie Beach	1965	ABBBS banding records; Dennis <i>et al.</i> 2011
Spencer Gulf - east	'nest in mangroves' near Mambray Creek	1897	SA Museum - Oology collection; Dennis <i>et al.</i> 2011
"	'nest in mangroves' near Port Germein	1898 & 1903	"
"	'nest in mangroves' near Port Broughton	1918	" (SAO 3:132-133)
Kangaroo Island	in dead tree (location withheld)	2004-13	Dennis 2007; Dennis <i>et al.</i> 2011
"	nest on boxthorn bush 2.5 m above ground, Nepean Bay	2001-02	TED pers. obs.
Murray River	in dead tree near Nildottie	last active in 1980	Robinson 1980; Dennis <i>et al.</i> 2011
"	in dead tree near Waikerie	1974	Dennis 2007
"	in dead tree over the Pike River, near Paringa	<i>ca</i> 1970s	I. Falkenberg pers. comm.

Black-tailed Nativehen roosting behaviour at Paiwalla Wetland

PETER KOCH

Paiwalla Wetland, 15 km north of Murray Bridge on the eastern side of the Lower Murray River in South Australia, is now an important site for water birds. Formerly an irrigated dairy farm, the area was purchased by the Wetland Habitat Trust and restored to form a wetland, largely with volunteer labour, between 1998 and 2002.

Covering approximately 100 hectares, the wetland consists of two basins within levee banks, periodically flooded from the river through two inlet regulators. The wetland now provides habitat for a wide range of species and substantial numbers of water birds.

In December 2013 an infra-red motion-sensing camera was set up. The camera has recorded some interesting night-time roosting behaviour by Black-tailed Nativehens, *Trybonyx ventralis*.

Figure 1 shows approximately 35 Black-tailed Nativehens standing in a defensive circle in water 40 mm deep. This behaviour would allow the birds to roost in relative safety from their main night-time predators, Water Rat, *Hydromys chrysogaster*, Red Fox, *Vulpes vulpes*, and Feral Cat, *Felis catus*, as any approach by a predator would be quickly noticed. (Some birds typically rest one half of their brain, keeping guard with the other half, while sleeping. At some stage in the sleep period the resting and active sides change over.)

The image was recorded on 4 February 2014 at 0134 h; air temperature was 14°C.

Figure 2, taken four days later and at a later stage of the night (8 February 2014, 0447 h, 16°C) shows a smaller defensive circle of Black-tailed Nativehens.

Other images show the birds starting to group up about 2300 h and eventually forming defensive circles. After about two to three hours, the groups seem to break up and mingle around, then form smaller circles. It is also possible that they move out of camera range and form large circles again.

Soon after these images were recorded, the area received 100 mm of rainfall, water depth increased and the birds moved elsewhere.

These photographs appear to be the first record of 'defensive circle' roosting behaviour in Black-tailed Nativehens. The behaviour is not recorded in *Handbook of Australian, New Zealand & Antarctic birds*.

