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PLUMAGE AND SIZE VARIATION IN ADULT AND JUVENILE RUFOUS TREECREEPERS *Climacteris rufa*

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Plumage descriptions and morphometric measurements were obtained from adult and juvenile Rufous Treecreepers of both sexes. Plumage characteristics differed between the sexes in adults and juveniles, and between adults and juveniles of the same sex. The main plumage differences between adults and juveniles were the overall darker coloration of the juvenile plumage and the variation in upper breast pattern. Males and females, and adults and juveniles (of the same sex) also exhibited significant size dimorphism in a number of morphometric characters.

INTRODUCTION

Differences in plumage and size are widely used to sex and age birds. In Rufous Treecreepers *Climacteris rufa*, the plumage of adult birds is sexually dichromatic (Keast 1957). Males have buff white streaking with black margins on their upper breast and females have finer buff white streaking with rufous margins. Females are also described as being slightly smaller than males (MacDonald 1973; Simpson and Day 1996; Schodde and Tidemann 1997), but a significant size difference between the sexes has not been determined. Simpson and Day (1996) also note that the plumage of juvenile Rufous Treecreepers has not been adequately described. Documenting the plumage and morphometric characteristics of juveniles can assist in sexing and ageing individuals.

Previous descriptions of the Rufous Treecreeper have recorded some variation in colour and size throughout its distribution. Male specimens from the Eyre Peninsula, South Australia, were described as having more prominent black and white upper breast streaking (Howe 1921; Condon 1951; Keast 1957) and being generally paler in colour (Matthews cited in Ford 1971) than those from the south-west of Western Australia. However, Ford (1971) suggested that chest markings are more prominent in recently moulted birds and that descriptions of geographic differences in plumage have not considered fading, wear and stage of moult. Keast (1957) provided measurements of wing and tail length showing that birds from the Eyre Peninsula are larger than those from the south-west of Western Australia.

In the above studies, descriptions of plumage colour were not based on a standard measure (e.g. a colour guide) and morphometric measurements were generally collected on very few individuals from any given area. Therefore, comparisons between geographic regions are tenuous. The aims of my study were to: a) provide a detailed description of the plumage of adults and juveniles using a standard measure; b) determine the extent of size differences between sexes in adults and juveniles; and c) determine the extent of size differences between adults and juveniles of the same sex.

METHODS

Study area and sample population

As part of a detailed study on the ecology of the Rufous Treecreeper, I colour-banded 222 adults and 139 juveniles between June 1997 and January 1999 at Dryandra State Forest (centred on 32°45'S, 116°55'E) and the nearby Yilliminning agricultural district (centred on 32°54'S, 117°24'E) in the wheatbelt of Western Australia. All data collected on individuals classified as juveniles were from known age birds that had recently fledged from monitored nests. Most of these individuals (95%) were less than two months old (i.e. less than one month fledged). Birds of unknown age (i.e. those banded prior to the first breeding season and birds moving into the study area) were classified as adults.

Plumage

The primary criterion for sexing adult Rufous Treecreepers is the difference in upper breast plumage. This is widely accepted as truly representing the sex of an individual (e.g. Keast 1957; Noske 1980; Rose 1996) and is supported by dissected specimens (Ford 1971). I have included a description of adult plumage to allow for comparison with juveniles rather than to re-ascribe plumage differences between adult males and females. The sexing of juveniles based on plumage is more problematic, as juvenile plumage has previously not been described in detail. However, every juvenile classified as male or female based on the differences I describe, that remained in the study area for greater than three months, developed adult plumage characteristics consistent with their ascribed sex.

A detailed description of adult and juvenile plumage of both sexes was recorded using the plumage and soft parts description sheet issued by the Australian Bird and Bat Banding Scheme (ABBBS). Plumage colour was described using the Naturalist's Color Guide (Smithe 1975). As this is a time consuming process, these descriptions were obtained from single individuals to reduce extended handling of birds. However, notes on important plumage characteristics (e.g. upper breast plumage

and face markings) were recorded from approximately 20 individuals in each sex and age class.

