SOUTH AUSTRALIAN
ORNITHOLOGIST
VOLUME 47 - PART 1 - August - 2022

Journal of
The South Australian Ornithological Association

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Adelaide Rosella *Platycercus elegans adelaidae*, Mount Barker, March 2012

Image Kevin Williams

Print Post Approved 100004336

Plumage diversity in the Adelaide Rosella: a case for taxonomic revision

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ABSTRACT – In a quantitative and statistical analysis of plumages in the Adelaide Rosella we show variation throughout its distribution and latitudinal change from chiefly red in the south through orange in the centre to yellow in the north, consistent with Gloger's ecophenotypic rule. We find that the change is clinal through southern and central populations, whereas a northern population in the South Flinders Ranges is essentially allopatric and shows no recognisable latitudinal change. Sexual dichromatism is present in northern populations. Our results highlight the potential influence, on plumages at endpoints in the cline, of the Kangaroo Island Rosella in the south and Flinders Rosella in the north, suggesting past and/or continuing gene flow. We propose a taxonomic revision for the Adelaide Rosella that reflects our findings.

INTRODUCTION

The Crimson Rosella *Platycercus elegans* (Gmelin, 1788) group of parrots occurs widely in eastern and south-eastern Australia, west to the South Australian gulfs (Forshaw 1981), in a complex pattern of distribution and variation that has defied taxonomic consensus for over a century (Mathews 1912, 1913, 1916–17, 1918, 1920, 1930, 1931, 1946; Ashby 1917, 1925; Cayley 1938; Condon 1941; Cain 1955; Keast 1961; Schodde 1997; Collar 1997; Joseph *et al.* 2008; Forshaw and Knight 2011).

Two isolated populations, *P. e. nigrescens* Ramsay, 1888 and *P. e. filewoodi* McAllan and Bruce, 1989, are present in northern and mid-eastern Queensland respectively. Populations at present recognised as the nominate subspecies *P. e. elegans* are part of a widespread south-eastern Australian clade that is sister to the forementioned pair in the phylogenetic analysis of Joseph *et al.* (2008). They extend from south-eastern Queensland into south-eastern South Australia, north and west to Bordertown, Keith and Salt Creek (see Gazetteer for SA localities). In the same clade, the Yellow Rosella *P. e. flaveolus* Gould, 1837 occurs in River Red Gum *Eucalyptus camaldulensis* forests and adjacent woodlands of the Murray, Murrumbidgee, Lachlan and lower Darling Rivers. In South Australia it has been recorded south to the mouth of the Marne River at Wongulla and to Mannum (Figure 1; Mathews 1912; Condon 1968; Schodde 1997).

Finally, there is a phenotypically and taxonomically complex but genetically coherent group (Joseph *et al.* 2008) of South Australian populations occupying the South Flinders Ranges, Mid North, Mount Lofty Ranges, Fleurieu Peninsula and Kangaroo Island (Figure 1; see https://birdssa.asn.au/wp-content/uploads/Crimson-Rosella-28-05-2020.png for details of distribution across the state). The Crimson Rosella on Kangaroo Island is the distinctive deep crimson subspecies *P. e. melanopterus* North, 1906. All remaining populations across the Flinders and Mount Lofty Ranges regions are variable and are conventionally known as the Adelaide Rosella, whose unsettled early taxonomy is summarised in the Appendix. It is now well known that some Adelaide Rosellas of the Fleurieu Peninsula are scarlet in body plumage and are assigned to *P. e. fleurieuensis* Ashby, 1917. Ashby (1918) gave their northern

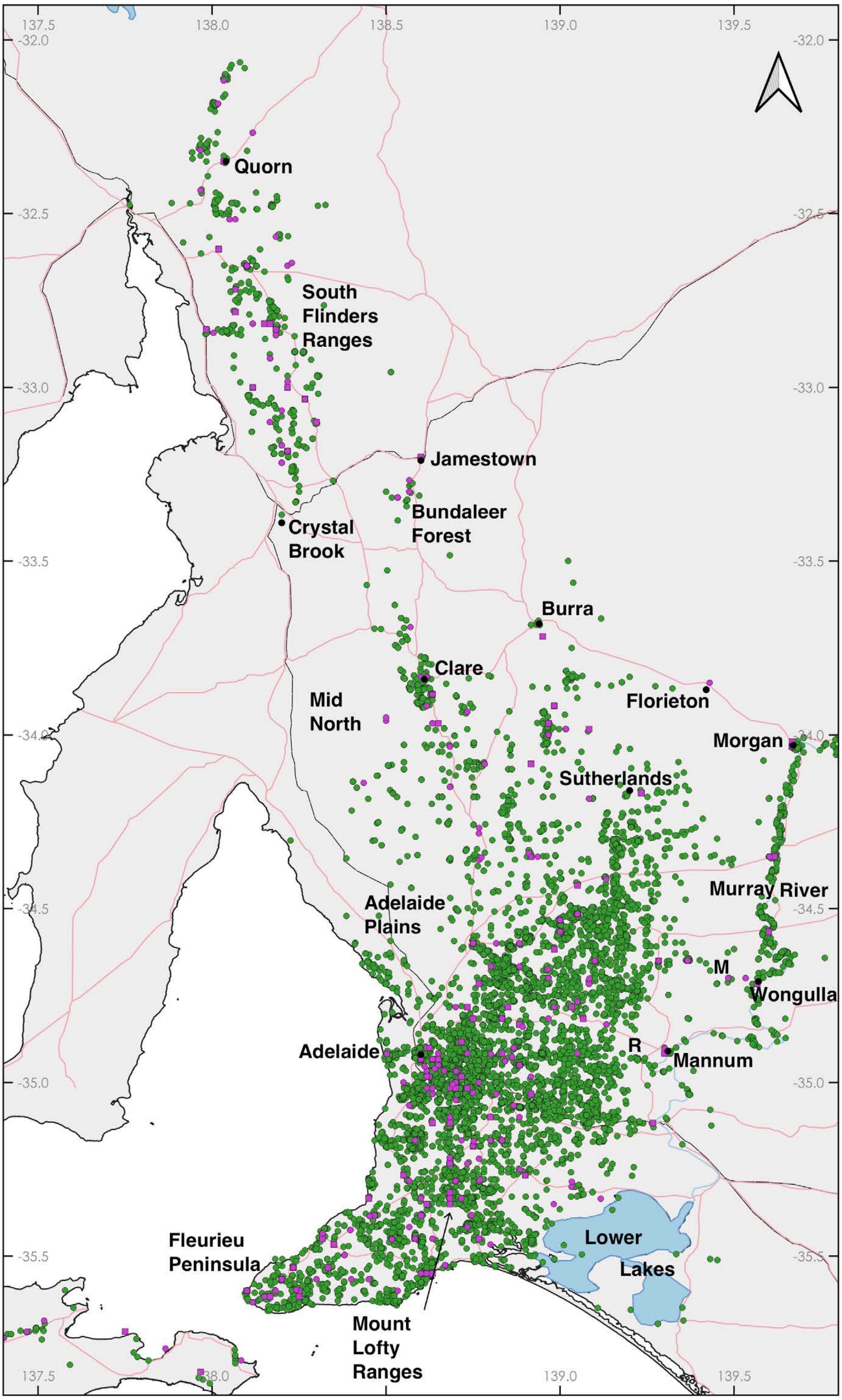

Figure 1. Map of specimen (purple) and sight (green) record localities for the Adelaide Rosella, and for the Yellow Rosella along the Murray River, showing contact between the two at the junction of the Marne (M) and Murray Rivers at Wongulla and more tenuously further south along Reedy Creek (R) near Mannum. The largely isolated population of Adelaide Rosellas in the South Flinders Ranges and some Kangaroo Island Crimson Rosella records are also shown.

limit as Meadows, but Schodde (1997) defined it as the Inman and Bungala Rivers (Normanville and Yankalilla), Hindmarsh Valley and Crows Nest Range [*sic* = Road] northwest of Port Elliot. Adelaide Rosellas in the South Flinders Ranges by contrast are predominantly yellow and were earlier considered Yellow Rosellas *P. (e.) flaveolus* (Campbell 1900; North 1912; Ashby 1917, 1925; RAOU 1926; Mathews 1930, 1931). Now assigned to *P. e. subadelaidae* Mathews, 1912, they are distributed in eucalypt forests and woodlands from the Beetaloo Valley north of Crystal Brook, north to beyond Quorn as far as Buckaringa (Schodde 1997) (Figure 1).

The geographically intervening central populations of Adelaide Rosella are intermediate in colour, generally orange but highly variable. They range through the Mount Lofty Ranges, extending west onto the Adelaide Plains and east to the Murray River and Lower Lakes and sporadically beyond the Murray. Northwards they are recorded in the hills beyond Bungaree (north of Clare) and near Burra, and north-east to Sutherlands (Boehm 1959), Florieton (Forshaw 1981; Schodde 1997) and Brookfield Conservation Park (Birds SA records). A small outlier occurs around Jamestown and Bundaleer (Figure 1).

Condon (1941: 136) described the progression in colour changes from south to north as a 'well defined geocline series which comprises *fleurieuensis*, *adelaidae* and *subadelaidae*' and retained all three subspecies in subsequent lists (Condon 1968, 1975), but Schodde (1997) treated the geographically and phenotypically intermediate group (*adelaidae*) as an intergradient or hybrid population and taxonomically as *P. e. subadelaidae* – *P. e. fleurieuensis*. This entity, now lacking a subspecific name, is consequently missing from BirdLife Australia's Working List of Australian Birds (https://www.birdlife.org.au/conservation/science/taxonomy). The name *P. e. adelaidae* Gould, 1840 continues nonetheless to be applied in published accounts, either to these extensive central populations or to all Adelaide Rosellas (Collar 1997; Higgins 1999; Eckert 2000; Gower 2012; Carpenter and Black 2015; Ribot *et al.* 2019). As if to emphasise the taxonomic uncertainty of the central group, Forshaw and Knight (2011) labelled them *P. e. fleurieuensis* x *P. e. subadelaidae* x *P. e. flaveolus.*

The naming of subspecies as geographically restricted, differentiated populations within the species acknowledges their potential for evolutionary independence and their significance as units of conservation management (Schodde and Mason 1999; Rising 2007; Remsen 2010; Patten 2015; Patten and Remsen 2017). Present taxonomy of the Crimson Rosella complex (Schodde 1997) supposes that, within their defined distributions, the two named Adelaide Rosella subspecies are of a consistent and diagnosable phenotype, while the intervening population, being of hybrid origin, is variable and less readily defined. Yet varied plumage has been reported within the distribution of *P. e. fleurieuensis* (Ashby 1917; Lendon 1968, 1973; Higgins 1999) and, although not explicitly by most authors, also in *P. e. subadelaidae* (Morgan in North 1912; L. Pedler, pers. comm.).

In this study, we provide qualitative information on plumage colouration in the Crimson Rosella complex and a quantitative analysis of plumage variation in the Adelaide Rosella across its range. We test which of the following patterns is best supported statistically in seeking the most appropriate taxonomic treatment:

1. A single clinally variable population and therefore one subspecies.

2. Two populations (as subspecies) *sensu* Schodde (1997): one northern in the South Flinders Ranges and predominantly yellow, a second from the Fleurieu Peninsula and predominantly red, and a hybrid/intergradient zone between them.

3. Two populations: one northern, predominantly yellow, in the South Flinders

Ranges and the second comprising all other populations from the Fleurieu Peninsula to Bundaleer. This also warrants two subspecies.

4. Three populations *sensu* Condon (1941, 1968, 1975): red in the Fleurieu Peninsula, orange in the extensive central distribution and yellow in the South Flinders Ranges. This warrants three subspecies.

METHODS

Plumage

One of us (AB) first assessed plumage colouration of adult specimens of the Crimson Rosella complex in the South Australian Museum, Adelaide (SAMA) by reference to the colours of Smithe (1975). They comprised 173 Adelaide Rosellas, 17 Crimson Rosellas from the South East of South Australia and Victoria, 13 from Kangaroo Island, and 13 Yellow Rosellas. Adults were recognised by black lesser wing coverts and the absence of green in body plumage.

A plumage scoring method was developed, each specimen given a value (0–6), according to the colouration of dorsal and ventral plumage, following a method described below and applied by Bocalini and Silveira (2015), Black *et al.* (2019) and Lima *et al.* (2020). Using this scoring method, all adult specimens of the Adelaide Rosella in SAMA and the Australian National Wildlife Collection, Canberra (ANWC) (total N = 424) were assessed by AB in the final survey. Upperparts assessed for colour were nape and rump and the fringes of black-centred mantle and scapular feathers and tertials; underparts examined included breast, belly, flanks, vent and undertail.

Plumages of Adelaide Rosellas were scored within the range of colours between those of Yellow Rosellas and Crimson Rosellas, as follows:

- **0:** bright yellow above and below with a red-orange frontal band and sparse orange on the underparts in some (Yellow and palest Adelaide Rosellas);
- **1:** yellow or creamy yellow above and yellow below but with mottled orange in the breast, vent and undertail;
- **2:** as for 1 but more extensively orange below;
- **3:** creamy yellow above but largely or fully orange below, or orange above but with orange and yellow below;
- **4:** fully orange above and below;
- **5:** red (scarlet) below but orange or paler above;
- **6:** truly red both above and below (as in typical Crimson Rosellas).

In view of the close similarity between Yellow Rosellas and the palest Adelaide Rosellas, we scored both and compared their plumages closely to investigate possible distinguishing traits.

The names and numbers of Smithe's colours used in this study and their relationship to the scoring of Adelaide Rosellas are shown in Table 1.

Statistical analysis

The extent to which variation in colour score could be partitioned into geographic areas was explored using k-means analysis (MacQueen 1967), which allocates samples into k groups, where k is nominated by the investigator. For this purpose, we used the collection locality to allocate each specimen to one of eight 0.5° latitudinal bands between -36° and -32°. The optimal k value is the one with the lowest within-cluster sums of squares, i.e. with the least variation within each identified cluster. This approach was used to explore whether rosellas from any latitudinal bands were consistently grouped together based on the frequency of colour scores with k values between two and six.

Table 1. Smithe's (1975) named and numbered colours employed in this study, populations where commonly found within the Crimson Rosella complex, and their application in Adelaide Rosella plumage scoring.

Smithe's colour name and number	Common name	Where exemplified in Crimson Rosella complex	Adelaide Rosella plumage score
Carmine (8)	crimson	sspp. *elegans*, *melanopterus*	
Spectrum red (11)	crimson	sspp. *elegans*, *melanopterus*	
Ruby (10)	scarlet (red)	ssp. *fleurieuensis*	5-6
Scarlet (14)	scarlet (red)	ssp. *fleurieuensis*	5-6
Flame scarlet (15)	orange	Typical Adelaide Rosella	3-4
Chrome orange (16)	orange	Typical Adelaide Rosella	3-4
Spectrum orange (17)	orange	ssp. *subadelaidae*	2
Straw yellow (56)	yellow	sspp. *subadelaidae*, *flaveolus*	0-2
Cream color (54)	yellow	sspp. *subadelaidae*, *flaveolus*	0-2
Olive yellow (52)	'lime'	sspp. *subadelaidae*, *flaveolus*	0-2

The Chi-squared statistic and adjusted residuals (Haberman 1973) were used to test for significant differences in the frequency of colour scores at the determined k value.

Regression analyses were used to describe the relationship between colour score and latitude. Linear, quadratic and cubic regressions were calculated. The magnitude of the coefficient of determination (R^2) was used to assess which equation best fitted the data.

Sexual dimorphism in colour score was tested using Oneway Analysis of Variance where the variances were homogeneous, as indicated by Levene's statistic. Where the variances were not homogeneous, a non-parametric equivalent (Mann–Whitney U statistic) was used.

All statistical analyses were performed using IBM SPSS v28 (IBM Corp. 2021). Descriptive statistics are given as mean ± standard deviation.

RESULTS

Plumage

The dorsal plumage of adult Crimson Rosellas *P. e. elegans* is between Smithe's (1975) 'spectrum red' (numbered 11), a bright mid red, and 'carmine' (8) a darker tone justifying the crimson descriptor but of similar hue. Slightly paler yet subjectively red are 'ruby' (10) and 'scarlet' (14). 'Flame scarlet' (15), 'chrome orange' (16) and 'spectrum orange' (17) are progressively paler and more orange hues (see Table 1).