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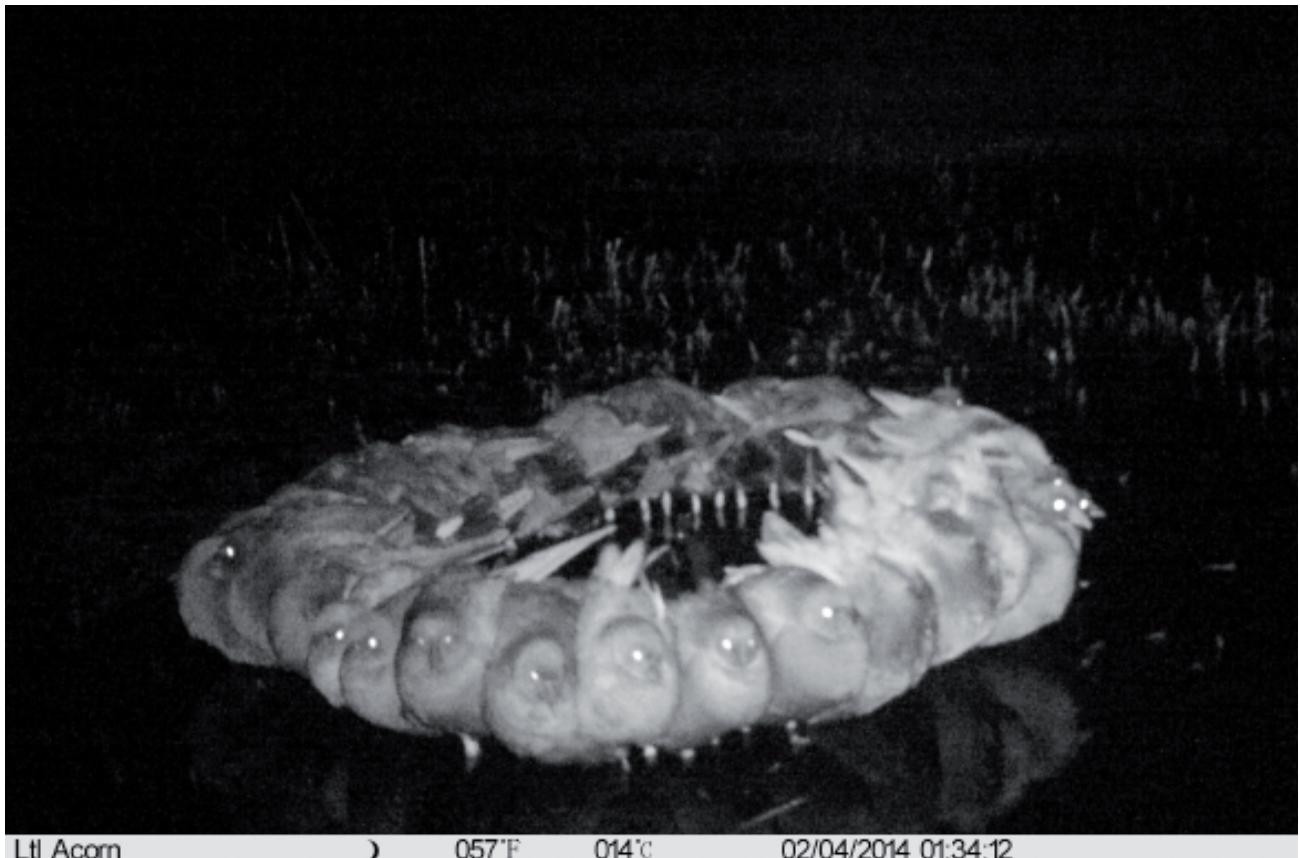


Figure 1. Approximately 35 Black-tailed Nativehens in a defensive circle



Figure 2. A smaller group of Black-tailed Nativehens in a defensive circle

The White-plumed Honeyeater on Eyre Peninsula

G. CARPENTER AND E. SMITH

The White-plumed Honeyeater, *Ptilotula penicillata*, is common in open eucalypt woodlands across eastern and central Australia. Red Gum, *Eucalyptus camaldulensis*, is especially favoured (Jones 1981, Blakers, Davies and Reilly 1984, Loyn 1985, Higgins, Peter and Steele 2001). In South Australia White-plumed Honeyeater occurs in the north and east, extending west to Port Augusta and the Stuart Highway (and just further to the Baxter Hills – McGilp 1932), and in the far north-west (Condon 1969, Blakers, Davies and Reilly 1984).

There are a few widely scattered reports of White-plumed Honeyeater from Eyre Peninsula. Weidenbach (1924) noted it as "frequently seen" in the Cleve Hills, and Jenkin and Waterman (1965) listed it for Coffin Bay. Mack (1969) recorded a pair nesting in Red Gums at Bascombe Well Conservation Park and Vincent (1974) recorded one at Coolanie in the Cleve Hills. Eckert, Parker and Reid (1985) however, regarded its status on Eyre Peninsula as unconfirmed because these reports contained insufficient supporting details.