Measurements

Head-bill, tail and maximum chord wing length measurements were taken on each bird following the procedures described in Lowe (1989). Birds were weighed in a weighing cone (see de Rebeira 1997) placed on an electronic balance.

Data analysis

Morphometric data were examined for departures from normality using normal probability plots and the Kolmogorov-Smirnov test. Tail measurements did not meet the assumptions of normality and were subsequently log (base 10) transformed. I used a two-sample *t* test to determine the significance of size differences between sexes in the same age class, and between age classes of the same sex.

RESULTS

Plumage

A detailed description of the plumage of adult and juvenile Rufous Treecreepers is included in Appendix 1. Table 1 summarizes the main plumage differences between sexes and adults and juveniles. In the following results, I focus primarily on plumage differences between adults and juveniles.

Generally, juveniles have darker plumage than adults. The face and crown/forehead/neck complex is very dark and this is easily identifiable when observing birds in the field. Juveniles do not have a cinnamon rufous eyebrow (characteristic of older birds), although this develops quite rapidly (occurring in birds of three to four months of age). Very young birds (one or two weeks post-fledging) may have wispy blackish neutral grey feathers protruding approximately 5 mm from the crown. These feathers fall out easily when the birds are handled and do not occur on older fledglings. This is a useful characteristic for identifying birds that have recently left the nest.

The bill of recently fledged birds, although primarily blackish neutral grey, is often paler at the edges and lower base with a pearl grey to pale horn colour. The gape flange is enlarged and cream coloured, and the palate is orange yellow (Table 1). The bill and gape flange become darker with age and the gape flange reduces in size.

The throat and upper breast of juvenile males is streaked with individual feathers consisting of a light cinnamon rufous stripe running down the rachis (rather than the buff white found in adults) and blackish neutral grey bands with a cinnamon rufous fringe on either side. The streaking can vary between individuals, but is usually more extensive and diffuse than in adults. In juvenile females, there is almost no sign of streaking, the throat and upper breast being a uniform light cinnamon rufous (or salmon colour) with a medium neutral grey tinge.

TABLE 1

Main plumage differences between adult and juvenile Rufous Treecreepers.

Character	Adult male	Adult female	Juvenile male	Juvenile female
Bill	Bill, cere and gape flange blackish neutral grey.	As male	Blackish neutral grey to light neutral grey. Paler at edges and lower base, pearl grey to pale horn. Bill becomes darker with age. Gape flange enlarged, cream colour. Palate orange yellow.	As male
Head and shoulders	Forehead and crown dark neutral grey. Cinnamon rufous eyebrow from bill to behind eye. Nape, mantle and scapulars ground cinnamon with robin rufous tinge.	As male	Forehead blackish neutral grey, crown slightly lighter. No cinnamon rufous eyebrow. Ear coverts robin rufous with dark neutral grey tinge. Nape medium neutral grey, mantle ground cinnamon, both tinged robin rufous. Scapulars Vandyke brown with edge of feathers robin rufous.	As male
Other face markings			Face and crown/forehead/nape complex darker than adult.	As male
Underparts	Upper breast streaked with individual feathers comprising a buff white centre with blackish neutral grey bands and a light cinnamon rufous fringe on either side. Lower breast cinnamon rufous with faint buff white streaks down centre of feathers.	Upper breast streaked with individual feathers comprising a buff white centre and rich cinnamon rufous fringe on either side. Lower breast light cinnamon rufous with ground cinnamon tinge extending around to top of shoulders giving bird a greyish 'collar'.	Throat and breast heavily streaked with individual feathers comprising a light cinnamon rufous centre with blackish neutral grey bands and a light cinnamon rufous fringe on either side. Lower breast light cinnamon rufous with dark neutral grey spots near end of feathers.	Throat light cinnamon rufous with a medium neutral grey tinge. Upper breast as throat with no discernible streaking of rufous and buff white feathers. Lower breast light cinnamon rufous.

At approximately two or three months after fledging, the juvenile plumage begins to develop distinct adult characteristics. A cinnamon-rufous eyebrow is usually present and the plumage of the face and crown is much lighter than younger birds. Buff white streaking begins to show on the upper breast of females and the breast streaking on males is less extensive and more characteristic of adult males. Within six months of fledging, juvenile plumage closely resembles that of an adult and there does not appear to be an immature plumage stage.

