

Breeding seasonality and primary moult in weavers in eastern South Africa

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Summary

Oschadleus, H.D. & Underhill, L.G. Breeding seasonality and primary moult in weavers in eastern South Africa. *Durban Museum Novitates* 31: 24-31. The breeding seasonality of Village *Ploceus cucullatus*, Yellow *P. subaureus*, Spectacled *P. ocularis* and Thick-billed *Amblyospiza albifrons* weavers in KwaZulu-Natal is fairly similar. The median breeding period of the three *Ploceus* species is in November and that of the Thick-billed Weaver is in December. The length of the egg-laying season is 3.7 – 4.1 months in the three *Ploceus* species and 4.4 months in the Thick-billed Weaver. The breeding seasonality is similar in the Eastern Cape and former Transvaal regions, both being summer-rainfall areas, but it is more variable in KwaZulu-Natal. In the three *Ploceus* species, duration of moult was shortest in Yellow Weavers (66 days), intermediate in Village Weavers (96 days), and longest in Spectacled Weavers (114 days). Primary moult started in February and ended in May for these three species in KwaZulu-Natal. There were enough data for Village Weaver to analyse moult for three separate years, imposing a constant duration on all years. Start date varied significantly by up to two weeks in different years. The Thick-billed Weaver had a similar duration of moult in Gauteng and KwaZulu-Natal of 71 and 73 days respectively, but the start date was significantly earlier in Gauteng (five weeks earlier).

KEYWORDS: *breeding seasonality, Gauteng, Kwazulu-Natal, Ploceidae, primary moult.*

Introduction

The Village *Ploceus cucullatus*, Yellow *P. subaureus*, Spectacled *P. ocularis* and Thick-billed *Amblyospiza albifrons* weavers are four common weavers found in eastern South Africa. They have broadly similar distributions in the coastal regions of the Eastern Cape and KwaZulu-Natal, with the Yellow Weaver being the most coastal species (Harrison *et al.* 1997). Farther north, the distributions diverge (Harrison *et al.* 1997; Parker 1999; Fry & Keith 2004). In southern Africa these species are confined to the summer-rainfall region.

The four species are poorly studied in southern Africa, although there is an extensive literature on the Village Weaver farther north in Africa (e.g. Collias & Collias 1970; da Camara-Smeets 1982; Adegoke 1983; Lahti & Lahti 2002), and two studies in South Africa (Collias & Collias 1971a, b). Even though the Thick-billed Weaver has a wide distribution extending northwards to East and West Africa, the only comprehensive studies are at the southern extremity of its range, in KwaZulu-Natal (Laycock 1979, 1982, 1984). The Spectacled Weaver is also a widespread African species but with even fewer studies (Skead 1953; Craig 1984). Limited field notes have been published for Yellow Weaver (Skead 1995).

The Spectacled Weaver is mainly insectivorous; it is a solitary, monogamous breeder (Craig 1984). The other three weavers are largely seed-eaters; they are colonial, polygynous breeders (Fry & Keith 2004). The peak breeding season in

KwaZulu-Natal for these four weavers is September to January (Harrison *et al.* 1997).

Of the four species, only the Thick-billed Weaver has undergone a range expansion (Harrison *et al.* 1997); it expanded its range to Gauteng in the 1960s, in what appears to have been a natural expansion along the Olifants River from Mpumalanga (Tarboton 1968; Leinberger 1982; Winterton 1982; Tarboton *et al.* 1987; Harrison *et al.* 1997). This range expansion is continuing (Leinberger 1997). This region has summer rainfall, as does KwaZulu-Natal. There have been no studies of this species in Gauteng.

The aim of this paper was to quantify breeding seasonality in these four weavers and to extend the range of species for which estimates of primary moult parameters are available. This paper examines the parameters of primary moult of adults of these four species in eastern South Africa, and considers the timing of moult in relation to timing of breeding. In KwaZulu-Natal, adult wing-moult has been considered in Thick-billed Weavers; but this study used an unorthodox approach, so the results are not readily compatible with any other studies (Laycock 1982; Brown *et al.* 2001). Wing-moult has been studied in Village Weavers in the Eastern Cape, using the same analysis technique as used in this paper, so the results are comparable (Craig *et al.* 2001). In addition to presenting results on primary moult for the four species in KwaZulu-Natal, this paper presents results for the Thick-billed Weaver in the new extension of its range in Gauteng.