A recent biological survey of Eyre Peninsula that included ten sites in Red Gum woodland did not record White-plumed Honeyeater (Brandle 2010), and GC had not previously recorded the species during numerous visits to the region since 1986. Eucalypt woodlands on Eyre Peninsula are

isolated from the north by semi-arid low open woodlands dominated by Western Myall, *Acacia papyrocarpa*, over chenopods. Red Gum woodland occurs widely in the south-west of Eyre Peninsula, where Reid (1978) noted the unusual occurrence of Yellow-plumed Honeyeaters, *P. ornata*, instead, a honeyeater normally confined to mallee.

While driving across Eyre Peninsula on 17 January 2011, GC stopped briefly in Kimba under the shade of some street trees. Above were heard repeated 'chip, chip, chip' calls that sounded like young White-plumed Honeyeater. Realising its significance, the source of the calls was followed to ensure they were not *P. ornata*, a relatively common species in this district. Two adult and two immature honeyeaters were located about 15 m up in the canopy of a flowering Sugar Gum, *Eucalyptus cladocalyx*. Their unstreaked, pale yellowish-green appearance and presence of white neck plumes identified them as White-plumed Honeyeater. An adult also visited the flowers of planted Coral Gums, *E. torquata*, in a nearby garden. Feeding in the same trees were several Red Wattlebirds, *Anthochaera carunculata*.

GC visited Kimba again briefly on 27 October 2011 when several White-plumed Honeyeaters were seen and heard in the same area, although time did not permit a search for any nesting activity. On 22 March 2012 White-plumed Honeyeaters were found to be widespread in flowering eucalypts in the town, particularly Coral Gum and SA Blue Gum, *E. leucoxylon*. Also of interest on the latter visit were several New Holland Honeyeaters, *Phylidonyris novaehollandiae*, present in many towns on Eyre Peninsula but not previously observed at Kimba (GC pers. obs.).

ES has observed birds while living at Whyalla since the late 1980s. A single White-plumed Honeyeater was first seen there on 1 September 1995, with a pair the following day. They were not seen again until December 1998 and bred in early 1999. They were then reported only occasionally until large rains in January 2007, with several present since.

Our observations suggest that White-plumed Honeyeater is gradually colonising towns on Eyre Peninsula, with small populations now established at Kimba and Whyalla. White-plumed Honeyeater is well known to colonise plantings of ornamental eucalypts in suburban areas, including areas outside of its historic range (Hindwood 1950, Jones 1981).

Read (1999) noted that White-plumed Honeyeater had become abundant in eucalypt plantings at Roxby Downs township by September 1990, only a few years after its establishment in 1986. It is likely that homestead gardens with ornamental eucalypts have provided stepping stones for dispersal through non-eucalypt habitats, possibly aided by above average rainfall in recent years. Read (1999) noted the likely source of birds at Roxby Downs to be Andamooka and Roxby Downs homestead gardens, with the closest naturally occurring eucalypts (Red Gums) 40 km away.

It is most likely that the source of Eyre Peninsula birds is Port Augusta, where the species is common (GC pers. obs.). P. Langdon (pers. comm.) also observed a single White-plumed Honeyeater in planted eucalypts at Pandurra Homestead on 24 September 1974, 35 km SW of Port Augusta.

ACKNOWLEDGEMENT

We thank Peter Langdon for providing information on his observation at Pandurra Homestead.

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The Spotted Dove on Eyre Peninsula

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In South Australia the Spotted Dove, *Spilopelia chinensis*, inhabits mainly suburban gardens, orchards and coastal vegetation from the South East westwards to Yorke Peninsula and north to Port Augusta (Blakers, Davies and Reilly 1984). Its occurrence in South Australia is thought to have originated from an accidental release from the Adelaide Zoo in 1931 (Condon 1968).