Measurements

There were clear size differences between males and females, and adults and juveniles for almost all of the measurements taken (Table 2). In adults, males had significantly higher mean weight, head-bill, wing and tail measurements ($P < .001$; Table 3) illustrating that sexual dimorphism is not confined to plumage. These measures were generally useful in discriminating between the sexes, although they were not mutually exclusive. For example, 89.5 per cent of males had a head-bill measurement greater than 39 mm, whereas 85 per cent of females were less than or equal to 39 mm; 85.5 per cent of males weighed more than 32.5 grams, and 87 per cent of females weighed less than or equal to 32.5 grams. These two measurements provided the clearest separation between the sexes (Fig. 1).

There were significant size differences between the sexes in juveniles for weight, head-bill ($P < .001$) and wing

TABLE 2

Summary of morphometric measurements taken on Rufous Treecreepers. Mn = mean, Sd = standard deviation, Rng = range.

		Weight (grams)			Head-bill (mm)			Wing (mm)			Tail (mm)		
Adults	*No.*	*Mn*	*Sd*	*Rng*	*Mn*	*Sd*	*Rng*	*Mn*	*Sd*	*Rng*	*Mn*	*Sd*	*Rng*
Male	123	34.6	1.95	29.5–39.5	39.9	0.79	37.7–41.8	88.8	1.97	83–93	68.8	2.54	60–74
Female	99	30.8	2.04	25.7–38.3	38.4	0.75	36.7–40.9	85.8	2.32	80–90	66.5	2.33	61–72
Juveniles													
Male	72	30.5	2.23	24.9–36.0	36.9	1.09	34.4–39.8	80.3	5.60	68–90	60.1	7.52	41–71
Female	67	27.7	1.85	23.5–31.7	35.8	0.87	34.1–38.3	78.5	5.48	64–87	59.1	6.90	39–66

TABLE 3

Results of the *t* tests comparing differences in the morphometric measurements taken on adults and juveniles. The comparisons made were adult male — adult female (degrees of freedom (df) 220); adult male — juvenile male (df 193); adult female — juvenile female (df 164) and juvenile male — juvenile female (df 137). The table shows *t* values and levels of significance (*P < .05; **P < .001; n.s. not significant).

	Adult male				Juvenile female			
	Weight	*Head-bill*	*Wing*	*Tail*	*Weight*	*Head-bill*	*Wing*	*Tail*
Adult female	13.6 **	13.9 **	10.0 **	6.6 **	9.9 **	21.1 **	11.8 **	9.4 **
Juvenile male	13.2 **	22.5 **	15.2 **	11.3 **	8.1 **	6.8 **	2.0 *	0.7 n.s.