Methods

Breeding seasonality data were obtained from the BirdLife South Africa Nest Record Card Scheme (NRC) (R.P. Prÿs-Jones & I. Newton unpubl. data; Underhill *et al.* 1991) and by adding unpublished records of breeding of Thick-billed Weaver in Gauteng (HDO unpubl. data). Prÿs-Jones and Newton (unpubl. data) estimated the month of laying of the first egg for each record. They then summarised breeding seasonality for all birds in South Africa by presenting monthly totals of clutches laid per species per region. One of the regions they used was the former Transvaal province: this region incorporates the current Gauteng Province, from where most of the records originate. To compare breeding seasonality of weavers, the tabulated data of Prÿs-Jones & Newton (unpubl. data) were used to estimate the median and the 5th and 95th percentiles

relative distance into November. Thus the median lies 17.7% into November (month 11), calculated as 11.177 (and rounded to 11.2 for presentation). The 5th and 95th percentiles were interpolated in a similar fashion. Dates in January were recorded as being in month 1 (not month 0).

Ringling data were collected by ringers in the standard SAFRING (South African Bird Ringing Unit) electronic format. This includes standard ringing information (such as location and date) and data on bird body mass, wing length and primary moult (de Beer *et al.* 2001). Ringling and recapture records submitted to SAFRING until mid-January 2005 for adults of the four species were extracted from the database. Primary moult records were extracted from SAFRING's database for Village, Yellow, Spectacled and Thick-billed weavers in KwaZulu-Natal and for Thick-billed Weavers in Gauteng (Fig. 1). For this analysis, the Village Weaver records were restricted

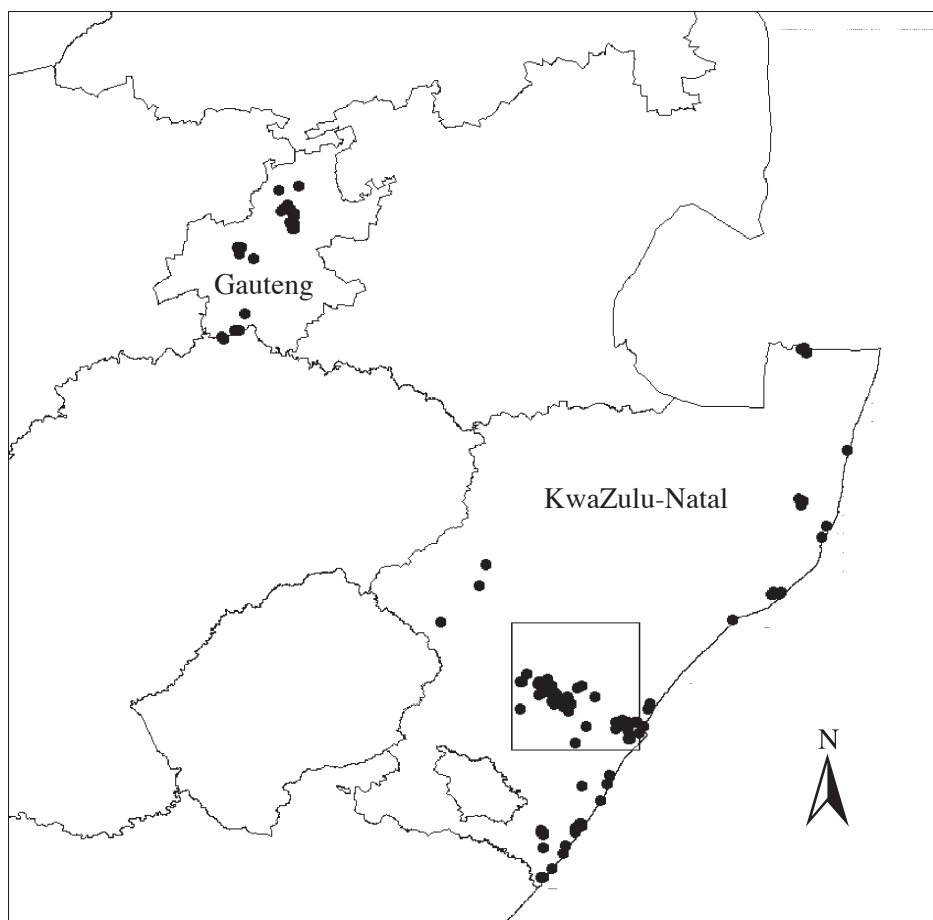


Fig. 1. Capture sites for adult Village, Yellow, Spectacled and Thick-billed weavers in eastern South Africa, from which primary moult data were obtained. Gauteng shows Thick-billed Weaver records; the square in KwaZulu-Natal shows the records for Village Weavers; the whole of KwaZulu-Natal has records for Yellow, Spectacled and Thick-billed weavers, including a large proportion in the grid.