The first record from Eyre Peninsula was of two presumed deliberately introduced birds in the grounds of the agricultural research centre at Minnipa on 23 July 1965 (Chapman 1966). Green in Glover (1968) reported a "colony of 15+ apparently confined to a large garden in the Hundred of Hawker" (= Tumby Bay district) on 8 September 1966. Paton in Reid (1976) saw a few at Port Lincoln on 13-14 September 1975 and Gill in Reid (1976) reported that about a dozen were released in Port Lincoln by a local aviculturalist in about 1972, where they were "plentiful" and "slowly increasing".

By the early 1980s there were still a few reports from Port Lincoln (e.g. Filsell in Glover 1983, Blakers, Davies and Reilly 1984), although that population is apparently no longer extant (J. Cooper pers. comm, GC pers. obs.). To the north-west, Read in Carpenter (1994) reported in October 1993 that a small population had recently established in the Roxby Downs township.

These were also likely to have been deliberately liberated, but were being controlled.

GC has recorded small numbers of Spotted Dove on north-eastern Eyre Peninsula from 2000 onwards. On 17 February 2000 a pair of doves flew overhead from an area of mangroves along an inlet just south of Arno Bay. One bird landed briefly on an exposed branch where the spotted neck feathers and grey-brown plumage were easily seen. The bird was very wary and flew off when approached to 30 m. The following day another pair of Spotted Doves was seen in mangroves at Second Creek, Tumby Bay, about 70 km SW of Arno Bay and 50 km NE of Port Lincoln. No doves were observed during brief searches in the towns of Arno Bay or Tumby Bay at this time.

On 22 March 2012 four Spotted Doves were seen in the township of Kimba. These were perched in low garden trees and feeding on the ground in a vacant lot. A loose group of about ten Spotted Doves was seen in coastal dune shrubland near the Lucky Bay rubbish dump (NE of Cowell) on 19 June 2012. On 26 February 2014 a single bird was also flushed from coastal shrubland at the southern edge of Port Neill township.

ES has observed birds while living at Whyalla since the late 1980s. A single Spotted Dove was first seen there on 6 September 1990. There were subsequently three reports in October 1994 and two in March 1997 (including a juvenile). Since 1997 they have slowly increased although the total population is suspected to be small, with the maximum recorded at any time being four.

These records indicate that Spotted Doves are slowly increasing in range on Eyre Peninsula, most likely having spread south along the coast from Port Augusta where the species is abundant (GC pers. obs.). The presence of mangroves in this area, a favoured habitat of Spotted Doves elsewhere (e.g. Gulf St Vincent), may have aided dispersal around the more hostile semi-arid habitats of northern Eyre Peninsula. Without

active control, Spotted Doves have the potential to become abundant across Eyre Peninsula as they have in south-eastern parts of the State.

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Obituary: Frank Richard Hewett Chapman

7 July 1937 to 8 February 2014

ANDREW BLACK

Frank was the only son and the oldest of three children of Frank Hewett Chapman and Nancy (née Richards) and a proud descendant of colonial pioneer Samuel Chapman who arrived aboard the Cygnet in 1836. He grew up in North Adelaide and Walkerville but moved to the 'family farm', a property of 330 hectares at Coromandel Valley, on the death of his grandfather (also Frank) in 1951. He loved the rural life as it was then, rode his own horse, kept all manner of pets and bred and trained sheep dogs, but his greatest early and lifelong passion was the study of birds in nature.

His father was a lawyer and staunch Liberal Party politician who kept a large aviary and joined the SAOA in May 1950, becoming President for one term in 1955. The younger Frank joined only 18 months after his father at the age of 14½. He attended Prince Alfred College and went on to Roseworthy as his grandfather had done, receiving his diploma with Honours in 1957 but within two years his father was dead and Frank had to assume the role of head of family and manager of its property.