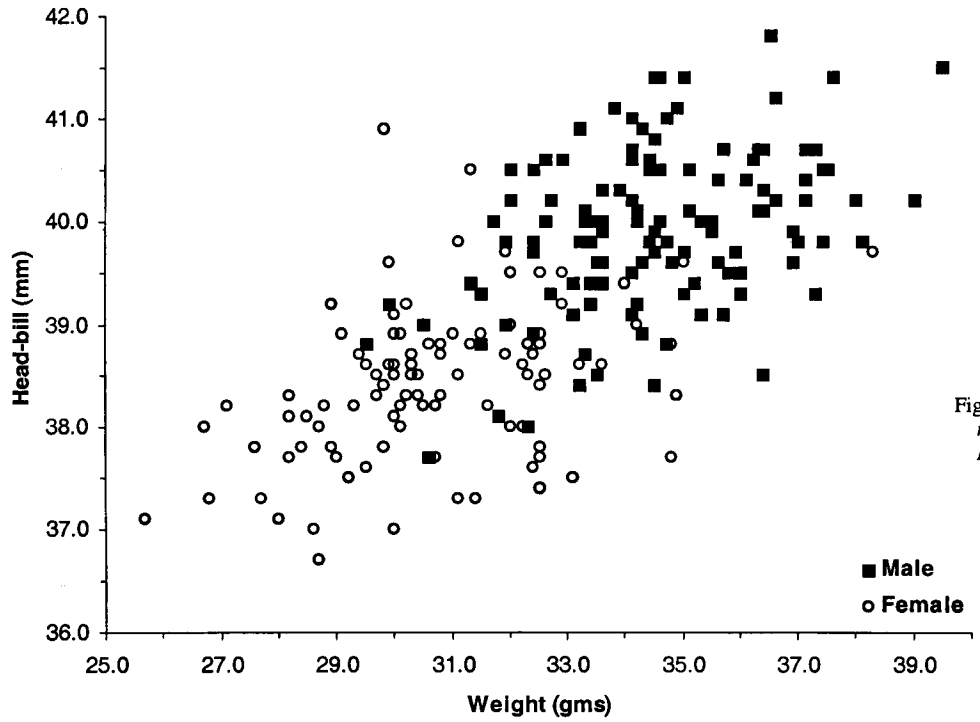

Figure 1. *Distribution of weight and head-bill measurements for adult male and female Rufous Treecreepers.*

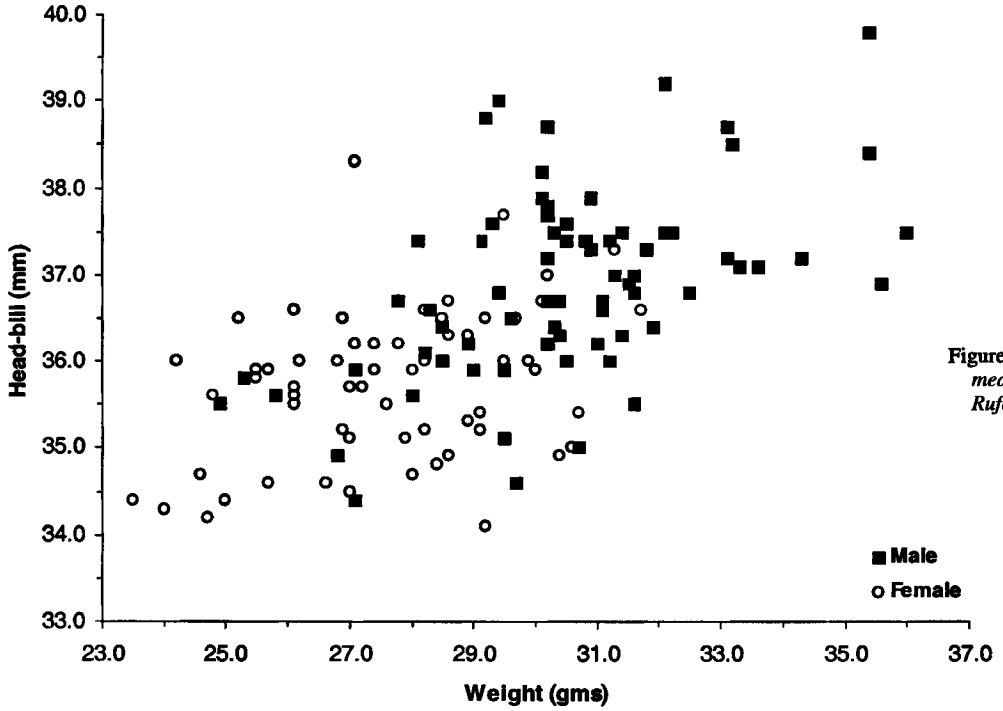

Figure 2. *Distribution of weight and head-bill measurements for juvenile male and female Rufous Treecreepers.*

($P < .05$) measurements (Table 3). However, there was more overlap between the sexes in juvenile birds compared to adults (Fig. 2). Weight had the clearest separation; 79 per cent of males weighed more than 29 grams, whereas 76 per cent of females weighed less than or equal to 29 grams.

There were significant size differences between adults and juveniles of the same sex ($P < .001$; Table 3) and morphometric measurements are useful in the aging of Rufous Treecreepers. Head-bill is probably the best measure to use, as wing and tail measurements for juveniles had high standard deviations (Table 2). For example, 94.5 per cent of adult males had a head-bill greater than 38.5 mm, whereas 91.5 per cent of juvenile males were less than or equal to 38.5 mm; 97 per cent of adult females had a head-bill greater than 37 mm, 95.5 per cent of juvenile females were less than or equal to 37 mm.