Crimson Rosellas *P. e. elegans* of the South East of South Australia are between spectrum red and carmine above and a little paler below, between spectrum red and ruby. The plumage of the Kangaroo Island subspecies P. *e. melanopterus* is a stronger and darker crimson, closer to carmine above, while approximating spectrum red below.

The bright yellow underparts of adult Yellow Rosellas *P. e. flaveolus* are between 'straw yellow' (56) and slightly duller 'cream color' (54); the posterior neck and mantle and scapular fringes are between 'olive yellow' (52) and straw yellow and the rump is close to olive yellow but paler, described herein as a 'lime' colour.

The plumage of most Adelaide Rosellas, unlike the even toning of truly scarlet individuals, is generally mottled, due to variable basal and terminal yellow in orange body feathers. Variation in the palest specimens depends largely on the extent of orange on the underparts, rather than on differences in hue.

The darkest Adelaide Rosellas from the Fleurieu Peninsula are barely distinguishable from *P. e. elegans*, between spectrum red, ruby and scarlet above, and scarlet below. Such specimens are readily identified as red or scarlet but may be distinguished from the darker crimson P. *e. melanopterus* of Kangaroo Island. Others from the Fleurieu Peninsula resemble Adelaide Rosellas of the Mount Lofty Ranges or suburban Adelaide, the plumage of their underparts varying between flame scarlet and chrome orange. There is much variation in dorsal plumage among these southern Adelaide Rosellas, colouration being strongest on the rump, less consistent on posterior neck and scapular fringes, and with mantle fringes pale and dull in all but the most highly coloured birds (Figures 2 and 5). Further north, rosellas are a paler orange (chrome orange to spectrum orange), with increasing yellow in the plumage (Figures 3 and 6).

The yellow tones of the palest Adelaide Rosellas resemble those of Yellow Rosellas and six specimens with negligible orange in body plumage are barely distinguishable, four from the Flinders Ranges, one from the Marne River and one exceptional specimen from south of Langhorne Creek (Eckert 2000, SAMA B57121, but see below). However, we found subtle plumage differences between the yellowest Adelaide Rosellas and Yellow Rosellas. Orange in the underparts of *flaveolus* appears as a wash of colour over the breast and occasionally the belly, whereas in Adelaide Rosellas with minimal orange, it is present patchily in the breast, vent and undertail and may be absent from the belly. Another distinction is in the red-orange frontal bar which is limited and well defined in *flaveolus* but less distinctly demarcated in Adelaide Rosellas, traces of orange extending diffusely over the crown. Pale yellow Adelaide Rosellas are usual in the Flinders Ranges population, common in parts of the Mid North but uncommon further south. The fringes of mantle and scapular feathers of such pale Adelaide Rosellas, while yellow, are not as consistently bright as in Yellow Rosellas and may be duller than Smithe's 'cream color', as in many typical orange birds (Figures 4 and 7). The rump in pale Adelaide Rosellas generally shows some orange, unlike the plain lime-tinged rump of Yellow Rosellas, but in the Flinders Ranges and Clare region (DD pers. obs. and Figure 4b) rumps are typically lime-tinged, and any orange in rump plumage is the exception.

Variation in plumage scores across the distribution of the Adelaide Rosella is mapped in Figure 8 and shown as a scatterplot against latitude in Figure 9.

Statistical results

In sequential k-means analyses (k = 2–6) of the partitioning of variation in colour score into geographic areas across eight latitudinal bands (Figure 9), the only statistically significant value was k = 2, i.e. two groups were identified, one occurring south of and one north of -34.5° (Figure 10). In addition, the analyses classified bands south and north of -34.5° as different at all k values. The three bands south of -34.5° were first found different from each other at k = 3, whereas bands to the north were classified as different only when k ≥ 4. Thus, the five northern bands were more alike than the three southern bands. There were statistically significant differences between the frequency of colour scores when samples were pooled into the two groups, south and north of -34.5° (χ^2 = 163.1, df = 6, p = 0.0005). The sign of the adjusted residuals divided the two groups. Rosellas with colour scores ≥ 3 (redder) were over-represented south of -34.5°, whereas rosellas with colour scores of 1 or 2 (yellower) were over-represented to the north (Table 2).

A quadratic equation ($y = 0.0372 + 22.5x + 0.34x^2$) most parsimoniously described the relationship between colour score and latitude. Latitude explained (R^2 x 100 =) 53.4% of the variance in colour score. Moving from south to north the average colour score declined steeply to about -34° and was virtually flat north of -33.5° (Figure 9).

Variances in colour score between samples were not significantly different south of -34.5° (Levene's statistic = 0.131, p = 0.718) and there was no significant difference in colour score between females (3.36 ± 1.045, n = 64) and males (3.12 ± 1.097, n = 198; $F_{1,260}$ = 2.332, p = 0.128). In contrast, north of -34.5° variances in colour score were significantly different (Levene's statistic = 6.073, p = 0.015) and colour scores were significantly different between the sexes (Mann–Whitney U = 1394, p = 0.002). Females had a higher average colour score and lower variance (1.98 ± 0.69, n = 46) than males (1.56 ± 0.76, n = 87).

DISCUSSION

Fleurieu Peninsula and Flinders phenotypes

Many Adelaide Rosellas on the Fleurieu Peninsula are scarlet but not all (Ashby 1917). We confirm that exceptionally vivid individuals occur there but only a minority are of the reddest hue both above and below and others resemble Adelaide Rosellas elsewhere. Higgins (1999) found less variation in plumage among Fleurieu birds than north of Myponga but recognised a continuous cline in colouration. Some Fleurieu Peninsula residents report both 'Crimson Rosellas' and 'Adelaide Rosellas' in the region after comparing their observations against illustrations in field guides, one commenting on their 'interbreeding', presuming that the variety of intermediately plumaged birds represented 'hybrids' (pers. comm. to AB). While technically incorrect, these are reasonable interpretations of the variety there (AB pers. obs.).

North and east of the Inman and Hindmarsh Valleys, as far as Kuitpo and Meadows (Ashby 1917, 1918; this study), many highly coloured birds can be found among paler individuals. North of -35°, about the latitude of Adelaide and Mount Barker, rosellas are generally orange or orange and yellow. Fully orange birds are rare north of the Barossa, but we found one such example among the large Bundaleer Forest sample (Figure 8).

Table 2. Observed and expected frequencies of seven colour categories in Adelaide Rosellas south and north of -34.5°. Adjusted residuals indicate the magnitude of differences in observed frequencies from random expectations, * p < 0.05, ** p < 0.01. Negative adjusted residuals indicate under-represented cells; positive values indicate over-represented cells.

Colour score	South		North		Total
	Observed number (expected)	Adjusted residual	Observed number (expected)	Adjusted residual	
0	1 (2.6)	-1.7	3 (1.4)	1.7	4
1	11 (48.5)	-10.1**	63 (25.5)	10.1**	74
2	69 (85.2)	-3.6 *	61 (44.8)	3.6*	130
3	87 (67.5)	4.6*	16 (35.5)	-4.6*	103
4	88 (59.7)	7.1**	3 (31.3)	-7.1**	91
5	13 (8.4)	2.7*	0 (4.5)	-2.7*	13
6	9 (5.9)	2.2*	0 (3.1)	-2.2*	9
Total	**278**		**146**		**424**

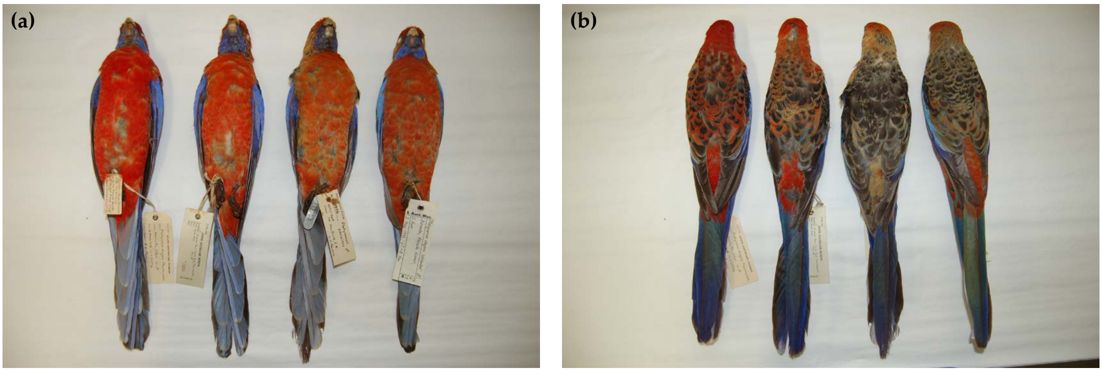

Figure 2. **(a)** Ventral view of some darker Adelaide Rosellas, all males. From left to right: SAMA B22774 Cape Jervis, SAMA B19716 8 km S of Delamere, SAMA B23956 Mt Hayfield, all Fleurieu Peninsula, SAMA B16912 Burnside, suburban Adelaide. Note subtle variation in tone among Fleurieu birds and the strongly coloured Burnside bird. **(b)** Dorsal view of the same specimens and in the same order. Variation is more evident among Fleurieu birds. From left to right, they were scored 6, 5, 3 and 4 respectively. Images P. Horton

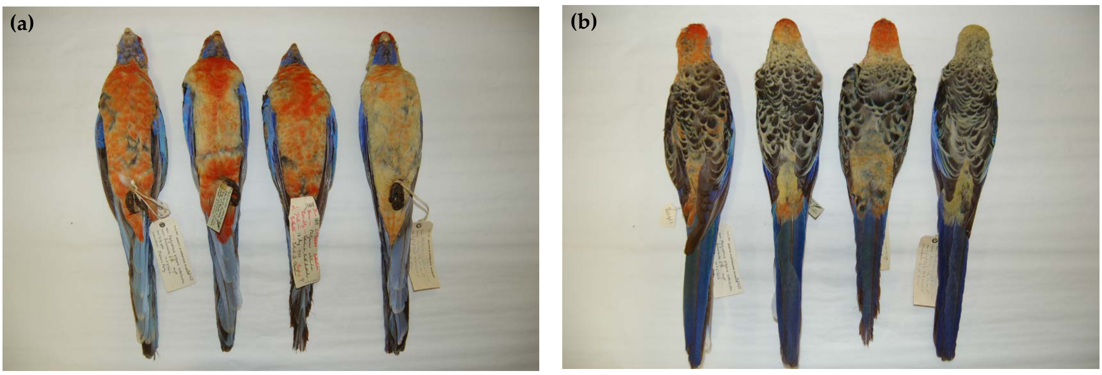

Figure 3. **(a)** Ventral view of some orange Adelaide Rosellas, all males. From left to right: SAMA B27636 Gumeracha, SAMA B22767 Chain of Ponds, both Mount Lofty Ranges, SAMA B22235 Sutherlands, SAMA B23852 Brady Creek west of Robertstown, both Mid North. Despite much variation, all show some orange on vent and undertail plumage. **(b)** Dorsal view of same specimens in same order. All show some orange in rump plumage. From left to right, they were scored 3, 2, 3 and 1 respectively. Images P. Horton

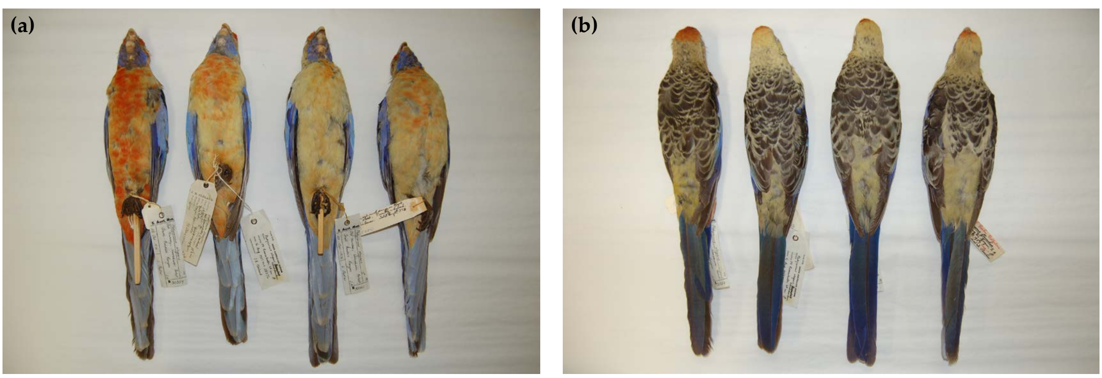

Figure 4. **(a)** Ventral view of some paler (yellow) Adelaide Rosellas, all males. From left to right: SAMA B30359 Wirrabara Forest, SAMA B28276 Mount Remarkable, SAMA B30360 Wirrabara Forest, all Flinders Ranges, SAMA B25080 Morgan, labelled *flaveolus*. The Morgan specimen shows traces of orange on vent and undertail plumage, an Adelaide Rosella trait. **(b)** Dorsal view of same specimens. Note traces of orange on the crown but absence of any orange in rump plumage. From left to right, they were scored 2, 1, 0 and 1 respectively. Images P. Horton

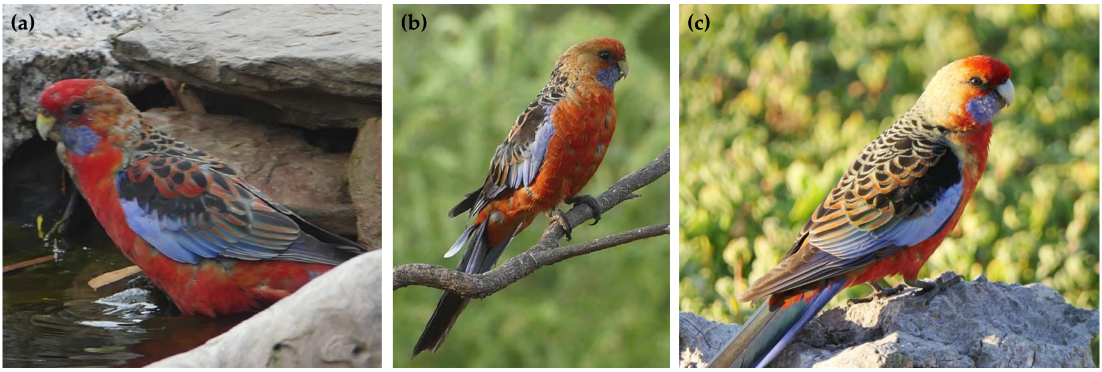

Figure 5. (a) A scarlet Adelaide Rosella, Victor Harbor. Image G. Dare
(b) A more typical Adelaide Rosella, Victor Harbor. Image G. Dare
(c) A pale Fleurieu Peninsula Adelaide Rosella, Waitpinga. Image E. Steele-Collins

Figure 6. (a) A brightly plumaged Adelaide Rosella, Scott Conservation Park. Image R. Daly
(b) A typical Adelaide Rosella, Burnside. Image G Dare
(c) A pale Adelaide Rosella, Barossa Valley. Image G. Dare

Figure 7. (a) A Flinders Ranges Adelaide Rosella, Telowie Gorge. Image G. Dare
(b) Male (above) and female Flinders Rosellas. Image B. Haase
(c) A yellow Adelaide Rosella, Clare. Image D. Donato