Fortunately leadership (as well as politics) came naturally to Frank; he was President of the Mitcham Young Liberals from 1960 to 1962 and Secretary to the Mitcham branch of the Party from 1964 to 1967. In the same period he became Vice-President of the SAOA in 1960 and President in 1962. He thus became the youngest President of the Association and he took its leadership for eight successive years. During that period regular field excursions were established on a monthly basis and camp-outs were arranged annually from 1964. He participated strongly in



all Association activities and, while he published relatively little (Blaylock 2000), he had a very wide knowledge of our birds, giving at least nine presentations on different bird groups at general meetings between 1965 and 1972 (Chapman 1965–1972). He also produced a small SA Museum educational booklet on the identification of red robins (Chapman 1970).

The years leading up to and beyond 1962 were a crucial period for the Association (Schodde 2000), when strongly divergent views were held amongst members concerning conservation and the need for stronger legislative protection for wildlife. Frank's views were firm and he managed opposition from some members, many

a good deal his senior, with scrupulous honesty, efficiency and calmness, confident in his complete grasp of the rules for the conduct of meetings.

In the early 1960s his advocacy influenced government in several conservation-related policies; full year-round protection for pelicans on the Coorong (Chapman 1963); discontinuation of the issuing of licences to take birds from the wild for commercial purposes; and formal control over permits for collecting eggs and skins.

On 30 June 1961 Dick Schodde and Warren Hitchcock proposed that the Association sponsor a public meeting on the subject of nature conservation and Ron Gibbs and Frank were appointed as a subcommittee to make suitable arrangements. The meeting took place on 6 April 1962 and was chaired by SAOA President Basil Newland; papers were presented by the three named above and Dr Colin James. At the meeting a member of the audience put an unanticipated motion that a council of organisations and individuals be formed to promote action and change and, after some debate and opposition, it was carried by majority. Frank led a committee of nine to draw up rules and chaired a meeting of interested parties on 31 October 1962 at which the Conservation Coordinating Council of South Australia was proposed. He chaired further meetings until that body was dissolved, its role being assumed by the Conservation Council of South Australia from 1970. The initiative of this group of SAOA members (with Bob Brown and Ed Newman) also led to the formation of the Nature Conservation Society of South Australia. Moves towards its formation were well under way before the April 1962 meeting and Frank was one of at least 12 SAOA members among the 29 invited to its inaugural meeting on 6 June 1962.

A major priority of the Association in the 1960s was the protection of areas of suitable habitat and he was forever watchful for an opportunity to create new Reserves. With Bob Brown and other members he made careful initial assessments of several possible land parcels; subsequent

representation on behalf of the SAOA resulted in the dedication of Warrenben, Clement Gap and Cox Scrub Conservation Parks. His direction and focus during the 1960s inspired many future office-holders who joined the Association in that period.

In July 1963 Frank and Brian Glover addressed the Parliamentary Land Committee, advocating expansion of the existing reserve (now Mount Rescue Conservation Park) into un-allotted Crown Land to the north and east between Bordertown and Pinnaroo which was then being considered for agricultural expansion. After several years without resolution but with smaller reserves created in 1967, indications appeared in 1969 of imminent release of land for development. Frank and the Association became active in a very public campaign for the 'Tiger Country' that followed, leading at first to a proposed compromise with limited releases for agriculture, but ultimately to retention of the whole area and creation in 1979 of Ngarkat Conservation Park. Camp-outs that detected the presence of a number of birds of conservation significance had been held in the Crown Lands in 1967 and 1971. In the meantime he had responded publicly to landholder pressure for the partial resumption of existing reserves, to which the Government appeared likely to agree. A number of SAOA members participated during 1968 in one particularly important campaign to protect Hambidge Conservation Park, about 45% of which might have been lost otherwise.