DISCUSSION

Plumage

The main plumage differences between juvenile (less than two months old) and adult Rufous Treecreepers in my study area are the generally darker coloration of the juvenile plumage and the variations in upper breast pattern and colour (Table 1). The darker coloration is particularly strong in the face, crown, forehead and nape. The streaking on the upper breast plumage of juvenile males is generally more extensive than for the adult and is slightly different in colour. Juvenile females have almost no discernible upper breast streaking.

Bill and gape flange colour are also useful in identifying young birds, although the corner of the gape flange may retain a hint of cream for up to 18 months in some individuals and should be used with caution as an aging characteristic. Recently fledged birds may be recognized by the presence of small, wispy feathers protruding from the crown. Any attempts to age Rufous Treecreepers should use a combination of the above characteristics for confident identification.

I recorded differences in the upper breast plumage of approximately 20-day-old nestling males (n = 6) and females (n = 3) and this may be a useful characteristic for sexing birds in the nest. Noske (1982) noted that nestling Brown Treecreepers *C. picumnus* show plumage differences at approximately 14–16 days.

Ford (1971) suggested that immediate post-moult plumage of Rufous Treecreepers is quite bold (particularly the upper breast of males) and this may explain differences in plumage descriptions. In my study, plumage descriptions were taken during the early-mid breeding season (September–November). Primary moult for adults occurs between November–May (unpubl. data), hence plumage colour in autumn and early winter may be slightly different than described here. Also, as I only recorded detailed plumage descriptions from single specimens, I have no data on individual variation for most of the plumage characteristics described.

Measurements

Male Rufous Treecreepers are significantly larger than females and this trend is common in a number of avian species (Amadon 1977). Sexual dimorphism develops at an early age as juvenile birds exhibit size and plumage differences between the sexes. The less clear separation in juveniles compared to adults is probably a result of the rapid growth of young birds. Although the majority of individuals were measured within a month of fledging, there may be considerable size differences between recently fledged and one month fledged individuals. In the closely

related Brown Treecreeper, there is also strong sexual dimorphism based on morphometric measurements and plumage (Noske 1982).

The most significant size differences between males and females, in both age classes, occurred in head-bill and body weight (Table 3). Head-bill was generally a reliable measure with relatively small standard deviations (Table 2). However, in some species (e.g. Eastern Spinebill *Acanthorhynchus tenuirostris*) head-bill length may vary seasonally probably owing to different foraging behaviours (e.g. moving from nectar to insect feeding; Jordan 1987). This is unlikely to occur in Rufous Treecreepers as the bill is quite sturdy and foraging behaviour does not differ markedly between seasons (pers. obs.).

Although body weight differed between the sexes, this result should be interpreted with caution as weight can fluctuate widely over short time periods. Clark (1979) noted that body weight is influenced by factors such as time of day, season, stage of reproductive cycle and year to year variation in food availability. I made no attempt to control for these factors when weighing birds. However, the relatively small standard deviations recorded for weight measurements suggests that Rufous Treecreepers may not show marked fluctuations and this may be characteristic of non-migratory temperate woodland and forest species (Clark 1979).

Body weight may fluctuate within a particular range for a particular sex, thereby still exhibiting overall differences between males and females. In Rufous Treecreepers, weight may fluctuate more widely for breeding females owing to egg production, incubation (only females incubate; pers. obs.) and care of young. The weight range for adult females was 12.6 grams which was slightly higher than males at 10.0 grams (Table 2). However, I found no difference in the body weight of adult females measured at the beginning of the breeding season (August/September: mean weight 31.14 grams) compared to the end of the season (December/January: mean weight 30.38 grams; $t = 1.28$, df 49, $P = .21$).