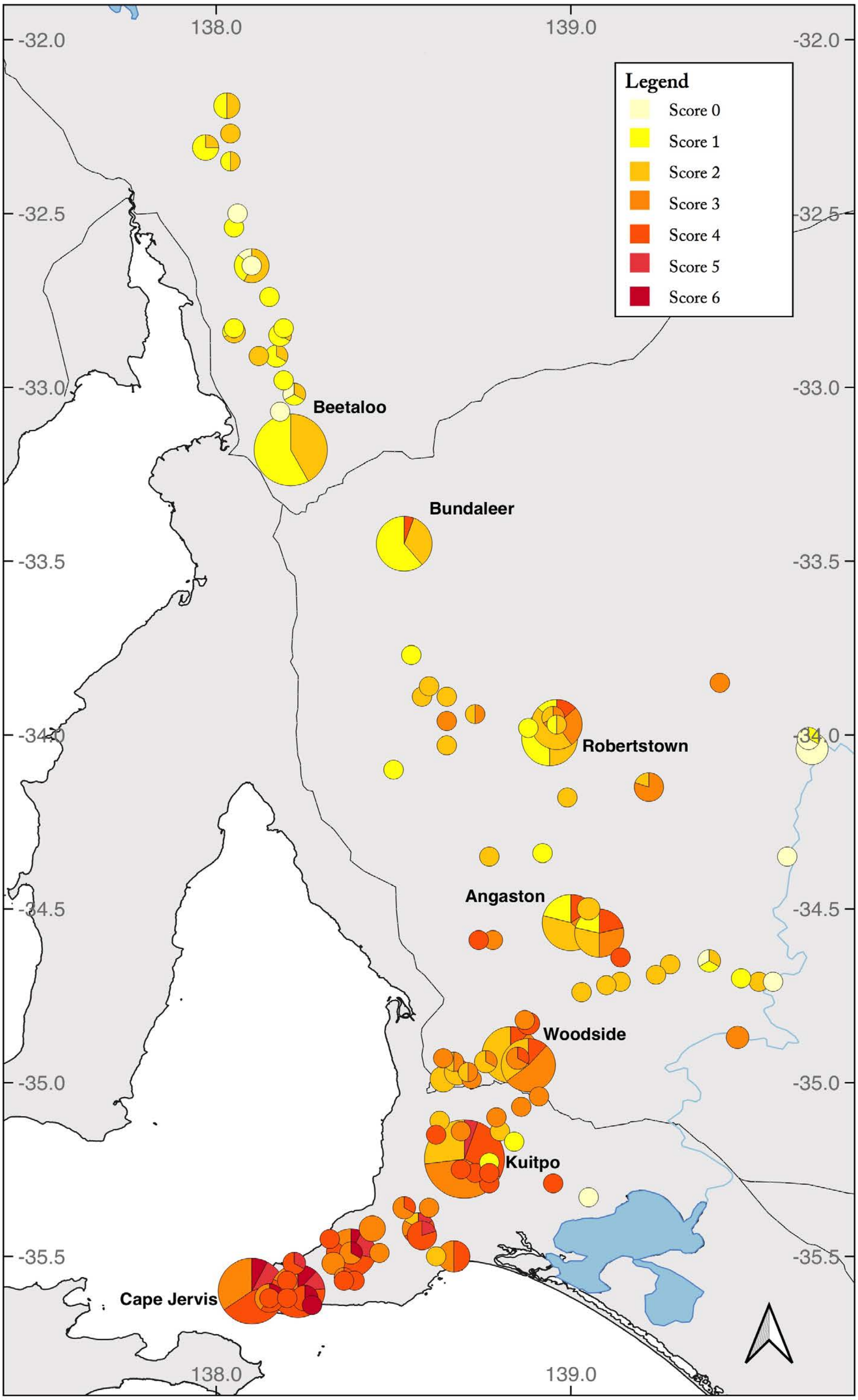

Figure 8. Map showing plumage scores for all Adelaide Rosella specimens examined, together with Yellow Rosella specimens from Morgan and downstream. The smallest circles represent single specimens.

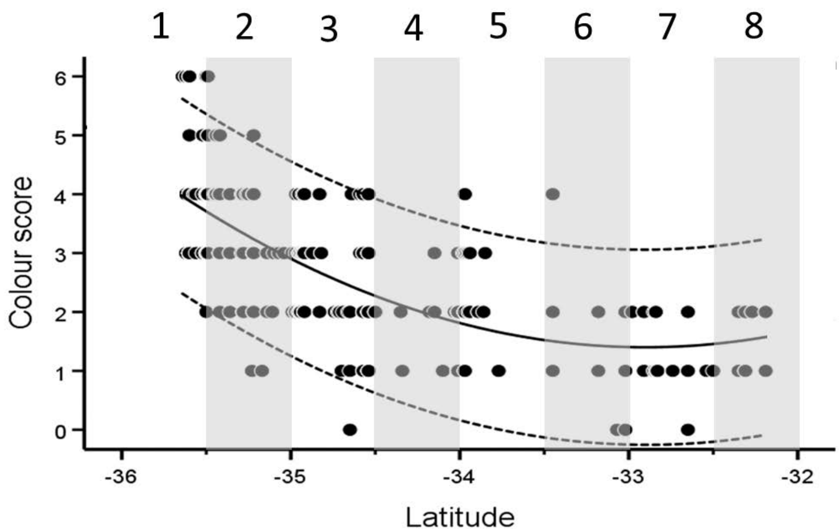

Figure 9. Scatterplot showing the relationship between colour score and latitude in decimal degrees for 424 Adelaide Rosellas. The solid line shows a quadratic regression between the two variables ($R^2 = 0.534$). Dashed lines indicate 95% confidence intervals. Alternating white and grey vertical bands indicate the 0.5° bands into which skins were placed for k-means analysis. These bands are numbered from 1 in the south to 8 in the north.

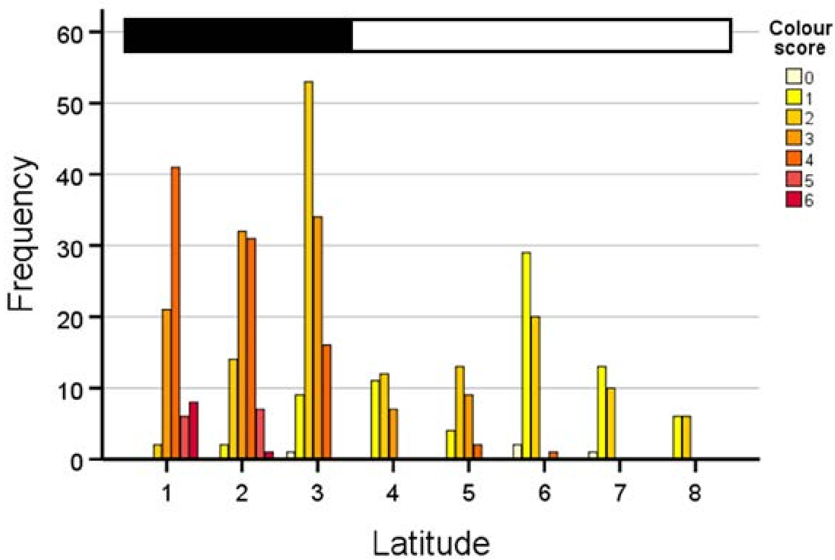

Figure 10. Frequency of colour scores across eight 0.5° latitudinal bands running from south (1) to north (8) for 424 Adelaide Rosellas. The horizontal bar above the graph indicates the division of the latitudinal bands into two groups as determined by k-means analyses.

The largely isolated South Flinders Ranges population is pale and mostly yellow. Morgan (in North 1912: 120) first questioned its treatment as a Yellow Rosella while living at Laura between 1893 and 1897 (Horton *et al.* 2018), observing that some birds there had such 'a great deal of red about them' that they resembled Adelaide Rosellas. We confirm such variation. While some exhibit limited orange on breast, vent and undertail, a few as little as Yellow Rosellas, others are more extensively orange below. This population is separated by about 30 km from the population of rosellas near Bundaleer, and about 50 km from those north of Bungaree, the consequence of intervening naturally treeless *Lomandra* tussock grasslands (Specht 1972). Plumages on either side of those discontinuities are however generally similar (Ashby 1917; DD pers. obs.; L. Pedler pers. comm.; this study). Thus, pale yellow birds with limited orange extend south through the Clare district, and rosellas with fully orange underparts are not seen there. These predominantly yellow Adelaide Rosellas have the same lime-coloured rumps as Yellow Rosellas, with few and minor exceptions, whereas many elsewhere in the Mid North show some orange in rump plumage.

Sexual dimorphism

Condon (1941), Lendon (1973) and Hutchins and Lovell (1985) referred to the male rosella's larger head and bill, which may be evident in the field (DD and GJ pers. obs.). Higgins (1999) noted differences in dorsal and underwing plumage. Lendon (1968, 1973), Forshaw (1969, 1981) and Hutchins and Lovell (1985) reported sexual dichromatism in paler populations, with females showing more orange plumage than males. It is the experience of DD in the Clare district that only males are of the yellowest form and that females may have more extensively orange underparts. Our data confirm the presence of sexual dichromatism in populations (see Figure 7) north of but not south of -34.5°, the latitude of Angaston.

Interaction between Yellow and Adelaide Rosellas

A century ago, Adelaide and Yellow Rosellas were said to meet at Mannum, where W. A. [= W. T.] Angove 'took their [= Adelaide Rosella] eggs ... in October 1907' (North 1912: 118), and at Schuetze Landing, a little upstream of Mannum (E. Ashby in Mathews 1917). Ashby (*loc. cit.*) believed that the two forms merged there but residents considered each was separately represented. Further north, Lendon (1973) observed both on the lower Marne River and collected a Yellow Rosella (SAMA B24749) about three kilometres upstream of Wongulla; he too believed that they remained separate. Other authors have assumed that interbreeding occurs through contact along the Marne (Cain 1955; Condon 1968; Forshaw, 1969, 1981; Hutchins and Lovell 1985; Schodde 1997; Eckert 2000) and surrounding mallee lands (Forshaw 1981; Schodde 1997). Some have suggested that this also occurs along Burra Creek to its entry into the Murray at Morgan (Condon 1968; Hutchins and Lovell 1985) or across the Mount Mary Plains east of Sutherlands (Boehm 1954, though retracted 1959; Schodde 1997). Recent records, including specimens (Figure 1), indicate an uninterrupted distribution between Yellow and Adelaide Rosellas through Wongulla and the Marne River. A more tenuous connection is shown downstream from Wongulla to Mannum and along Reedy Creek (Figure 1) and the minor drainages nearby of Saunders and Shepherd Creeks (AB pers. obs.), records being sparse in the region otherwise (SAOA 1977; Paton *et al.* 1994). Lendon (1968) and Cox (1973) found Yellow Rosellas to be rare south of Wongulla and Cox (1973) saw Adelaide Rosellas only occasionally nearby at Reedy Creek during 28 months residence at Mannum, suggesting a change since the beginning of the 20th century. Recently, Adelaide Rosellas are reliably reported along Reedy Creek and on both banks of the Murray at Mannum (AB pers. data).

Joseph *et al.* (2008) found Yellow and Adelaide Rosellas to be genetically distinct and, in their supplementary material, drew attention to the meagre specimen record and imperfect identification of pale rosellas within the potential contact zone between Morgan and Mannum. In particular they questioned the holotype locality of the presently unrecognised *P. flaveolus innominatus* Mathews, 1912 reportedly taken by Ashby at Mannum (AMNH 627551) (Figure 11). We have examined a second *flaveolus* skin from 'near Mannum' according to its original label, SAMA B52248, collected by S. A. White in November 1913. Among 11 skins labelled *P. e. flaveolus* from south of Morgan, we detected Adelaide Rosella traits, the presence of orange in undertail plumage, in three: SAMA B25080 from Morgan (1957; see Figure 4), SAMA B52247 (1913) from between Morgan and Blanchetown and Lendon's specimen SAMA B24749 (1956) from west of Wongulla and thus on the Marne. Of eleven other specimens from the Marne River or from near Cambrai, which is on the Marne, seven are typical Adelaide Rosellas but four are very pale, suggesting intergradation, with two, ANWC 11806 and ANSP 191255, close to the *flaveolus* phenotype but with faint orange over the crown and in undertail plumage (Figure 11).

Figure 11. Ventral and dorsal views of the holotype of *P. flaveolus innominatus* Mathews, 1912, AMNH 622751 Mannum (left in each) and Marne River specimen ANSP 191255. Note only a trace of orange on the upper breast of the former and widespread, orange-tinged feathers on underparts and crown of the latter. Compare the latter with SAMA 30360 from Wirrabara Forest in Figure 4. Image L. Joseph

Eckert (2000) reported possible sight records of Yellow Rosellas north-east of Strathalbyn and obtained a specimen south of Langhorne Creek in December 1995 (SAMA B57121) that he found identical to that form. We accept his identification but suspect an escaped cage bird, since a Yellow Rosella specimen obtained by Eckert on an unstated date (SAMA B57120) is from a nearby aviary.

The degree to which Yellow and Adelaide Rosellas have been in contact historically, while confidently and frequently asserted, remains unclear. Enzyme electrophoresis (Joseph and Hope 1984) provided evidence of introgression but DNA data (Joseph *et al.* 2008) demonstrate their genetic distinction despite low within- and between-population diversity among all south-east Australian populations. At the eastern end of the Yellow Rosella's range, Cain (1955) could not confirm contact with the Crimson Rosella; he postulated that they were terminal components of a 'ring species' in which two reproductively isolated populations are connected by serial intergrading populations, and that 'Casuarina' woodlands represented a habitat barrier. Joseph *et al.* (2008) found the hypothesis unsupported by their data, which revealed genotypic and phenotypic discordances and multiple genetic discontinuities. On the other hand, they did not reject that a continuous circular distribution had been involved in the evolutionary history of the southern Crimson Rosella group.

Clearance of 'Casuarina' woodlands might explain records first documented by Martindale (1974) of Adelaide-like rosellas between Wagga Wagga and Gundagai, New South Wales (Schodde 1997; Higgins 1999; Joseph *et al.* 2008). These intergrades are now readily encountered in both New South Wales and Victoria and specimens are held in North American museums and ANWC (L. Joseph pers. comm.). The clearance of mallee in South

Australia might similarly have disturbed the purported separation of Yellow and Adelaide Rosellas. Because few relevant specimens have been taken since the holotype of *innominatus*, reports of Yellow Rosellas south of Morgan and particularly south of Wongulla might include birds of intergradient phenotype. Observations of Adelaide Rosellas near the river at Mannum, as above, and of rosellas with extensively orange underparts near Weston Flat east of Morgan in November 2018 (AB pers. obs.) and by Roger Schmitke since around 2010 (pers. comm. and photos to AB) provide evidence that the two forms are presently and perhaps increasingly in reproductive contact.

A variable entity

Our results show that Adelaide Rosella plumages vary in a latitudinal cline and individually throughout their range, with red birds predominating in the south and yellow birds in the north. As shown in the Crimson Rosella complex more broadly (Ribot *et al.* 2019), this is consistent with Gloger's (1833) ecophenotypic rule in which heavily pigmented forms occupy more humid portions of a species' range, and lightly pigmented forms the more arid. There has been uncertainty, however, in defining the geographic extent of the cline. Ashby (1925: 89) suggested that there was 'a complete gradation' across all populations and, while Condon (1941) and Cain (1955) appeared to support that view, Forshaw (1981) and Schodde (1997) found that it occurred largely within the central population. Higgins (1999) described a cline with local variation involving southern and central populations but relatively consistent plumage in the South Flinders population. Lendon (1973) and Hutchins and Lovell (1985) held similar views. Variation is present nonetheless in the South Flinders population and latitudinal change within it has not been addressed.

Our regression analysis shows that plumage variation exists as a cline in relation to latitude as far north as the Bundaleer sample at around -33.3° (Figures 8 to 10, Gazetteer), beyond which the curve flattens, and no cline is evident.

The Fleurieu Peninsula contains the scarlet *fleurieuensis* phenotype, but Lendon (1968, 1973) observed paler birds there and rejected Ashby's subspecies. Mathews (1930, 1931) had placed *fleurieuensis* in synonymy and Collar (1997) omitted it. Ashby himself (1917: 43) did not claim that all Fleurieu Peninsula Rosellas were of the scarlet form, only 'a quota of highly coloured birds' being seen in their stronghold between Normanville, Second Valley and Cape Jervis. The scarlet form is represented north to Kuitpo Forest, beyond which most Adelaide Rosellas in the Mount Lofty Ranges and adjacent plains are either fully orange or orange and yellow. Regression studies of plumage score versus latitude reveal no disjunction through this part of the Adelaide Rosella's range.

The *subadelaidae* phenotype of the Flinders Ranges population is of pale largely yellow birds with lime coloured rump and patchy orange restricted chiefly to the breast, vent and undertail. A similar phenotype predominates in the Clare and Bundaleer regions, with orange-rumped birds in a small minority. More extensively orange individuals with orange in the rump are more common immediately to the west near Blyth and to the east south of Burra (DD pers. obs.).