While a passionate advocate for conservation Frank was also a keen and careful bird-observer. There is little doubt that his most exciting observations (and certainly the most significant) began on 9 October 1965 at the annual camp-out on southern Yorke Peninsula when he obtained several brief views of a skulking bird, whose loud and far carrying calls had first been reported by Brian Glover in January of that year but remained unidentified. Frank believed that the bird belonged to an unknown population of Western Whipbird which, at the time, had not been recorded anywhere in the State for nearly

thirty years. After examining skins in the South Australian Museum he overcame the Curator Herb Condon's scepticism and, with Condon and Max Waterman's mist-netting crew, returned to Pondalowie Bay on 30 October when his identification was thoroughly confirmed (Condon 1966).

In 1963 Frank joined the public service within the Department of Agriculture and in 1965 became Local Government Liaison Officer with State-wide responsibility for weed control. He left the Department in 1971 and began to modify production at Coromandel Valley, introducing potatoes and later strawberries. He developed the Coromandel Shopping Centre on family land in 1976.

Frank served a second term as SAOA Vice-President from 1976 to 1979 and continued to enjoy SAOA camp-outs with his family through that period, notably exploiting the capabilities of a canoe at Lake Merretti in 1976 (Vincent 2000), but we saw little of him thereafter. Unrecognised bipolar affective disorder began to have an increasing effect on him. He invested compulsively in speculative ventures and fell seriously into debt twice within a few years in the 1980s and was obliged to sell much of his property. Frank was a battler and engaged enthusiastically in heavy labouring work such as fencing until a serious back injury brought an end to it. Coronary heart disease presented next and was the cause of his demise. He is survived by his wife Catherine, two daughters and two sons, and five grandchildren.

Sources: son Frank, Brian Blaylock and conservation collaborators Bob Brown, Ron Gibbs, Dick Schodde and Anne and Peter Reeves.

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Book Review

Finding Australian birds: a field guide to birding locations

TIM DOLBY AND ROHAN CLARKE. 2014

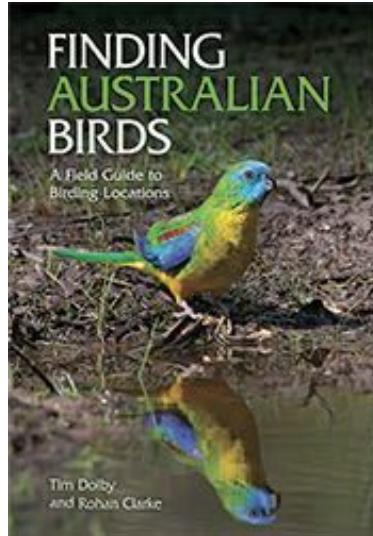
*CSIRO Publishing, Collingwood, Victoria. A\$49.95.
Paperback, 624 pages, numerous photographs and maps.*

This is a beautifully illustrated addition to the stable of books that began with John Bransbury's *Where to find birds in Australia*. It is most similar to the second edition of Thomas and Thomas, *Birds of Australia* as both now cover all the mainland Australian States, plus the offshore islands and territories. Trips to Ashmore Reef and some contact information for pelagic trips around Australia are also covered. In a word, it provides an impressive coverage for any Australian or international birdwatchers planning a visit anywhere in Australia and its territories.

To put the book through its paces I reviewed the sections with which I am most familiar or have visited myself: South Australia and Christmas, Cocos (Keeling) and Lord Howe Islands.

It is useful to first consider the authors' advice on how to use the book. There are two target audiences: birders with general interests and birders with specific target species in mind. For those with general interests it provides lists of birds that may usually be found at many locations both in major cities and in national parks, reserves, coastlines, saltfields and wetlands. Some information is also given for non-birding family members about other attractions near the selected birding sites.

For those with specific target species in mind more specific detail in the form of mud-maps, habitat descriptions and photographs is provided.



For some species such as the Plains Wanderer this is particularly important because habitat can vary significantly over relatively short distances.