Plumage differences between adult male and female Rufous Treecreepers have long been recognized (e.g. Keast 1957). In my study, I have shown that plumage also differs between juvenile males and females and these differences are not the same as those recorded for adults. In addition to the sexually dichromatic plumage, males and females exhibit significant size dimorphism in a number of morphometric characters. As I have used a standard, repeatable measure for recording plumage and size characteristics, this should allow valid comparisons between the results from my study and future studies conducted in different regions, on live birds, using the same methods. This will contribute to our knowledge of geographic variation in the plumage and size of Rufous Treecreepers.

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REFERENCES

Amadon, D. (1977). Further comments on sexual size dimorphism in birds. *Wilson Bull.* **89:** 619–620.

Clark, G. A. (1979). Body weights of birds: a review. *Condor* **81:** 193–202.

Condon, H. T. (1951). Notes on the birds of South Australia: occurrence, distribution and taxonomy. *Sth. Aust. Orn.* **20:** 26–68.

de Rebeira, P. (1997). A weighing cone design for use on electronic balances. *Corella* **21:** 55–57.

Ford, J. (1971). Distribution and taxonomy of southern birds in the Great Victoria Desert. *Emu* **71:** 27–36.

Howe, F. E. (1921). The genus *Climacteris* (Tree-creepers). *Emu* **21:** 32–41.

Jordan, R. (1987). Seasonal variation in head-bill length for the Eastern Spinebill *Acanthorhynchus tenuirostris* at Barren Grounds Nature Reserve, New South Wales. *Corella* **11:** 118–120.

Keast, A. (1957). Variation and speciation in the genus *Climacteris* Temminck (Aves: Sittidae). *Aust. J. Zool.* **5:** 474–495.

Lowe, K. W. (1989). 'The Australian Bird Bander's Manual.' (Australian Bird and Bat Banding Schemes, and Australian National Parks and Wildlife Service: Canberra.)

MacDonald, J. D. (1973). 'Birds of Australia.' (Reed: Chatswood.)

Noske, R. A. (1980). Cooperative breeding by treecreepers. *Emu* **80:** 35–36.

Noske, R. A. (1982). 'Comparative Behaviour and Ecology of Some Australian Bark Foraging Birds.' (PhD Thesis, University of New England: Armidale.)

Rose, A. M. (1996). Territorial and breeding behaviour of the Rufous Treecreeper (*Climacteris rufa*) in the Stirling Ranges, Western Australia. *Corella* **20:** 55–61.

Schodde, R. and Tidemann, S. C. (Eds) (1997). 'Readers Digest Complete Book of Australian Birds. 2nd Edition.' (Readers Digest: Sydney.)

Simpson, K. and Day, N. (1996). 'Field Guide to the Birds of Australia. 5th Edition.' (Penguin Books: Ringwood.)

Smithe, F. B. (1975). 'Naturalist's Color Guide.' (American Museum of Natural History: New York.)

APPENDIX 1

Full plumage descriptions for adult and juvenile Rufous Treecreepers. Numbers in brackets refer to colour as per Smithe (1975).

Juvenile female (less than 2 months old)

Bill

Upper mandible blackish neutral grey (82) grading to light neutral grey (85), paler at edges and base, pearl grey (81) to almost white/pale horn colour (92). Lower mandible as above, pinkish flesh colour (5) where base of bill meets chin. Bill becomes darker with age. Cere dark neutral grey (83). Gape flange enlarged, cream colour (54). Palate orange yellow (18).

Eye

Inner iris jet black (89), outer iris dark brownish olive (129). Ring skin blackish neutral grey. Ring feathers robin rufous (340), darker than adults.

Head and shoulders

Lores robin rufous with a dark neutral grey tinge. Forehead blackish neutral grey, crown slightly lighter. No cinnamon rufous (40) eyebrow. Ear coverts robin rufous with a dark neutral grey tinge. Nape medium neutral grey (84), mantle ground cinnamon (239), both tinged robin rufous. Scapulars Vandyke brown (221) with edge of feathers robin rufous.

Other face markings

Face is darker than adult, has blackish neutral grey striations prominent when observing birds in the field. Crown/forehead/nape complex darker than adult. In certain individuals (mostly less than one week old fledglings), wispy feathers of blackish neutral grey protrude about 5 mm from the crown. These are very fine, but are visible in the field. They fall out easily when birds are handled and do not occur on older individuals.