Joseph *et al.* (2008) considered that the Adelaide Rosella is more likely to have resulted from Pleistocene secondary contact between Crimson and Yellow Rosellas than to have evolved independently in isolation but that in either case its present cline developed subsequently as a result of strong selective pressure across an environmental gradient. Alternatively, R. Schodde (*in litt.* to AB) suggested that during Pleistocene arid periods, Fleurieu Peninsula, Mount Lofty Ranges and Flinders Ranges populations contracted into isolates, expanding and intergrading during warmer pluvials, accounting therein for the Adelaide Rosella's present plumage diversity. Earlier, Ford (1977) had suggested that subspecies *flaveolus* had differentiated as a Mount Lofty Ranges isolate before moving northwards to the Flinders Range and eastwards to Murray River woodlands. Joseph *et al.* (2008) found no support for Ford's (1977) hypothesis and inferred that the two yellower subspecies, *flaveolus* and *subadelaidae* evolved independently. While we did not distinguish a small number of *subadelaidae* specimens from Yellow Rosellas quantitatively, subtle plumage differences between the typical phenotype of each supports the independence of these two forms. Furthermore, Higgins (1999) showed that *P. e. flaveolus* is significantly smaller on average than *P. e. subadelaidae* in wing, tail, bill and tarsus length, and weight. There are also differences in juvenile and immature plumages. In young Adelaide Rosellas from throughout its range much of the body plumage is olive green but young Yellow Rosellas more closely resemble adults and are yellow with a pale greenish wash (DD pers. obs.). Lendon (1973) observed that young Yellow Rosellas were generally dull yellowish green, young Adelaide Rosellas being olive green, and Hutchins and Lovell (1985) wrote that some young Yellow Rosellas leave the nest as a dull version of the adult. The successional plumages of maturing birds among members of the Crimson Rosella complex are worthy of further study.

The pronounced diversity in plumage colours among Adelaide Rosellas is uncommon in a natural population. Bocalini and Silveira (2015) and Lima *et al.* (2020) addressed similar taxonomic questions in studies of *Forpus* parrotlets and *Picumnus* piculets respectively in north-eastern South America. Among 518 specimens of the four then named subspecies of *Forpus xanthopterygius*, Bocalini and Silveira (2015) found variation in plumage (scored 0–5) throughout their combined distributions with duller individuals predominating in more humid and brighter in drier habitats respectively. Lima *et al.* (2020) examined two named species (alternatively subspecies) of *Picumnus* piculets where phenotypic intermediates had been reported and another subspecies named. They applied a plumage score (1–5) to 66 museum specimens and 284 photographs of wild birds. Each method produced a similar result, clinal change across the total distribution following Gloger's rule and phenotypic diversity throughout. Those authors argued that the described patterns of plumage diversity represented a single polymorphic species with clinal variation. They revised existing taxonomy, naming a single species with synonyms but no subspecies. Both studies' findings closely parallel ours and, since all Adelaide Rosellas are combined in a single genetically coherent group (Joseph *et al.* 2008), a single name might similarly be applied to that entity.

Yet, while clinal change is present in plumage from the Fleurieu Peninsula through the Mount Lofty Ranges and Mid North, the cline ceases through the Flinders population, where limited diversity of plumage appears consistent throughout. Its relative homogeneity is evident in the map (Figure 8) and in regression studies (Figures 9 and 10), there being negligible latitudinal change north of -33.5°. That population is essentially isolated by tussock grasslands to the south and east and in both these respects our findings differ from those of the above authors. Another allopatric and unvarying population assigned to the same microsatellite cluster as the Adelaide Rosella is the Kangaroo Island Crimson Rosella *P. e. melanopterus* (Joseph *et al.* 2008), whose consistency of plumage and isolation by a sea barrier have hindered its recognition as an integral component of the Adelaide Rosella complex.

The significance of -34.5°

Our analyses (Figure 10 and Table 2) divided latitudinal colour variation into two natural groups, one south of and one north of -34.5°. This latitude was defined by our methods but is not the point of division between the two groups because the cline in colour score continues through it. The latitude reflects a change between wetter mainly hilly localities of the Mount Lofty Ranges in the south and drier mainly plains localities north of the Barossa. It is possible also that it represents an approximate boundary between the influences on plumage colours through introgression from *subadelaidae* in the north and *melanopterus* in the south. The former is most evident in Bundaleer and Clare Valley populations which are clearly intergradient, the latter on Fleurieu Peninsula as long recognised.

Taxonomic implications

Here we turn to the four patterns of plumage variation offered as alternative hypotheses. We reject patterns 2 and 4 because our results provide no basis for recognising Fleurieu Peninsula rosellas as a subspecies, since they merge with the main central population in a cline that extends through the Mount Lofty Ranges and Mid North. Pattern 1 is also rejected, because the South Flinders Ranges population is not part of the cline. Pattern 3 is represented by our data and we consequently recognise two geographically definable subspecies within the Adelaide Rosella. They are (1) the clinally and individually variable central + southern populations, and (2) the less varied, geographically restricted and essentially allopatric northern population of the South Flinders Ranges. For the former, the name *Platycercus elegans adelaidae* Gould, 1840 has priority over *P. e. fleurieuensis* Ashby, 1917. We acknowledge that evidence favours a hybrid origin for this entity. The pattern of colour variation could be explained by local adaptation, secondary admixture of previously differentiated populations, or some combination of the two. Spectrophotometric analysis of colour variation and additional genetic data will be required to test to what extent the variable plumages in Adelaide Rosellas reflect these alternative evolutionary processes.

In summary, we find a cline in adult plumage colour within the Adelaide/Kangaroo Island Rosella lineage (Joseph *et al.* 2008) between uniformly red *P. e. melanopterus*, through variable red, orange and yellow *P. e. adelaidae,* to primarily yellow *P. e. subadelaidae*. The cline is within *P. e. adelaidae* alone, and extends between the two more consistently plumaged populations, separated in the south by Backstairs Passage, the 14 kilometres of sea that isolated *P. e. melanopterus* on Kangaroo Island most recently 8,900 years ago (Belperio and Flint 1999), and in the north across almost treeless grasslands separating Beetaloo, Bundaleer, the Bungaree Hills and Burra. Genetic data suggest that the Adelaide/Kangaroo Island Rosella lineage diverged from other components of *P. elegans* prior to the disjunction of island from peninsula (Joseph *et al.* 2008). Despite the close resemblance of some *P. e. subadelaidae* and *P. e. flaveolus* they belong to separate lineages (Joseph *et al.* 2008).

In accordance with our findings, we identify three subspecies within the Adelaide Rosella complex:

Platycercus elegans melanopterus Kangaroo Island Rosella,
P. e. adelaidae (including *P. e. fleurieuensis* in synonymy) Adelaide Rosella,
P. e. subadelaidae Flinders Rosella.

ACKNOWLEDGEMENTS

We thank Maya Penck and Philippa Horton, South Australian Museum, Adelaide and Leo Joseph, Australian National Wildlife Collection, Canberra for their support of our museum work. Elizabeth Steele-Collins, Bob Daly and Bernie Haase responded to our request for images of the Adelaide Rosella and Geoffrey Dabb provided the reproduction of Gould’s plate. AB enjoyed the late Stephen Walker’s support in assessing Adelaide Rosella plumages in the field. In acknowledging their longstanding interest in and extensive knowledge of the Crimson Rosella complex, we are indebted to Richard Schodde and Leo Joseph for advice over several years and for guidance to pertinent literature. Lynn Pedler kindly shared his extensive knowledge of rosellas in the Mid North. As reviewer, Leo Joseph provided additional insight and encouraged consolidation as well as expansion of the scope of this paper. We received further helpful advice from two anonymous reviewers and from Editor Philippa Horton and we thank Belinda Cale of the editorial team for her inspired reformatting.

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APPENDIX
Early taxonomy of the Adelaide Rosella

Gould

Gould (1840) described the Adelaide Rosella *Platycercus adelaidae* from specimens obtained during his visit to South Australia in 1839 when he collected from the Adelaide Plains, Mount Lofty Ranges and 'Belts of the Murray' (western Murray Mallee) (Carpenter and Black 2015). His illustration of the parrot (Gould 1840–48: Plate 22) was of two distinctly different birds (Figure 12). The body of one is an almost evenly coloured orange, including all underparts, crown, posterior neck, lower back, rump and the fringes of black-centred mantle feathers, scapulars and tertials. The other bird is paler, mostly yellow but with patches of reddish orange, including a frontal bar with diffuse extension over the crown, and on the throat, upper breast, vent and undertail coverts.

Gould expressed 'considerable perplexity from its close similarity in some stages of its plumage' to the Crimson Rosella *Platycercus elegans* but failed adequately to describe the diversity of plumage that his artists figured so strikingly. He wrote that the paler bird was 'an immature bird in the course of change from the green plumage to adult dress' but both are adults. We now understand Gould's 'perplexity' at the similarities of Adelaide and Crimson Rosellas and are accustomed to the great variation in Adelaide Rosella plumage.

Mathews, Ashby and others

Mathews's (1912) 'Reference-list to the birds of Australia' introduced to Australian ornithology the naming of geographically partitioned differentiated populations as subspecies. He interpreted Gould's 'perplexity' in that context, recognising the Adelaide Rosella as a subspecies of the Crimson Rosella with the scientific name *Platycercus elegans adelaidae.* Even more astutely, he named S. A. White's almost yellow rosella from near Port Augusta as *Platycercus elegans* *subadelaidae*, appreciating its similarity to the Adelaide Rosella but differing in its 'less brilliant underparts and reduced red over the crown.' When Mathews (1913) published a further 'List', he had relegated his recently described subspecies *subadelaidae* to synonymy in *P. e. adelaidae* but reinstated it as a separate subspecies in *The Birds of Australia* (Mathews 1916–1917).

Shortly afterwards, Ashby (1917) described a scarlet variant *Platycercus elegans fleurieuensis* from specimens he and Frank Parsons had collected on the Fleurieu Peninsula (Schodde *et al.* 2021). Although he named it as a subspecies of the Crimson Rosella, his preference then (Ashby 1917) was to place both *fleurieuensis* and *flaveolus*, in which he included Flinders and Mid North populations, as subspecies of the Adelaide Rosella. Ashby (1925) further promoted the Adelaide Rosella as a species, explicitly rejecting Mathews's placement of it as a subspecies of *elegans* but conceded that two species might be 'more correct', in which case *adelaidae* and *fleurieuensis* should be subspecies of *flaveolus*. In this indecisive and self-contradictory interpretation, he overlooked or ignored Mathews's insightful treatment of *subadelaidae* and continued to include Flinders and Mid North populations in the Yellow Rosella. Mathews (1920) added Ashby's subspecies *fleurieuensis* in a Supplement to *The Birds of Australia* but, perhaps influenced by Ashby, included *subadelaidae* within the Yellow Rosella as *P. flaveolus subadelaidae*.

Because the naming of subspecies had not yet become established in Australia, the Australian Checklist (RAOU 1926) included them only as synonyms for named species. Adelaide and Yellow Rosellas were listed as species with *subadelaidae* a synonym of the Yellow Rosella and *fleurieuensis* a synonym of the Adelaide Rosella.

Mathews's next listings (1930, 1931) relegated *fleurieuensis* to synonymy in *P. e. adelaidae*; he continued to name the Flinders population as *P. flaveolus subadelaidae*.

Figure 12. Strikingly different plumage patterns in Gould's Adelaide Rosellas.

While Mathews equivocated, Parsons advised Neville Cayley that he believed his co-collector Ashby was 'in error in stating that *Pl. flaveolus* extends through the Flinders Ranges' (Cayley 1938: 155–156). In Parsons's view Flinders birds represented the yellow extreme among Adelaide Rosellas and '*Pl. flaveolus* in South Australia is only found along the Murray'.

Condon (1941) recognised the Yellow Rosella as a subspecies and the Adelaide Rosella as a cline of three subspecies, *fleurieuensis*, *adelaidae* and *subadelaidae*. Cain (1955) followed Condon but was undecided how to represent the cline taxonomically. Both authors implied that all four subspecies interbred.

In his final 'working list', Mathews (1946) named *adelaidae* and *fleurieuensis* as subspecies of *elegans* but was unable to categorise *subadelaidae*. He wrote of it as a 'form (that) may connect [species] *flaveolus* and [species] *elegans*', thus implying cross-species hybridisation but without elaborating on the implications of such a suggestion. Hybridisation between species, let alone the existence of hybrid populations, was a contested topic until well after Mayr's mid-twentieth century elucidation of the 'biological species concept' (Mallet 2005).

Gazetteer of South Australian localities

Locality	Latitude/Longitude	Locality	Latitude/Longitude
Adelaide	34° 56′ S, 138° 36′ E	Marne River (source)	34° 40′ S, 139° 07′ E
Angaston	34° 30′ S, 139° 03′ E	Meadows	35° 11′ S, 138° 45′ E
Beetaloo (Reservoir)	33° 11′ S, 138° 13′ E	Morgan	34° 02′ S, 139° 40′ E
Blanchetown	34° 21′ S, 139° 37′ E	Mount Barker	35° 05′ S, 138° 52′ E
Blyth	33° 51′ S, 138° 29′ E	Mount Compass	35° 21′ S, 138° 37′ E
Bordertown	36° 19′ S, 140° 46′ E	Mount Hayfield	35° 31′ S, 138° 20′ E
Brady Creek	33° 58′ S, 139° 00′ E	Mount Mary	34° 06′ S, 139° 26′ E
Brookfield Conservation Park	34° 21′ S, 139° 31′ E	Mount Remarkable	32° 48′ S, 138° 08′ E
Buckaringa	32° 02′ S, 138° 03′ E	Murray Bridge	35° 07′ S, 139° 16′ E
Bundaleer (Forest)	33° 17′ S, 138° 34′ E	Myponga	35° 23′ S, 138° 28′ E
Bungaree (Hills)	33° 43′ S, 138° 33′ E	Normanville	35° 27′ S, 138° 19′ E
Burnside	34° 57′ S, 138° 40′ E	Port Elliot	35° 32′ S, 138° 41′ E
Burra	33° 40′ S, 138° 55′ E	Quorn	32° 21′ S, 138° 03′ E
Cambrai	34° 39′ S, 139° 17′ E	Reedy Creek	34° 55′ S, 139° 11′ E
Cape Jervis	35° 36′ S, 138° 06′ E	Robertstown	33° 59′ S, 139° 05′ E
Chain of Ponds	34° 49′ S, 138° 50′ E	Salt Creek	36° 07′ S, 139° 39′ E
Clare	33° 50′ S, 138° 37′ E	Schuetze Landing	34° 52′ S, 139° 27′ E
Crystal Brook	33° 21′ S, 138° 12′ E	Scott Conservation Park	35° 25′ S, 138° 44′ E
Delamere	35° 34′ S, 138° 12′ E	Second Valley	35° 32′ S, 138° 13′ E
Florieton	33° 51′ S, 139° 26′ E	Strathalbyn	35° 16′ S, 138° 54′ E
Gumeracha	34° 49′ S, 138° 53′ E	Sutherlands	34° 09′ S, 139° 13′ E
Hindmarsh Valley	35° 30′ S, 138° 37′ E	Telowie Gorge	33° 02′ S, 138° 07′ E
Inman Valley	35° 29′ S, 138° 28′ E	Waitpinga	35° 36′ S, 138° 32′ E
Jamestown	33° 12′ S, 138° 36′ E	Weston Flat	34° 02′ S, 139° 49′ E
Keith	36° 06′ S, 140° 21′ E	Wirrabara Forest	33° 03′ S, 138° 13′ E
Kuitpo Forest	35° 13′ S, 138° 41′ E	Wongulla	34° 42′ S, 139° 34′ E
Langhorne Creek	35° 18′ S, 139° 02′ E	Victor Harbor	35° 33′ S, 138° 38′ E
Laura	33° 11′ S, 138° 18′ E	Yankalilla	35° 28′ S, 138° 21′ E
Mannum	34° 55′ S, 139° 18′ E		

The Spotted Bowerbird *Chlamydera maculata* in South Australia

GRAHAM CARPENTER

ABSTRACT – Other than a recent observation in the far North East, the Spotted Bowerbird has been considered extinct in its main area of distribution in South Australia along the River Murray since the 1930s. Past observations and specimens from South Australia are reviewed and additional historic reports presented. Compounding threats (habitat loss by rabbits and clearance, predation by foxes and human persecution at focal locations) no doubt led to its inevitable decline and extinction along the River Murray.