The layout of the book follows a sensible pattern with a separate section for each State. Each State is divided into birding regions with birding highlights for each. Each region is then further divided into important birding sites. South Australia is divided into two regions:

1. Adelaide and the South East and,
2. Arid Lands: the Flinders Ranges, Eyre Peninsula and the South Australian outback.

To my eye this is far too crude a division, sometimes leading to juxtaposition of sites that are widely separated, not to mention habitat differences. For example, Gluepot Reserve and other Murray Mallee locations are combined with Eyre Peninsula and the Strzelecki and Birdsville Tracks.

A larger number of regions for South Australia would facilitate planning, particularly for international visitors, as the distances between sites within each region are considerable. Restricting the Adelaide Region to Adelaide, the Mount Lofty Ranges, Dry Creek, Port Gawler, Goolwa and Kangaroo Island and treating the South East as a separate region would make more sense.

Similarly, the second region is too wide-ranging to be compatible with the sites selected. Breaking it into six areas: Arid Lands to the west of Ceduna, Flinders Ranges, the SA outback, Eyre

Peninsula, Yorke Peninsula and the Murray Mallee would align the sites selected with regions so Innes National Park on Yorke Peninsula would not be followed by Gluepot in the Murray Mallee.

On the selection of sites there is little to quibble with. They are the premier sites in SA and most SA readers will be familiar with them. The renaming of Dublin near Thompson Beach as *Dunlin* is an amusing slip of the sort inevitable in a book written by and for birdwatchers. Other errors are more important as they may lead international visitors astray. They should be corrected in a revised edition. Examples are access to Price Saltfields, Koonchera Dune, Buckland Park Lake and pelagics from Port MacDonnell.

Price Saltfields has been closed to birdwatchers since December 2012. As visiting birders are instructed to contact Birds SA to get the latest information on access to sites, that information can fortunately be made available. Similarly, the track to Koonchera Dune has been gated and locked. Sites for Grey Grasswren are still available directly off the Birdsville Track nearby or on the Inside Track, when open.

It is implied that Buckland Park Lake is easily accessed from Port Gawler Road. Generally that is not so and a key to Dry Creek Saltfields is required. Combining these two locations and Greenfields Wetlands, Magazine Road is the way to go.

The reference to pelagic boat trips from Port MacDonnell implies that they are organised by BirdsSA. That is not the case. They are organised privately with the skipper who has the necessary commercial charter licence and insurance.

Turning to the islands, they can be divided into two types: islands to the north of Australia that attract a seemingly never-ending stream of Asian vagrants and islands in the Pacific and Southern Oceans that have breeding colonies of seabirds. Christmas and Cocos(Keeling) Islands belong in the first group and are particularly attractive destinations for those birders seeking to boost

their Australian list. They have a limited number of endemics but their main attraction is the unknown menu of Asian vagrants that may be found. For other birders both islands offer very scenic locations and, with a little luck, excellent views of the endemics. From my limited experience the descriptions of sites on both islands are excellent. Time of year is an important factor to consider when visiting these locations.

Lord Howe Island falls into the second category and is a major breeding site for a number of seabirds: White and Sooty Terns, Black-winged and Providence Petrels, and Little Shearwater to name a few. Again time of year is important. All of these species can be seen from land but most seabirders will want to take a trip to Ball's Pyramid to see White-bellied Storm Petrel, Grey Ternlet and Kermadec Petrel.

My only quibble with the information provided for these islands is the lack of a map showing the key birding locations. Although excellent directions to the sites are given, nothing beats a good mud-map for planning purposes.

To sum up, despite the issues raised, this book is an important addition to existing books on where to find birds in Australia. Australian listers will find the sections on the northern islands and territories of most interest, given the experience of at least one of the authors in the area, but there is plenty of information for birders of all degrees of skill and interest. It is well worth having if you plan to go birding anywhere 'new' in Australia.

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