for each species and region. The median was calculated by finding the cumulative monthly sums of the percentage of nest records. The median month was the month in which the cumulative sum first exceeded 50%. The values of the sums of the previous and successive months were used to assign a relative distance into the month. For example, if there were 47% of cumulative records by the end of October, and 64% by the end of November, the median clearly is during November. This, using proportions, gives $(50-47)/(64-47) = 17.7\%$, the

to a one-by-one degree grid cell with 29°S and 30°E in the northwestern corner, because a large number of records were available from here. In all species, moult of the primaries is descendant, with the feathers renewed from innermost to outermost.

To determine the relative mass of each primary, as described in Underhill and Summers (1993), the primaries of the wings of a Thick-billed Weaver specimen were dried in an oven at 60°C for 24 hours to eliminate moisture and weighed

(Ohaus GA200D balance, precision 0.0001g). These values were averaged and used to calculate the relative mass of each primary. For Village Weaver the published relative mass of each primary was used (Craig *et al.* 2001). Wings of Yellow and Spectacled weavers were not available. Underhill & Joubert (1995) showed that small samples are adequate to determine the relative masses of primary feathers because there is little intra-specific variation in this characteristic. They also showed that within the Charadriiformes, the relative masses of the primary feathers were so similar that the average value for the species for which data were available could safely be used for species for which data were unavailable; we used the same approach here. The wing shape of the Yellow Weaver is most similar to that of the Cape Weaver (HDO pers. obs) and the published relative masses for this species were used (Underhill & Joubert 1995). For Spectacled Weaver the wing shape is partially described by Moreau (1960: 449) and the most similar wing is that of the Thick-billed Weaver (pers. obs).

The Underhill-Zucchini moult model (Underhill & Zucchini 1988), developed to estimate start and duration of primary moult, was applied to the data sets. The data were considered to be of 'type□2' of Underhill & Zucchini (1988), because full moult scores were recorded for each bird and all birds were considered available for sampling throughout the moult period. The parameters of primary moult were estimated using the transformations recommended by Summers *et al.* (1980, 1983), designed to reduce the bias introduced by the fact that the individual feathers are of different masses. The moult index used was percentage feather mass grown (PFMG), calculated from the moult score for the individual feathers according to the method of Underhill & Summers (1993). Moult records were from 1977 to 2004, although over 67% were from 1998 to 2004 (67% for Yellow, 71% for Village, 72% for Spectacled, 88% for Thick-billed in KwaZulu-Natal, 100% for

Thick-billed Weaver in Gauteng).

Brandao (1998) (see also Underhill *et al.* in press) extended the Underhill-Zucchini (1988) moult model to estimate starting dates for groups of birds (e.g. males and females, or annual groups), holding the other two parameters (duration and standard deviation) constant. Brandao (1998) also developed rigorous statistical testing, using the likelihood ratio test, of the null hypothesis that the starting date for each group was the same. This method was applied to estimate starting dates for Village Weavers for each of three years.

Results

In KwaZulu-Natal, breeding seasonality by the four species of weavers is fairly similar; the three *Ploceus* species have the medians of their breeding periods in November and that of the Thick-billed Weaver is in December (Table 1). The length of the egg-laying season (5th and 95th percentiles) is 3.7–4.1 months in the three *Ploceus* species and 4.4 months in the Thick-billed Weaver. The breeding seasonality is similar in the Eastern Cape and former Transvaal regions, both also being summer rainfall areas, but with more variability than in KwaZulu-Natal (Table 1).

Moulting birds were captured throughout the moulting season (Fig. 2); this enabled the moult parameters to be estimated reliably. For Thick-billed Weavers, however, the number of records of active moult was relatively small (60 of 179 records in Gauteng, and 105 of 462 records in KwaZulu-Natal); this was reflected in the larger standard errors compared to the other species (Table 3).

In the three *Ploceus* species duration of moult was shortest in Yellow Weaver (66 days), intermediate in Village Weaver (96 days), and longest in Spectacled Weaver (114 days). Moult started in February and ended in May for these three species in KwaZulu-Natal.