INTRODUCTION

In his *Synopsis of the Birds of Australia, and the Adjacent Islands* (Plate 6), Gould (1837–38) described and illustrated the Spotted Bowerbird under the name *Calodera maculata*. It was subsequently listed as *Chlamydera maculata* in Volume 4 of his *Birds of Australia* (1848), although he also used the genus name *Chlamydodera* in later publications (e.g. Gould 1865). The species formerly occurred widely in inland Queensland and New South Wales (NSW), extending into north-western Victoria and eastern South Australia (SA). The similar Western Bowerbird *Chlamydera guttata* occurs in far north-western SA, where patches of Native Fig *Ficus platypoda* on granitic outcrops are a favoured habitat (Higgins *et al.* 2006).

Boehm (1956) reviewed the status of the Spotted Bowerbird in SA, listing all records known up to that time. He concluded that it was probably extinct but formerly distributed along the River Murray valley and adjacent scrubs as far south as Swan Reach, and that it was not rare in the early days of settlement.

Reid (2000) noted that the species occurred on the Eyre Creek and Georgina and Diamantina Rivers in south-western Queensland, and predicted its occurrence in the far North East of SA. He subsequently observed one Spotted Bowerbird on the Diamantina River, Pandie Pandie Station, in May 2015 (Reid 2017; Carpenter and Horton 2020).

The following is a further review of records and specimens, together with some new historic reports sourced from anonymous articles within online newspapers available on the National Library of Australia website (trove.nla.gov.au). Localities mentioned along the River Murray in SA are mapped in Figure 1, and known specimens of Spotted Bowerbird from SA are listed in Table 1.

REVIEW OF SIGHT RECORDS

Sturt (1849) observed 'Caloderae' (presumably the Spotted Bowerbird after Gould 1837–38) during his central Australian explorations, including in SA. On his march northwards from the Darling River to Fort Grey (far north-western NSW) in August 1845, Sturt (1849) observed 'numerous Caloderae, and other smaller birds in the brushes, apparently on the move whilst there was water for them, that had been left by the then recent rains.' In early September, he also saw them in far north-eastern SA, north of the Stony Desert, in box-tree [Coolibah *Eucalyptus coolabah*] forest (probably near where Eyre Creek meets Goyders Lagoon – Reid 2000; J. Reid pers. comm.). Despite travelling extensively along the River Murray, Sturt failed to make mention of bowerbirds elsewhere, including in his annotated list of birds seen during his 1845 expedition.

According to North (1901–04, 1: 43)

> In South Australia, the Spotted Bowerbird is apparently a rare species, and appears to be confined to the Murray River scrubs, a situation similar to that in which it is found in the adjoining portion of North-western Victoria. Neither Dr. A. M. Morgan, nor Mr. A. Zietz, the Assistant-Director of the South Australian Museum, have met with it in South Australia. Replying to an inquiry of mine, Mr. Zietz writes as follows: - 'In regard to *Chlamydodera maculata*, we have no specimens from this State in our Museum Collection. All I know about its occurrence in South Australia is the information received from a settler, resident at Morgan, on the Murray River, who with his son was visiting the Museum. On showing them our collection of bird-skins, both recognised at once *C. maculata* as a species known to them as "Cabbage-birds", from their destructive habit of eating the leaves of those plants in their kitchen garden, and which these birds were constantly visiting.'

Samuel Sanders (Junior, in Boehm 1956) knew of two districts along the river where Spotted Bowerbirds could be found in the early 1900s. These were North West Bend (per S. McIntosh), and at Barber's Flat [Banrock Station] near Kingston in 1914. Several were subsequently shot by the owner, Samuel Pope, at Banrock Homestead in March 1915, two of which were prepared by Sanders as mounts.

S. A. White in Mathews (1925–27) stated that 'where this bird was once very plentiful on the River Murray in SA years ago there is not one to be seen now.' Ashby (1928) saw the fig tree at Border Cliffs Homestead that had been visited by bowerbirds when the fruit were ripe. Tindale (1930) reported a single bowerbird in a patch of mallee scrub three miles (5 km) north of Swan Reach, near the eastern bank of the river, in November–December 1929. McGilp (1934) was told of a bird that lived in the garden at Chowilla Homestead in the early 1930s, but which was unfortunately killed by a cat just prior to his visit in October 1933. He concluded that the species must be very rare along that part of the river, and had heard no other reference to a bird being seen in recent years.

Condon (1969) listed it as rare or possibly extinct in South Australia, and cited no recent records. There have been no records along the River Murray or adjacent areas of South Australia since.

NEW HISTORIC RECORDS

McIntosh (1936) reported that bowerbirds invariably harvested the first fruits in October or November of early-fruiting tomato varieties planted in an experimental orchard established at Overland Corner in 1896.

An A. Featherstone of Overland Corner donated a skin of a Spotted Bowerbird to the South Australian Museum (SAMA) in June 1889 (Anon. 1889; Board of Governors 1889). The current location of this specimen is unknown but it may still exist in another institution, because the Museum continued to send SA material interstate and overseas on exchange until the late 19th to early 20th centuries (Horton *et al.* 2018).

Anon. (1920a) stated that

> Everybody knows of the bower bird and owners of isolated gardens along the river are familiar with the pretty creature, but its nest is known to few and its play-ground and bower to fewer. One of these bowers and playgrounds was discovered existing close to Mr. W. Thompson's homestead above Murtho Park, and some time ago Mr. Oliver, who is rusticating in the neighbourhood, was kind enough to bring along a photograph of it to this office. This particular bower is in a lignum bush. We have heard that one was

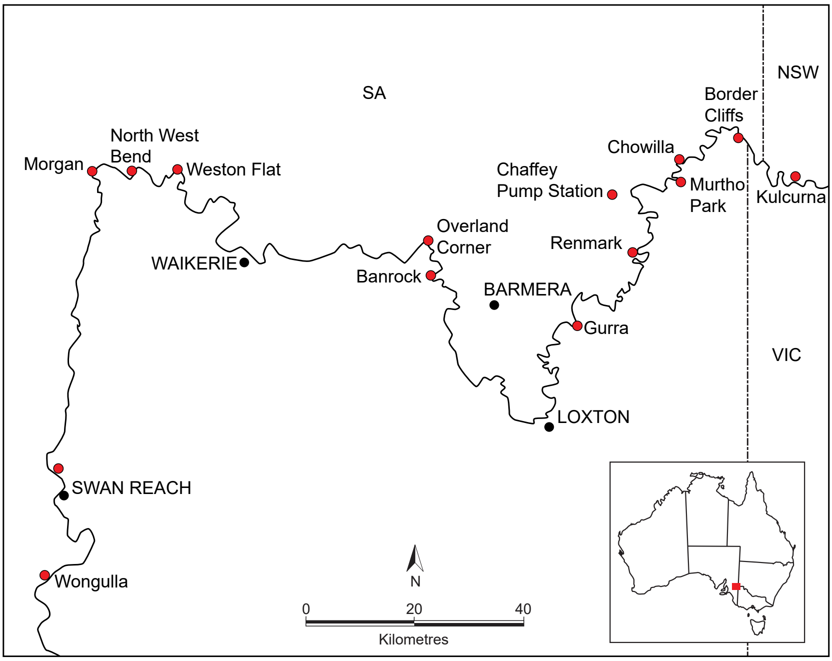

Figure 1. Map of localities mentioned in the text, in the River Murray region, South Australia. Red dots show the location of specimen or sight records of Spotted Bowerbird.

> discovered years ago, by Mr. John Higgins of Kulcurna [Kulcurna Station, NSW, 34° 02′ 45″ S, 141° 04′ 00″ E, about 13 km upstream of Murtho and 9 km E of the SA border]. The playground is beautified with bleached bones, pieces of glass or anything that makes a glittering show.

G.E.A.R. in Anon. (1920b) noted that

> In none of our wanderings, so far, in the upper Murray Valley, have we met with the spotted bower bird, or come upon his haunts. We have listened for his varied notes for days; we have searched the teatree scrubs for miles, but have neither seen nor heard him once. The spotted bower bird is no longer habitant of the upper Murray lands. He has gone, probably never more to return. Yet, according to Mr. W. R. Lewis, of Berri [Gurra Station – Anon. 1928], a man in whose word the utmost reliance can be placed, it is not so many years ago that the spotted bower bird was among the most common of birds on the river. Lately we had the pleasure of calling upon Mr. and Mrs. Lewis, and hearing, in Mr. Lewis's own words, a little of the spotted bower bird as he knew it about his home by the big river about a decade or so ago. Said Mr. Lewis: - 'One thing that has particularly struck me with regard to the bird life now to what it was a few years ago, is the entire disappearance of the bower birds. Years ago, these birds were very numerous, and often built their queer playgrounds among the ti-trees not far from the house. The birds would come into the garden morning and evening, raiding the strawberry patch for ripe strawberries with which to – no, not to eat, but to adorn their playgrounds. They were uncommonly strange birds, and the best mimics among birds I have ever known. They used to sit up in the trees and mimic the cries of our old house cat and the sharp, snap-like bark of our dog, to perfection. It's a pity that they have disappeared.'

Table 1. Specimens of Spotted Bowerbirds probably from South Australia (arranged in approximate chronological order). AM = Australian Museum (Sydney); AMNH = American Museum of Natural History (New York); BMNH = British Museum of Natural History (Natural History Museum, NHM, Tring); SAMA = South Australian Museum (Adelaide).

Specimen	Date collected	Location	Collector/Donator	Institution	Specimen No.	Reference
Skin	No date (probably c. 1842)	River Murray	Fortnum, C. D. E.	Senckenberg Museum, Frankfurt (exchange from BMNH)	SMF 63313	G. Mayr (*in litt.*); NHM online catalogue
Skin	No date (probably 1860s)	SA	White, W.	SAMA	B3069	P. Horton pers. comm.
Skin	No date (probably 1860s)	SA	White, W.	?SAMA, Location unknown	B3243	P. Horton pers. comm.
Mount	No date (probably 1860s)	SA	White, W.	SAMA	B13155	P. Horton pers. comm.
Skin	No date 1800s	SA	Gawler Institute	SAMA	B7007	P. Horton pers. comm.
Male skin	No date (possibly 1860s)	SA	Sydney Museum (possibly White, S.)	?BMNH, Location unknown		Sharpe (1881)
Unsexed skin	No date, registered Feb 1912 (probably collected 1860s)	Interior of SA	White, S.	AM (ex Dobroyd Collection)	O.18080	Zietz in North (1901–04)
Skin	No date (probably 1860s)	Interior of SA	White, S.	AM, sent to Princeton University Museum (now closed), 30 April 1958	O.18081	Zietz in North (1901–04); L. Tsang (*in litt.*)
6 skins	Feb–Mar 1883	Overland Corner	Andrews, F. W.	Location unknown		Zietz in North (1901–04)
2 male skins	No date (probably 1889–95)	River Murray scrub, SA	Cockerell, James F.	SAMA	B7673 & 4	Condon in Boehm (1956)
Skin	June 1889 or earlier	Overland Corner	Featherstone, A.	SAMA, location unknown	Not registered	Anon (1889); Board of Governors (1889)
Male skin	1898	Renmark	Perks, R. H.	BMNH	98.5.17.82	Sharpe (1906); NHM online catalogue
Male skin	31 Jan 1912	SA	Cleland, J. B.	AMNH (formerly BMNH)	AM 679122	Mathews (1912); Hartert (1929)

During a trip on a steamer from Morgan to Mildura, Salter (1925) made a road trip to the pumping station and irrigation channels at Chaffey [on Ral Ral Creek about 12 km NNW of Renmark 34° 04′ 25″ S, 140° 42′ 19″ E], where 'we made the acquaintance of the bower bird, whose favourite imitating trick is to suggest a man chopping wood. Often you will think you can hear the unmistakable ring of an axe, but it is only the bower bird beating his beak against a tree.'

Bellchambers (1925) stated 'this interesting bird was one time fairly plentiful along the valley of the Murray, from the Rhine [= Marne River, Wongulla] up past Renmark, and I have also found their bowers along the eastern slopes of the Flinders Range. Being accused of mischief in the orchard, this bird has been pretty well exterminated. … I should much like to hear from Journal readers of their continued existence in any part of this State at the present time.' Bellchambers was keen to secure two pairs for his sanctuary at Humbug Scrub, but was unable to obtain any.

Sir John Melrose of Ulooloo Station, north of Hallett (Lower North), had 'several of the now almost extinct "bower birds" beside other interesting specimens of Australian bird life' kept in a large 'bird flight' near the homestead (Anon. 1936). If they were in fact Spotted Bowerbirds, their source is unknown.

SPECIMENS OF SPOTTED BOWERBIRDS FROM SA

Condon in Boehm (1956) gave a summary of specimens at SAMA, noting that there were two skins from SA (B7673 and B7674), both males collected by J. T. Cockerell, without dates but with the locality given as 'River Murray Scrub, SA'. There were also 'five skins (one mounted) without data in the William White collection which were probably taken in South Australia, as well as another, also without data, which came from the Gawler Institute.'

Dr Philippa Horton, former Senior Collection Manager, SAMA (pers. comm.), has kindly reviewed the specimens of Spotted Bowerbird currently held at that institution and noted that according to the museum database there are six specimens from SA: the two collected by Cockerell, three (one mounted) in the William White collection with no other data and another, with no data, from the Gawler Institute [see Table 1]. William White's mount B13155 is held in off-site storage. One of his skins (B3243) is missing and appears to have been missing for a long time, as it was not included in the John Sutton card index from the late 1920s. The remaining four specimens are in the main skin collection. There are some other mounts held in storage, all with no information. Horton agreed that the White specimens were most likely to have come from SA. The Gawler Institute one probably did also but, because that collection included interstate and overseas specimens, this is not certain. Why Condon found five William White specimens, while today's records indicate there were only ever three, remains unexplained.

Horton (2018) has clarified a common confusion that 'James Cockerell' is actually J. F. and not J. T. (James's father – John Thomas) as stated by Condon. James Frederick Cockerell resided at Mildura from 1889–95 and provided over 700 bird skins to SAMA from 1889–1894 (Horton 2018). About 100 are still retained at the Museum and are mostly labelled with a locality of Mildura, with a few from the River Murray district, SA (Horton 2018). It is assumed, therefore, that Cockerell's bowerbird specimens in SAMA labelled as 'River Murray scrub, South Australia' were collected in SA rather than in Victoria.

Zietz (in North 1901–04), having stated that there were no SA specimens of *C. maculata* in the SA Museum collection (see above), added that

> In looking over some lists for further evidence, I found that six specimens were obtained in the scrub at Overland Corner, on the Murray River, in 1883, by the late

> Mr. F. W. Andrews, a collector of the South Australian Museum. I myself have never seen any specimens of *C. maculata*, with a statement where they had been collected, except some two dozen skins obtained by the late Mr. James Cockerell, in the Murray River scrubs, near Mildura, Victoria.

The six bowerbirds collected at Overland Corner by F. W. Andrews were obtained in February–early March 1883 (Andrews 1883a; Zietz 1883; Zietz in North 1901–04), together with a bower and its contents (Andrews 1883b). Andrews (1883a) reported 'I returned from the Murray on March 8th after a very trying time of it with the hot weather.' The fate of Andrews's bowerbird specimens is unknown.

North (1901–04) also noted that there were two unlocalised specimens of *Chlamydera maculata* in the Australian Museum collection, 'obtained by the late Mr. S. White in South Australia.' There is currently one skin in the Australian Museum (O.18080; Table 1) from the 'interior of South Australia' registered in 1912; this is presumably one of the two collected by Samuel White (Senior). The second skin, O.18081, was sent by the then curator J. Allen Keast to Princeton University on 30 April 1958 (L. Tsang *in litt.*). Unfortunately, the natural history museum there has now closed so the fate of this specimen is unknown. Another skin (adult male, current location unknown) from 'South Australia' was presented to the British Museum of Natural History by the 'Sydney' (Australian) Museum some time prior to 1881 (Sharpe 1881: 390).