Back

Upper and lower back ground cinnamon with a robin rufous tinge. Rump and uppertail coverts robin rufous. Uppertail ground cinnamon with a blackish neutral grey band (not on outer feathers), lighter at tips.

Legs and feet

Tibia skin flesh colour with cinnamon rufous feathers. Tarsus, toes and claws medium neutral grey becoming darker with age. Soles pale neutral grey (86).

Underparts

Chin light cinnamon rufous/salmon colour (106), bristles around base of bill blackish neutral grey. Throat light cinnamon rufous/salmon with a medium neutral grey tinge. Upper breast as throat with no rufous and buff white (124) feathers as found in adult females. Lower breast light cinnamon rufous/salmon, flanks rich cinnamon rufous. Belly light cinnamon rufous/salmon with dark neutral grey spots occurring near the end of some feathers, usually in pairs on opposite sides of the rachis. Undertail coverts cinnamon rufous with dark neutral grey spots as described above. Undertail ground cinnamon with same band as uppertail, but much paler.

Upperwing

Primaries and secondaries Vandyke brown with a cinnamon rufous centre band and leading edge. Tertials natal brown (219a) with a cinnamon rufous edge, but no band. Primary, secondary, median and lesser coverts, and alula, Vandyke brown with a robin rufous edge.

Underwing

Primaries and secondaries ground cinnamon, lighter at tips and much lighter than upperwing. Centre band true cinnamon (139) rather than cinnamon rufous. Axillaries light ground cinnamon with cinnamon rufous edge, underwing coverts light cinnamon rufous/salmon.

Juvenile male

As female except:

Underparts

Throat and breast heavily streaked (streaking much more extensive than adult male, although variable), individual feathers consist of a centre shaft of light cinnamon rufous/salmon (rather than the buff white in adult males) with a blackish neutral grey band and light cinnamon rufous fringe on either side. Lower breast light cinnamon rufous/salmon with dark neutral grey spots as described above.

Adult female (1+)

Bill

Upper and lower mandible, cere and gape flange a blackish neutral grey. Palate cream colour.

Eye

Inner iris jet black, outer iris Prout's brown (121a), ring skin blackish neutral grey, ring feathers cinnamon rufous.

Head and shoulders

Lores and ear coverts robin rufous with a dark neutral grey tinge. Forehead and crown dark neutral grey. Nape, mantle and scapulars ground cinnamon with a robin rufous tinge. Cinnamon rufous eyebrow from bill to behind eye. In the field, face appears lighter than males.

Back

Upper and lower back ground cinnamon with a robin rufous tinge. Uppertail coverts robin rufous, uppertail ground cinnamon at base grading to robin rufous and lighter at tips with a blackish neutral grey band.

Legs and feet

Tibia, tarsus, toes and claws blackish neutral grey (cinnamon rufous feathers around tibia), soles pale neutral grey.

Underparts

Chin and throat light cinnamon rufous/salmon. Upper breast streaked with individual feathers comprising buff white centre and a rich cinnamon rufous fringe on either side. Lower breast light cinnamon rufous with a ground cinnamon tinge extending around to the top of the shoulders giving the bird a greyish 'collar'. Flanks rich cinnamon rufous with white/pale horn colour streaks down centre of feathers. Belly light cinnamon rufous/salmon with pale streaks down centre of feathers (as above). Undertail coverts light cinnamon rufous, paler at tips, medium neutral grey spots (in pairs) on either side of feather shaft near ends of feathers. Undertail as uppertail, but paler.

Upperwing

Primaries and secondaries Vandyke brown with a cinnamon rufous centre band. Tertials Vandyke brown. Primary, secondary, median and lesser coverts, and alula, Vandyke brown with robin rufous edge.

Underwing

Primaries, secondaries and axillaries as upperwing, but paler. Underwing coverts light cinnamon rufous.

Adult male

As female except:

Underparts

Upper breast streaked with individual feathers comprising buff white centre with blackish neutral grey bands and a light cinnamon rufous/salmon fringe on either side. Lower breast cinnamon rufous with buff white streaks down centre of feathers.