Samuel White (Senior) collected several bowerbirds from the River Murray in SA in 1864. In his list of birds collected during his Murray expedition from 26 September to 29 October 1864, based on the River Murray at 'Poodnooka', Samuel White (n.d.) recorded:

> 372. Male, Poodnooka, River Murray, Oct 9, 1864. I watched the bower of this bird and shot no less than 5 of them there, most of them no doubt being robers [*sic*] from other bowers as they pulled down the bower several times after I had put it up and carted away part of the stones as well as 'quondongs' [stones of *Santalum acuminatum*] which I put there. While watching the first bird (the owner of it) I saw him come about 10 am and commence hopping and running about around the place and adjusting the stones of the pavement making sometimes a low scraping noise and then a low chirruping whistle. I watched the bower several days at intervals and found they came about 10 o'clock in the morning or 4 in the afternoon. I once shot a pair which came (378 Male and 379, Female). The male bird appeared first then came the female when the male commenced hopping, running and fluttering and making a low whistling noise. They have a kind of screaming cry repeated 2 or three times in succession at intervals. They also have a kind of scraping noise like 'Cr. leucopterus' [= Grey Butcherbird *Cracticus torquatus*] (for which I have mistaken them) as well as a round whistle of several notes running up and finishing with the highest (something like the 'Milvus isurus') [an old name for Square-tailed Kite *Lophoictinia isura*, but presumably in error for Black Kite *M. migrans* or Whistling Kite *Haliastur sphenurus*]. They are not at all shy at their bower but I think they are weary [*sic*] while in the bush as I could not easily find them although I could hear them in many places sometimes in pairs.

Later in his notes, the pair of specimens (378 and 379) are listed as collected on Oct 12 1864, together with the comment 'Chlamydera (sent to Waller). Little or no differences between the sexes, perhaps a little paler.'

'Poodnooka' was the name of a pastoral station on the northern side of the River Murray near Weston Flat where Samuel's brother, William White, had obtained eggs of both the Scarlet-chested Parrot *Neophema splendida* and Regent Parrot *Polytelis anthopeplus* in September of the previous year (North 1894, 1901–04). 'Waller' is presumably Eli Waller, assistant taxidermist at the Australian Museum from 1850–56 and later a private taxidermist based in both Sydney and Brisbane (Horton *et al*. 2018), so it is not known if specimens sent to him were destined for the Australian Museum collection or for Waller's personal use. A collection of Waller's bowerbirds (including *C. maculata*, but not from SA) was later purchased by the Liverpool Museum, England, in 1879 (Picton 1880).

The monthly reports of the SA Museum (Waterhouse 1867) record that a Spotted Bowerbird skin was sent to the Musée de St Denis, Ile de la Réunion, in October 1867 and another to Mr Waller in Queensland in December 1867.

It is therefore possible that Samuel White's October 1864 skins are those at the Australian Museum. However, it is not known if other Spotted Bowerbirds were collected when Samuel White visited the upper Murray early in 1863 (by boat – White 1916) or by his son, S. A. (Albert) White, in a collecting trip to Weston Flat in 1887 (Linn 1989). Similarly, the source of W. White's specimens at SAMA (see above) is unknown, but may have been collected when at 'Poodnooka' in either 1863 or with brother Samuel in 1864. Further investigation and analysis of White's archived documents may provide clarification.

The Natural History Museum (formerly British Museum of Natural History, BMNH) at Tring has one skin from SA, a male numbered 98.5.17.82 from Renmark purchased from R. H. Perks in 1898 (NHM online catalogue; Table 1). Dr Robert H. Perks was a surgeon based in Adelaide in the 1890s and became chair of the Field Naturalists Society of South Australia at that time (Anon. 1895). The BMNH purchased 197 of his bird skins from SA (Sharpe 1906).

In addition, the BMNH bird accession book lists a Spotted Bowerbird among 39 bird specimens donated by C. D. E. Fortnum, Esqu. of Adelaide, SA, dated 29 June 1842 (Sharpe 1906; NHM online catalogue). Specimen number 25 is listed as '*Calodera maculata* – River Murray. Exchanged with Dr. Rüppell.' Dr. Rüppell's specimens are now held at the Senckenberg Museum, Frankfurt, Germany. Dr Gerald Mayr, Head of Ornithology, has kindy advised (email 22 Feb. 2022) that Fortnum's specimen is still held at that institution (SMF 63313; Table 1), donated by Rüppell in 1845, but there is no original label. Charles Fortnum resided with Charles Stuart at Fourth Creek (now Rostrevor) from 1840–1845 and collected birds and insects from Adelaide and the River Murray before returning to England (Warburton 1999).

Mathews (1912) described a new subspecies of the Spotted Bowerbird, *C. m. clelandi,* in his reference list to Australian birds, noting the type was from South Australia (No. 3656). Given the subspecies name, it was presumably based on a specimen provided to him by well-known South Australian ornithologist, J. B. Cleland. In his checklist of the birds of Australia (Mathews 1924: 214), the date of this specimen was given as Jan. 31st, 1912. In a review of Mathews's types, Hartert (1929) indicated that this was an unsexed skin in poor condition in BMNH labelled by Mathews '*Chlamydera maculata* South Australia? Dr Clelland'. This specimen is now at the American Museum of Natural History (AM 679122; Table 1). J. B. Cleland provided many specimens to assist Mathews with the preparation of his *Birds of Australia* (Paton 2017). However, Cleland's collections along the river at that time are known only from May 1910, May 1911 (Cleland *et al*. 1918) and later during an excursion of the Royal Australasian Ornithologists' Union (BirdLife Australia) in November–December 1913 (Chisholm 1914; Cleland 1914; Cleland *et al*. 1918), when bowerbirds were not recorded (White 1914).

DISCUSSION

This review confirms that the Spotted Bowerbird was widespread and relatively common along the River Murray and adjacent areas of South Australia until the late 1800s, followed by a rapid decline till the last reports in the 1930s. Records are as far downstream as near Swan Reach (Tindale 1930), although Boehm (1956) indicated without explanation that this record may be regarded as doubtful, presumably because it was in mallee habitat, well downstream and later than most other reports. However, given that a bird was seen 'at close hand' it is difficult to believe that the observer could have been mistaken. Further, Bellchambers (1925) indicated that they once occurred as far down as the mouth of the 'Rhine' (= Marne River, 15 km S of Swan Reach), although provided no details on the source of this information. His claim of finding bowers along the eastern slopes of the Flinders Ranges seems unlikely, although his bird observations reported elsewhere (including the River Murray near Mannum) indicate that he was a reliable observer (e.g. Bellchambers 1931). The likely source of the birds in captivity at a homestead near Hallett (Anon. 1936) would presumably be from a bird dealer rather than of wild birds.

It is evident that Spotted Bowerbirds had declined extensively by around 1900 because few well-known SA ornithologists were familiar with them at that time (North 1901–04). By 1920 few visitors to the river could find them. For example, they were not recorded during the Royal Australasian Ornithologists' Union expedition along the River Murray between Murray Bridge and Morgan in November–December 1913 (Chisholm 1914; White 1914), along the river between Morgan and Mildura in April 1917 (Morgan 1917), or during White and Morgan's trip downstream from Lake Victoria to Renmark in September–October 1917 (White 1918). In the region between Renmark and Wentworth, Chenery and Morgan (1920) reported them only from Kulkyne Station, Victoria. By this time only farmers and orchardists living along the river knew of them, mostly seen when the birds were raiding fruit in commercial orchards and homestead gardens, or through the location of bowers (often under Tangled Lignum *Duma florulenta*) on the River Murray floodplain.

A similar decline in abundance was reported upstream in adjoining parts of Victoria and New South Wales. The birds were evidently common in the early days, with no less than 39 collected between Echuca and Mildura during the National Museum of Victoria's collecting expedition in 1857 (Blandowski 1858), with his comment that 'this bird keeps in the dense scrub near the creeks and lagoons, and feeds on berries and is very shy'. Barrett (1919) noted an active bower under a boxthorn bush [presumably the introduced African Boxthorn *Lycium ferocissimum*] at Kulkyne Station, Victoria, and noted that he had heard that hundreds had been shot by settlers in the fruit-growing areas along the Murray. Favalaro (1940) noted that it was very common in Victoria from the SA border to Kerang in the early 1900s and in those days, bowers were common on the river flats and along that portion of the river frontage which now forms part of the Lock Island [Mildura, Victoria]. They survived in Victoria until the 1960s, with one record further upstream in a farm garden and orchard at Robinvale in 1979 (Emison *et al*. 1987) and occasional reports since (Higgins *et al*. 2006).

As concluded by Boehm (1956), it is likely that the decline was due to a combination of predation by foxes, grazing and clearance of habitat and by human persecution. Foxes became widespread along the River Murray in the early 1900s, following a series of rabbit plagues that denuded the river flats from the 1880s (Murchison 1887; Anon. 1918; Abbott 2011). The late 1890s also saw the rapid uptake and clearance of land along the river margins for irrigated agriculture. Although considered mostly sedentary, flocks of Spotted Bowerbirds may accumulate at favoured feeding trees (including fruit trees in orchards and gardens) after breeding (Higgins *et al*. 2006). At these times many were easily shot or poisoned, no doubt impacting the population over a wide area. For example, Elliott (1938) reported that about eighty had been shot in a week in an orchard near Mungindi, Queensland, and Favalaro (1940) said 'as many as thirty birds per week were destroyed in the vicinity of the Chaffey Homestead [Mildura, Victoria]'.

Trapping for the overseas bird trade may also have contributed to their decline. Bowerbirds were included in a shipment of 13,500 live birds consigned for collectors in Europe from an Adelaide bird dealer, John Foglia, in February 1905 (Anon. 1905).

The natural habitat of the Spotted Bowerbird is semi-arid and monsoonal woodlands that contain abundant fruiting trees and shrubs (Higgins *et al*. 2006). These include Currant Bush *Carissa lanceolata* and *C. ovata*, Native Orange *Capparis lasiantha* and *C. mitchelli*, Wilga *Geijera parviflora*, Desert Jasmine *Jasminium didymium*, Myrtle Tree *Canthium oleifolium*, Warrior Bush *Apophyllum anomalum*, Kurrajong *Brachychiton populneus*, Leafless Cherry *Exocarpos aphyllus*, Boobialla *Myoporum acuminatum* and Ruby Saltbush *Enchylaena tomentosa*, species reaching their greatest abundance and diversity in inland central New South Wales and Queensland (Cunningham *et al*. 1981). In SA, its habitat was mainly the River Box *Eucalyptus largiflorens* woodlands of the river flats and adjoining low woodlands with Native Pine *Callitris gracilis* and Dryland Teatree *Melaleuca lanceolata* etc. that (other than Ruby Saltbush) lack a similar diversity and abundance of fruiting species, and so may have been less productive habitat for bowerbirds. It is however noted that the shrub *Exocarpos strictus* (Pale-fruit Ballart) is relatively common on the River Murray floodplain in SA from the Victorian border downstream to about Loxton, with scattered occurrences to Waikerie. This plant grows to 6 m and produces 2–5 mm diameter globular fruit throughout the year (Jessop and Toelken 1986) and thus could have been important in influencing the former distribution of the Spotted Bowerbird in SA.

Further surveys in the far North East of SA may increase the number of observations in the only part of SA where the species may still occur.

ACKNOWLEDGEMENTS

I wish to thank Andrew Black and Philippa Horton whose extensive knowledge of the history of ornithology in SA and valuable comments added considerably to this note. Museum curators Gerald Mayr and Leah Tsang (and P. Horton) kindly provided details of the specimens held in their institutions. Philippa also sourced and allowed me to view copies of historic notes held at SAMA. Julian Reid provided information on Sturt's travels in the North East of SA.

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Bird notes

First record of White Wagtail *Motacilla alba* for South Australia

COLIN ROGERS, TERESA JACK AND WILLIAM BROOKER

INTRODUCTION

The White Wagtail *Motacilla alba* consists of numerous subspecies and breeds across high latitudes of the northern hemisphere from NE Canada, Iceland, Europe and Asia to China and Japan and the west coast of Alaska. In Asia, it winters across southern China and most of Indochina south to Thailand, Myanmar, the Andaman Islands, Bangladesh, and northern and north-eastern India (Alström and Mild 2003: 357). It is a vagrant to Australia and, prior to the sighting reported here, 26 records of White Wagtail had been accepted by the BirdLife Australia Rarities Committee (BARC), but this is the first record for South Australia (SA).

THE RECORD

While conducting a monthly summer wader survey in Price Saltfields, north-eastern Yorke Peninsula, SA, on 15 April 2021 at c. 1610 h, Colin Rogers (CR) was scanning the track counting Red-necked Stints when he noticed a wagtail associating with some White-fronted Chats *Epthianura albifrons* feeding on insects near saltbush along the edge of the track. Apart from the similarity in facial pattern it was soon obvious that the bird was a White Wagtail, which CR had seen on numerous occasions in Asia and Europe. Alerting Teresa and William to its presence we took several photographs, some reproduced here, over a period of about 10 minutes before the wagtail flew past us and was lost from sight. As it flew it made a series of thin high-pitched calls and displayed an obvious white wing-bar.

After continuing with the wader count, we returned down the same track and again saw the White Wagtail on the edge of the track well in front of us. However, we could not relocate the bird when we approached the area of the sighting and did not see it again before leaving at 1730 h.

DISCUSSION

The identification of the Price Saltfields bird as *Motacilla alba* is straightforward but identification to subspecies is more difficult, particularly when moult is incomplete.

Of the subspecies of White Wagtail noted by Alström and Mild (2003), four are possible vagrants to Australia (Menkhorst *et al.* 2017). These are: *M. a. leucopsis*, *M. a. ocularis*, *M. a. lugens*, and *M. a. baicalensis.* Of these, *lugens* and *ocularis* are ruled out as both have an obvious black eye-stripe running across a white face from the bill, through the eye to the nape. Figure 1 reveals a bird with a mostly white face and at best a light grey line between the eye and the nape. That leaves *leucopsis* and *baicalensis* as possible candidates.

In breeding plumage these two subspecies have similar black breast patches in profile, but the mantle, back and lesser wing coverts are black on *leucopsis* while they are grey on *baicalensis*. Examination of Figures 1 and 2 reveals that although the bird appears to have grey upperparts, the lesser wing coverts and

Figure 1. White Wagtail, Price Saltfields, 15 April 2021. Image Colin Rogers

Figure 2. White Wagtail with white face, black lesser wing coverts and some black mantle feathers suggestive of *M. a. leucopsis*. Price Saltfields, 15 April 2021. Images Colin Rogers

some mantle feathers are black suggesting that the bird is moulting into breeding plumage of subspecies *M. a. leucopsis*. However, intergrades between subspecies in north Asia makes precise identification difficult. Nevertheless, no other subspecies fits as well as *leucopsis* in this case.

Motacilla alba leucopsis breeds in eastern China and Korea and winters in southern China and south to Thailand, Myanmar, Andaman Islands, Bangladesh, and northern and north-eastern India. Consideration of previous weather patterns might explain why this individual was so far from its usual winter range. As illustrated in Figure 3, extreme weather systems existed off the north-west coast of Western Australia in early April 2021 (ABC 8 April 2021) and these impacted some of the southern wintering areas of *M. a. leucopsis*. Furthermore, Tropical Cyclone Seroja then crossed the Western Australian coast south of Geraldton on 11 April, an unusual southerly landfall for a cyclone (ABC 12 April 2021). This unusual series of weather systems may well have propelled the wagtail onto Australian shores and onto Yorke Peninsula in SA.

Prior to the record reported here a White Wagtail of the subspecies *M. a. lugens* was reported from Christmas Island on 19 March 2021 (Loh 2021). After our sighting, a White Wagtail, possibly of the race *leucopsis*, was reported on 27 April, from Home Beach on Stradbroke Island, Queensland (Dale and Ferber 2021).

Of the five species of Wagtail recorded in Australia (Menkhorst *et al.* 2017: 502–505) this first record of a White Wagtail for SA leaves only the Forest Wagtail *Dendronanthus indicus* yet to be recorded in the state.

The record was submitted to BARC as Case 1182 and accepted on 20 July 2021 and submitted to the South Australian Rarities Committee (SARC) as Case 142 and confirmed.

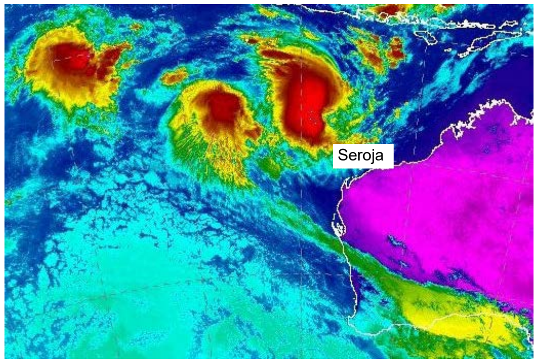

Figure 3. Two tropical lows and Tropical Cyclone Seroja off the coast of Western Australia on 8 April 2021. Source ABC (8 April 2021); Bureau of Meteorology

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Little Ravens *Corvus mellori* feeding on pine seeds

PENNY PATON

While conducting a three-monthly bird survey at Kooyonga Golf Course (KGC) on 24 May 2021, I observed a Little Raven *Corvus mellori* feeding on the ground under a pine tree and taking seeds from open pine cones on the ground (Figure 1). As I watched, a second bird that had been feeding nearby joined its presumed mate and began extracting seeds from open pine cones as well. The dominant pine tree species at KGC is the Aleppo Pine *Pinus halepensis* and the ravens were feeding on the ground under a pine of this species.

Figure 1. Little Raven feeding on Aleppo Pine seeds, Kooyonga Golf Course, 24 May 2021. Image Penny Paton

Barker and Vestjens (1990) recorded Australian Ravens *Corvus coronoides* feeding on unspecified parts of Radiata Pine *Pinus radiata* and other *Pinus* species, but there is no mention of Little Ravens feeding on pine seeds in any literature including HANZAB (Higgins *et al.* 2006). In the northern United States, Northern Ravens *Corvus corax* have been recorded occasionally feeding on the seeds of the Whitebark Pine *Pinus albicaulis* (Hutchins and Lanner 1982). There is a strong mutualistic relationship between the Whitebark Pine and Clark's Nutcracker *Nucifraga columbiana*, which belongs to the avian family Corvidae. The Whitebark Pine depends on the nutcracker to disperse its large wingless seeds through food caching, while the nutcracker uses fresh and stored seeds as a food source (United States Department of Agriculture 2012).

As well as the ravens, I made observations of two Australian Magpies *Gymnorhina tibicen* feeding on pine seeds at KGC on 24 May 2021. These were additional to my reports of this behaviour in November 1993 (Paton 1996) and August 2016 (Paton 2016). I did not note the sex of the birds on this occasion, but from photographs taken at the time, one bird was a female. Both birds were extracting the pine seeds from cones lying on the ground.

I suggested in earlier notes that this pine seed eating was a learned activity and this may still be the case, despite observing the activity on several occasions and in different parts of the golf course. At the nearby Glenelg Golf Course, which has been surveyed in a similar manner for birds for over 30 years and where Aleppo Pines are also very common, I have observed two Australian Magpies feeding on seeds from broken pine cones on the ground on only one occasion, on 28 November 2018. One of these birds had half of the top mandible missing which may have made foraging difficult. This is despite magpies being abundant and ravens present at Glenelg Golf Course.

In cultivated stands of Aleppo Pines in Jordan, the seed content of fat, protein, ash and total carbohydrates were 32.1%, 29.8%, 5.5% and 32.6% (Tulkan *et al.* 2013). The health and productivity of Aleppo Pine trees are influenced by water availability, temperature, soil fertility and competition from other plants (Ayari and Khouja 2014). Plants at golf courses are generally well-spaced and enjoy constant watering and fertiliser application, leading to prolific and regular cone production. It is likely that their seeds are very nutritious although each seed is small for birds the size of magpies and ravens. Aleppo Pine seeds are 6 mm long with a 25 mm wing to aid in seed dispersal (Landscape SA 2021). Despite this Aleppo Pines are widely used by Yellow-tailed Black Cockatoos *Xanda funereus*, due to their prolific cone production (J. van Weenen, pers. comm.). Some birds at Kooyonga Golf Course appear to be consuming this very abundant resource at different times of the year as an adjunct to their regular diet.

ACKNOWLEDGEMENTS

Many thanks to the reviewer and to editor Philippa Horton for suggestions which improved a first draft of this note.

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Phenotypic separation of three divergent taxa within the Splendid Fairywren *Malurus splendens*

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INTRODUCTION

The Splendid Fairywren *Malurus splendens* (Quoy and Gaimard, 1832) is distributed across the southern two-thirds of Australia. Three of its four presently recognised subspecies (Schodde and Mason 1999) were long known as separate species (RAOU 1926; Condon 1968). Parker's revision of the family Maluridae (in Schodde 1975) followed Ford's (1975) report of hybridisation between 'Splendid and Turquoise Wrens' in inland Western Australia and combined the three entities in one species. They are the Splendid Fairywren *M. s. splendens* of the forested south-west (southern population) and semi-arid to arid mid-west (northern population) of Western Australia, Turquoise Fairywren *M. s. callainus* Gould, 1867 of western South Australia, Central Australia and inland Western Australia, and Black-backed Fairywren *M. s. melanotus* Gould, 1841 of inland south-eastern Australia including the Murray Mallee and southern Olary Plains of South Australia, and north-western Victoria, western New South Wales and southern Queensland (Figures 1 and 2).

The phylogeographic study of Kearns *et al.* (2009) tested present taxonomy, sequencing the mitochondrial gene ND2 and applying spectrophotometry to the males' coloured plumage patches whose differences in hue and shade largely define subspecies boundaries. In their genetic analysis they recovered three moderately divergent clades (net DNA divergence between clades of 1.2–1.4%), corresponding with subspecies *splendens*, *callainus* and *melanotus*. A fourth subspecies in inland southern Queensland, *M. s. emmottorum* Schodde and Mason, 1999, was included in the *melanotus* clade and will not be considered further here.

Spectrophotometry distinguished between all subspecies through chromatic variation of their coloured plumage patches (Table 1).

Kearns *et al.* (2009) quoted wavelength ranges of 380–440 nm for violet, 440–485 nm for blue, and 485–500 nm for cyan (the hue between green and blue); however, we note that the boundary between violet and blue is usually given as 450 nm (e.g. Wikipedia https://en.wikipedia.org/wiki/Visible_spectrum). Their findings equate with violet for each patch in *splendens*, violet-blue for each in *melanotus*, and a violet bib contrasting with the almost greenish-blue ('turquoise') back in *callainus*. Kearns *et al.* (2009) did not assess the belly patch or address the contrast between bib and belly that most authors find distinguishes *callainus* from other subspecies, because of the inconsistent quality of belly plumage among their whole sample.

Table 1. Mean and standard deviation of hue (wavelength of maximum reflectance) of coloured plumage patches (nm) from Kearns *et al.* (2009). The southern and northern populations of subspecies *splendens* are as indicated in the Introduction.

Subspecies	Back	Bib
splendens southern	411 ± 10.0	400 ± 13.3
splendens northern	431 ± 12.1	417 ± 12.1
callainus	482 ± 11.1	425 ± 13.7
melanotus	447 ± 10.2	456 ± 8.5

A distinguishing plumage character not discussed by Kearns *et al.* (2009) is the width of the black breast band. Schodde and Mason (1999) found this to be broad in *splendens* and *callainus* but narrow in *melanotus*, whereas Higgins *et al.* (2001) found it broad only in *callainus* and narrow in both *splendens* and *melanotus*.

In a current study examining interactions between subspecies *callainus* and *melanotus* in South Australia, including evidence of hybridisation, we required a simple and consistent method of describing the colour patches, to assist in future assessment of colour variation where the subspecies occur close to each other. However, we found that field guide illustrations and earlier accounts of hue and shade were inconsistent and were either less than explicit, incomplete or inaccurate (e.g. Reid *et al*. 1977; Rowley and Russell 1997; Schodde and Mason 1999; Menkhorst *et al.* 2017). Only Higgins *et al.* (2001) offered a detailed and objective comparison, but theirs does not allow rapid interpretation. We therefore conducted a preliminary examination of fully coloured male specimens of these two subspecies, together with the nominate subspecies, and here report our findings that provide a simple distinction between the three taxa.

METHODS

We examined the following specimens of fully coloured male Splendid Fairywrens in the South Australian Museum, Adelaide (SAMA) (AB and PH) and Natural History Museum, Tring (NHM) (PH only): subspecies *splendens* (all from the southern population, n = 37), *callainus* (n = 59) and *melanotus* (all from South Australia and Victoria, i.e. southern distribution, n = 39).

We assessed the following colour patches. (1) Dorsum – the back plus most of the crown except for the forehead, which often appears slightly paler (barely discernible in Figure 2). Kearns *et al.* (2009) assessed the crown and back separately but found no difference in mean hue between them in *callainus* and little in southern *splendens* or *melanotus*. (2) Bib – the throat and upper chest, above the black breast band. (3) Belly – the colour patch below the black breast band.

The hue of each colour patch was assessed as violet, violet-blue, blue or greenish-blue, and these descriptions were compared with the objective spectrophotometric measurements of the colour patches by Kearns *et al.* (2009). The shade of each patch was assessed as dark, medium or pale, and the contrast in both hue and shade between bib and belly and between bib and dorsum as strong, slight or none.

The width of black breast and nape bands was measured to the nearest 0.5 mm in two places: within 5 mm of the middle (Midline) and at the band's widest point (Maximum width).

We used statistical analyses to test whether there were significant differences in the width of the breast and nape bands among *splendens*, *callainus* and *melanotus*. Levene's test was used to test for differences in the variance of these measurements between taxa. If variances were not significantly different, taxa were compared using a Fisher's parametric one-way Analysis of Variance (ANOVA) and where significant differences in measurements were found, Scheffe's *post hoc* tests were used to identify taxa that differed significantly. If variances differed significantly taxa were compared using a Kruskal–Wallis non-parametric ANOVA and where significant differences in measurements were found, Mann–Whitney tests identified which taxa differed significantly from each other. Statistical analyses were performed using IBM SPSS v.28 (IBM Corp. 2021). Descriptive statistics are given as mean ± standard deviation.

RESULTS

The hue and shade of colour patches, the contrast between patches, and the width of breast and nape bands, among male specimens examined, are summarised in Table 2.

Table 2. SAMA and NHM male Splendid Fairywren plumages. Breast and nape band widths are given as mean ± standard deviation for two methods, as described in the text.

Character		*M. s. splendens*	*M. s. callainus*	*M. s. melanotus*
Dorsum	hue	Violet	Blue to greenish-blue	Violet-blue
	shade	Dark	Pale	Medium to dark
Bib	hue	Violet	Violet to violet-blue	Violet-blue (to blue)
	shade	Dark	Dark	Medium to dark
Belly	hue	Violet	Blue to violet-blue (to greenish-blue)	Violet-blue to blue
	shade	Dark to medium	Medium to pale	Medium to pale
Bib/belly hue contrast		None, slight in some	Strong to slight	Slight, none in some
Bib/belly shade contrast		None, slight in some	Strong to slight	Slight
Bib/back hue contrast		Slight, none in some	Strong	None, slight in some
Bib/back shade contrast		None	Strong	None
Breast band mm Midline		2.74 ± 0.86	3.57 ± 1.19	1.66 ± 0.74
Breast band mm Max. width		4.15 ± 0.80	5.27 ± 1.29	3.00 ± 0.84
Nape band mm Midline		4.67 ± 1.13	5.14 ± 1.81	4.19 ± 1.47
Nape band mm Max. width		5.07 ± 1.04	5.93 ± 1.80	5.09 ± 1.12

Figure 1. Ventral view of three subspecies, two males each of *splendens* (left), *callainus* (middle), *melanotus* (right). Note variation in breast band width among subspecies, and contrasting bib/belly hue and shade in *callainus*. SAMA specimens left to right: (1) B372 Warren River, SW Western Australia (WA), 29 September 1912, W. D. Dodd; (2) B376 Warren River, SW WA, 10 October 1912, W. D. Dodd; (3) B33954 Hamilton Station, northern South Australia (SA), 19 June 1981, F. J. Badman; (4) B31226 False Bay, Eyre Peninsula, SA, 11 December 1977, J. Cox & N. Reid; (5) B33735 NW of Morgan, Murray Mallee, SA, 11 October 1980, W. Cunningham; (6) B8453 Pine Plains, Victoria, 19 October 1898, A. G. Campbell. Image Philippa Horton

Figure 2. Dorsal view of three subspecies, two males each of *splendens* (left), *callainus* (middle), *melanotus* (right). Note dorsal hues of violet, 'turquoise' and violet-blue respectively, and variation in nape band width. SAMA specimens left to right: (1) B4330 Mundaring, SW WA, 21 September 1922, F. E. Parsons; (2) B372 Warren River, SW WA, 29 September 1912, W. D. Dodd; (3) B28401 Ooldea, NW SA, 25 August 1922, J. B. Cleland; (4) B33954 Hamilton Station, northern SA, 19 June 1981, F. J. Badman; (5) B23287 Pinnaroo, Murray Mallee, SA, 28 September 1935, F. E. Parsons; (6) B4328 Bowhill, Murray Mallee, SA, October 1916, F. E. Parsons. Image Philippa Horton

There were significant differences in variance of the breast band width among the three taxa (Levene's test = 4.909, $p = 0.009$ for Midline and 8.673, $p < 0.0005$ for Maximum width). There were also significant differences in the mean breast band width among the three taxa (Kruskal–Wallis H = 52.85 for Midline, 54.195 for Maximum width, $p < 0.0005$ for each). *Post hoc* tests showed that *callainus* had significantly broader breast bands than both southern *splendens* ($p = 0.001$ for each method) and *melanotus* ($p < 0.0005$ for each method) and southern *splendens* had significantly broader breast bands than southern *melanotus* ($p < 0.0005$ for each method; Table 2; Figure 3 – Midline only).

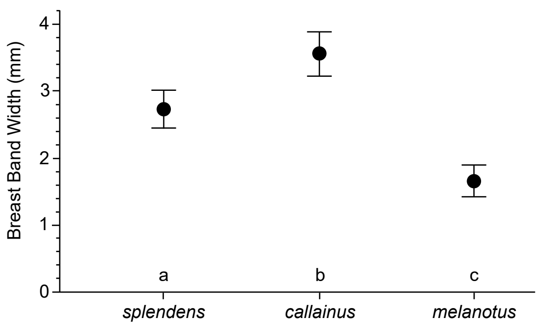

Figure 3. Mean (± 95% confidence interval) breast band Midline width in three subspecies of Splendid Fairywren. Letters above the x-axis indicate homogeneous groups based on post hoc tests.

There were no significant differences in the variances of Midline nape band width among the three taxa (Levene's test = 1.211, $p = 0.301$) but there were significant differences in the mean nape band width among them ($F_{2,119} = 4.804$, $p = 0.01$; Figure 2). *Post hoc* tests showed that *callainus* had a significantly wider nape band than southern *melanotus* ($p = 0.01$), whereas the band in southern *splendens* was intermediate, not differing significantly from either *callainus* ($p = 0.307$) or southern *melanotus* ($p = 0.363$) (Table 2; Figure 4). The trend was similar using Maximum width but with greater variation and no comparison reached statistical significance.

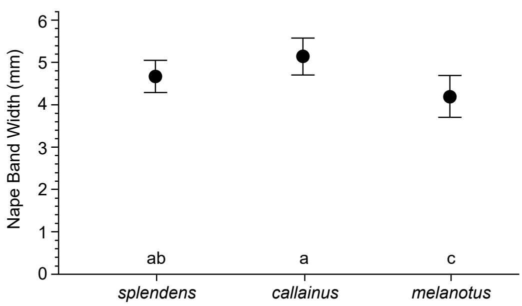

Figure 4. Mean (± 95% confidence interval) nape band Midline width in three subspecies of Splendid Fairywren. Letters above the x-axis indicate homogeneous groups based on post hoc tests.

DISCUSSION

The nature of light reflected from the colour patches of fairywrens is not due to pigmentary colour but is determined by a combination of surface structures of the feather barbs, melanic pigments within them, and the incident light (Prum 2006). Structural colours will appear different to human eyes, depending on whether they are seen in light or shade, on the angle of incident light and the angle from which the colour is viewed (Prum 2006). A further confounding factor lies in the use of colour photography which may not represent colour as seen in nature.

Nevertheless, the breeding male plumages of southern *splendens, callainus* and southern *melanotus* are distinct (Table 2). Our assessment of study skins lined up together and viewed at the same angle and under the same lighting conditions demonstrates that their hues can be categorised relatively simply, in terms that correlate well with the spectrophotometric measurements of Kearns *et al.* (2009). All three colour patches are violet in *splendens* and all three are varying hues of violet-blue to blue in *melanotus*. In *callainus* the violet to violet-blue bib contrasts strongly with a paler blue belly and especially with a paler and greener blue (turquoise) dorsum (Figures 1 and 2).

Our results also show the variability of hue of all three patches in *callainus* and to a lesser extent in the bib and belly of *melanotus*, a feature not readily discernible from the statistical data of Kearns *et al.* (2009), mean and standard deviation providing only an indicative range of reflectance wavelengths.

Critically, however, the marked contrast in hue between bib and belly in *callainus*, together with its strikingly paler and greener back, consistently separates it from the other two violet or violet-blue subspecies in which there is little or no contrast between colour patches.

We found that the width of the breast band often shows considerable variation within individuals (Figure 1), and the loss of a single black feather could significantly influence band width. Breast band width usually increases away from the midline, with mean maximum width being 1.51 (*splendens*), 1.48 (*callainus*) and 1.81 (*melanotus*) times the mean midline width (Table 2). These factors may account for differences in band width descriptions in previous publications.

However, using two measurement methods, our sample sizes showed that comparisons between subspecies are informative. The breast band is significantly broader in *callainus* than southern *splendens* and in southern *splendens* than southern *melanotus*, while Schodde and Mason (1999: 94) noted that it is even narrower in northern *melanotus*. A comparison of breast band width between southern and northern populations of *splendens* has not been published.

The nape band widths show a similar pattern of differences, at least for Midline measurements, but they are only significantly broader in *callainus* than in southern *melanotus*. Given that nape band width may be affected by the disposition of the skins (wider if the neck is more stretched), we consider that this is not a suitable character for distinguishing populations.

The black lower back band present in *callainus* and *melanotus* but not in the nominate subspecies was not included in this study.

ACKNOWLEDGEMENTS

We thank Hein van Grouw, Natural History Museum, Tring, for access to specimens and Nick Reid for his helpful review.

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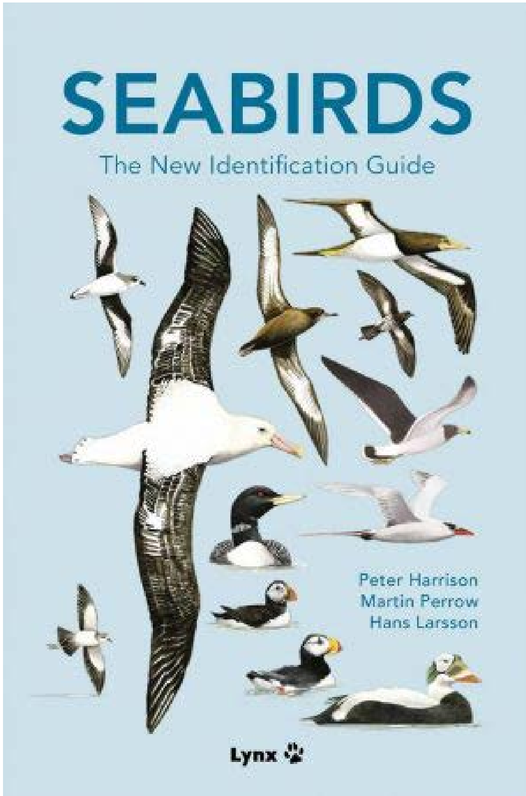
Book Reviews

Seabirds: the New Identification Guide

PETER HARRISON, MARTIN PERROW and HANS LARSSON, 2021

Lynx Edicions, Barcelona
price €75, hardback, 600 pages
434 species, 238 plates
ISBN 978-84-16728-41-1



Those who remember *Harrison's Seabirds: an Identification Guide* (Harrison 1983) will not be disappointed by this entirely new version. The old version was a *tour de force* produced by Peter Harrison alone but in this new version he is joined by another author, Martin Perrow, and another artist Hans Larsson. These three (described as HPL hereafter) have produced an exceptional trove of information with a global coverage too vast to cover here. To convey the comprehensive nature of the book this reviewer will focus on some of the seabirds seen off South Australia.

The book is based on the latest research at the date of publication incorporating or referencing the many taxonomic changes and discoveries that have occurred since 1983. As noted in the text, much seabird taxonomy is still in a state of flux, but it is not discussed in detail in the book, which focuses on identification. The layout is excellent and introduces each family with a general background before species accounts are presented. Each species, either singly or with a maximum of three in the case of smaller species, is then presented as a plate consisting of a page of text dealing with identification issues, a distribution map usually taken from del Hoyo and Collar (2014), and a facing page that contains the colour plate highlighting key identification features. The colour plates are annotated with additional identification information.

HPL illustrate seven species of great albatross, ten species of mollymawk and the two *Phoebetria* albatross, Sooty *P. fusca* and Light-mantled *P. palpebrata*. The Northern and Southern Royal Albatross and their identification will be familiar to South Australian seabirders as will some of those in the Wandering Albatross complex. The five species in the Wandering complex considered by HPL are superficially similar and they warn that identification remains challenging even for experienced observers, largely because the birds exhibit sexual dimorphism: males have larger bills and attain whiter plumage than females. In addition, those breeding at southern latitudes show whiter plumage that those from northern latitudes. This poses problems for differentiating older females from younger males of different species as both bill size and plumage features then overlap.

With that caveat in mind HPL provide useful information for distinguishing between the New Zealand (NZ) species, Antipodean Albatross *Diomedea antipodensis* and Gibson's Albatross *D. gibsoni*, and for distinguishing both from Wandering Albatross *D. exulans*. That is also true of the other two species, Tristan Albatross *D. dabbenena* and Amsterdam Albatross *D. amsterdamensis* and, although these two species have not been visually recorded in SA waters, Amsterdam Albatross has been seen off WA and both have been satellite tracked to positions off Eyre Peninsula and may turn up further east in SA waters. The description of older adult males by HPL will prove particularly useful as the two southern breeders, *D. exulans* and *D. gibsoni*, can be difficult to separate except on size when seen together. Although both NZ taxa are illustrated in plate 133, HPL treat *gibsoni* as a smaller eastern form or race of *exulans*, *D. e. gibsoni* and give *D. antipodensis* full species status. By comparison, Menkhorst *et al*. (2017: 40–41) combine the two NZ albatross under NZ Wandering Albatross, *D. antipodensis* and treat Gibson's as a subspecies of *antipodensis, D. a. gibsoni*. These differences reflect the current state of flux in taxonomy.

Of the ten mollymawk species covered by HPL only one, the Chatham Albatross *Thalassarche eremita*, has not been recorded in SA waters. All the others have now been recorded and HPL add to the challenge by treating Shy Albatross *Thalassarche cauta* and White-capped Albatross *Thalassarche steadi* as separate species. However, they warn that identification of the two species away from the breeding grounds is '…difficult to impossible except for adults and older immatures in optimal conditions.' SA seabirders will no doubt take up the challenge.

Prions are a challenge even under ideal conditions, largely because of the degree of overlap in bill size and facial markings. On that score HPL make some progress in drawing attention to the differences between different breeding populations. For example, the populations of Antarctic Prion *Pachyptila desolata* differ in appearance systematically across the Indian, Atlantic and Antarctic Oceans and these differences are illustrated in Plate 163. Knowledge of this diversity within species is obviously useful in limiting misidentification in this difficult group, particularly where clinal variation is present. In that respect, HPL advise that separation between Salvin's and Antarctic Prion may not always be possible because of 'the clinal variation in the virtually circumpolar Antarctic Prion, previously split into three (up to 6) "subspecies" according to locality: *desolata* (Kerguelen Is), *banksi* (Scotia Arc) and *alter* (NZ)'. These populations show variation in bill size that at the extremes makes some narrow-billed Antarctic Prions difficult to separate from some Slender-billed Prions *P. belcheri* (see Menkhorst *et al.* 2017: 53–56) or broader-billed individuals from s*alvini* as noted above. Similar challenges apply to other pairs causing confusion such as Broad-billed and MacGillivray's or Fairy and Fulmar Prions.

In addition to these two challenging groups, HPL also cover the storm petrels, petrels, shearwaters, diving petrels, terns, gulls, skuas, gannets, penguins, pelicans and cormorants that might be seen along the SA coastline. In that respect the coverage is far more extensive than presented by Howell and Zufelt (2019) who deal only with oceanic or pelagic birds. HPL also cover sea ducks, phalaropes and grebes although some of the latter are seldom, if ever, seen on the ocean. In addition, HPL do not follow Howell and Zufelt in all taxonomy. For example, they do not give all the four races of White-faced Storm Petrel *Peglagodroma marina* species status, thereby avoiding the banal name Australian Storm Petrel for the locally breeding race of White-faced Storm Petrel (Howell and Zufelt 2019: 266). They do, however, fall into that trap with the Gull-billed Tern, giving the Australasian race species status with the name Australian Tern *Gelochelidon macrotarsa*. This differs from the Menkhorst *et al*. (2017: 107) taxonomy that retains within *G. nilotica* the two races of Gull-billed Tern that occur in Australia (*G. n. macrotarsa* and *G. n. affinis*). This case illustrates the confusion that can occur in the allocation of common and scientific names because of uncoordinated revisions to existing taxonomy.

The HPL treatment of penguins that occur, or might occur, as vagrants on the SA coast is also interesting as they show three species of Rockhopper Penguin, Southern *Eudyptes chrysocome*, Northern *E. moseleyi*, and Eastern *E. filholi*. Identification of adults poses little difficulty but juveniles and immatures of Southern and Northern Rockhopper, the age most likely to come ashore along the SA coast, are difficult to distinguish from immature Fiordland Penguin *E. pachyrhynchus* that is a more regular visitor. All fledge with similar plumage and take three to four years to acquire adult plumage. However, the under-flipper patterns can be very useful for identification and are illustrated in the colour plates 124 and 126 and discussed in detail with reference to Figure 7 (HPL: 293).

HPL also distinguish the species Little Shearwater *Puffinus assimilis* from Subantarctic Shearwater *Puffinus elegans* and include the now generally accepted distinction between Grey-faced *Pterodroma gouldi* and Great-winged Petrel *Pterodroma macroptera.* The taxonomy of the Little Shearwater is in a state of flux and HPL note that in addition to *assimilis* the races *tunneyi*, *kermadecensis* and *haurakiensis* all appear to be divergent, so may be given species status in the future. The Subantarctic Shearwater *P. elegans* has been recorded infrequently in SA waters (there are also some specimens in the SA Museum) but is difficult to photograph given its very rapid flight and disinterest in boats or berley. Similar observations apply to the Diving Petrels, Common *Pelacanoides urinatrix* and South Georgian *P. georgicus* (there is a specimen of the latter in the SA Museum) but HPL note the recent discovery of a form of South Georgian Diving Petrel, Whenua Hou Diving Petrel *P. whenuahouensis*, in a small relict population on Codfish Island off South Island, NZ. There are also possibilities that cryptic species may be found in the large population of Common Diving Petrels spread across the southern latitudes.

The above discussion is restricted to some species that are or might be encountered in SA waters so cannot do justice to the comprehensive global coverage presented by HPL. In that respect, the attention to detail is exceptional and, even for someone who has seen many of the species illustrated, there was still a lot of new information in this guide. Although a guide on seabirds of the world can never be the last word, and HPL stress there is still much to learn, they make an important contribution. Seabirders everywhere will find the new identification guide an invaluable resource.

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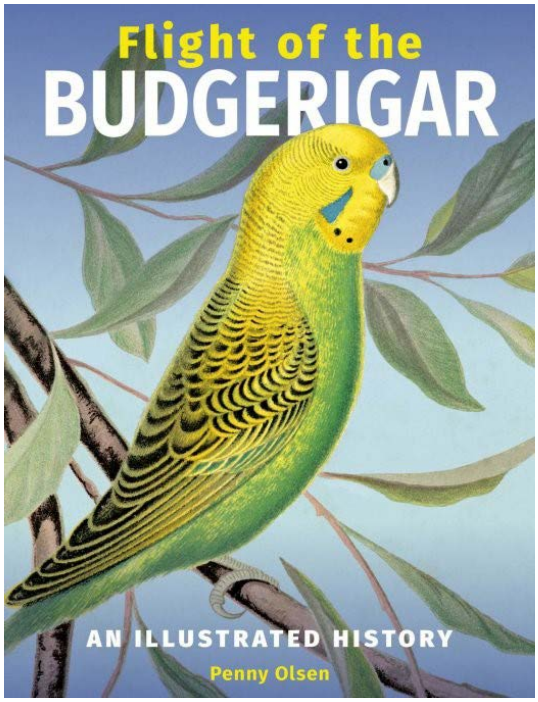
Colin Rogers

Flight of the Budgerigar: an Illustrated History

PENNY OLSEN, 2021

NLA Publishing, Canberra, ACT
rrp $49.99, softcover, 251 pages
colour and black and white illustrations
ISBN 978-0-642-27960-6



In the early days of colonial settlement, what we now know as the budgie was called Scalloped or Shell Parrot, among other names. John Gould, one of the first to bring live specimens back to Britain, knew it as 'Warbling Grass-Parakeet' but also recorded an Indigenous Australian name as 'Betcherrygar' and 'Butjeregah'. Olsen's research suggests this name may mean 'good eating' rather than being an identifying title. A table of Indigenous Australian names is included at the back of the book.

After reviewing the bird's origins in Australia, Olsen charts its transport overseas, first as skins, then as live birds. Live birds were highly sought after by the wealthy in the initial stages but the hardy and likeable little parrots soon became the subject of breeding farms in the UK and Europe. This, together with the delivery of huge numbers of wild-caught birds by the shipping trade, ensured its affordability and enjoyment by the less wealthy.

Inevitably, breeders found mutant individuals and used these to develop the huge number of colour, size and plumage variants available today.

Interestingly, budgies were far more popular overseas in the late 1800s and early 1900s and it was not until the 1930s that the budgie craze finally took off in Australia.

The author has cast her research net far and wide, covering much avicultural history as well as anecdotes of ownership by many well-known people. The book is extensively illustrated with historical images, photos and modern drawings and paintings.

The text has been set in a sans-serif font with a fairly light stroke. I found this made the reading task more difficult than usual, which for me detracted from an otherwise well-produced publication.

Merilyn Browne

NOTES

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 ISSN 0038-2973

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Style, measurements and abbreviations: Style generally follows the *Style Manual: for authors, editors and printers, Sixth edition,* Australian Government Publishing Service, Canberra 2002, or the current online edition. We encourage the use of the first person for a direct and engaging style. Spelling follows *The Macquarie Dictionary*, Eighth Edition, Macquarie Dictionary Publishers, Sydney, 2020. Use 's' not 'z' in words such as 'recognise', and 'ou' in words like 'colour'. Use single quotation marks, except where 'a quotation is "within" a quotation'. Check that all references mentioned in the text are in the References, and vice versa. To abbreviate, first use the full wording followed by the abbreviation in brackets, then use the abbreviation only. Numbers under 10 are spelled out and then Arabic numerals are used, e.g. nine whistlers but 10 finches. However, if a sentence or paragraph contains other numbers larger than 10, all numbers, including those under 10, should be given as Arabic numerals. No sentence should start with an Arabic numeral. Type a space between a numeral and its unit, e.g. 3 m. For time use the 24-hour clock system, e.g. 0735–2050 h. Give dates in the form 1 November 2008, though in tables and figures dates may be given as 1/11/2008, 20/9/2021 or 20/9/21. Geographical references should be in the form: 20 km NE (or north-east) of Adelaide; southern areas of South Australia; 35° 24′ S, 138° 39′ E. Other abbreviations are in the form: 8 x 42 binoculars; 2% (two percent); 3 m (three metres); $\bar{x}$ (mean); sd (standard deviation); χ^2 (Chi square); birds/km^2 or birds per km^2. Statistical symbols should not be italicised. Use lower case p for probability, N for population size, n for sample size.

Population Studies: Reviews of the birds of an area should include the habitats and climate and a summary of relevant literature. Include a map showing localities mentioned in the text, an insert showing the locality in Australia, and a scale. Extensive data on many species should be given in a table(s) or an annotated list. Summarise repeated patterns as ranges on each visit (e.g. 3–10 during Aug–Oct 2011–13), using measures of variance if there are sufficient data (e.g. means and standard deviations). If possible report breeding, seasonal movements, population trends, and other significant observations.

Editorial assistance: The editors will provide some assistance in the preparation of a manuscript. Submissions without a reasonable attempt to conform to the specifications above will be returned to the author for correction before being refereed. Acceptance of a manuscript will be subject to the decision of the editors.

Revised July 2022