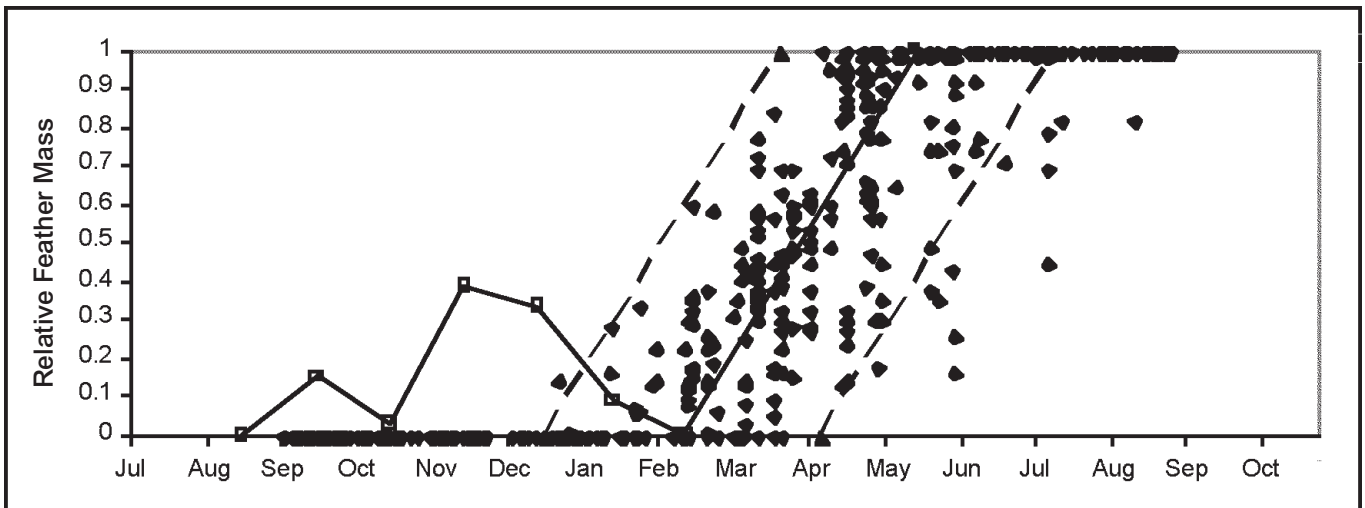
Table 1. Months of egg-laying (percentages) for Spectacled Weaver, Yellow Weaver, Village Weaver, and Thick-billed Weaver in South Africa (from Prÿs-Jones & Newton unpubl. data). For Thick-billed Weaver in the former Transvaal, HDO's records from Gauteng have been included. The percentages are summarized as 5th percentile (represents start of breeding), 95th percentiles (end of breeding), range (90% range of months of egg-laying) and median egg-laying month; numbers represent parts of months, e.g. 12.5 = mid December, 1.4 = 40% through January (see text). Localities are abbreviations for South African provinces: EC=Eastern Cape, KZN=KwaZulu-Natal, Tvl=former Transvaal (this region incorporates the current Gauteng Province)

Species	Area	Aug	Sep	Oct	Nov	Dec	Jan	Feb	n=	5 th	95 th	Range	Median
Spectacled Weaver													
	EC	-	6	32	35	21	6	-	34	9.9	1.2	3.3	11.3
	KZN	-	9	18	32	34	7	-	56	9.6	1.3	3.7	11.7
	Tvl	-	-	20	40	40	-	-	5	10.3	12.9	2.6	11.8
Yellow Weaver													
	EC	-	17	29	25	4	25	-	24	9.3	1.8	4.5	11.2
	KZN	-	18	23	38	13	7	<1	267	9.3	1.4	4.1	11.2
Village Weaver													
	EC	-	-	20	10	50	20	-	10	10.3	1.8	3.5	12.4
	KZN	-	15	3	39	34	9	-	98	9.3	1.5	4.1	11.8
	Tvl	7	40	16	24	9	2	2	55	8.7	12.9	4.2	10.2
Thick-billed Weaver													
	EC	-	5	5	14	64	9	5	22	10.1	2.0	3.9	12.4
	KZN	1	2	10	13	39	23	13	101	10.2	2.6	4.4	12.6
	Tvl	10	20	10	20	20	20	-	10	9.5	1.8	4.3	11.5

Table 2. Individual primary feather masses (g) of a Thick-billed Weaver specimen from Durban, KwaZulu-Natal, and the mean relative mass of each primary, used in the calculation of Percentage Feather Mass Grown.

Primary	Feather mass (g)		Mean relative feather masses
	Left wing	Right wing	
1	0.0239	0.0205	9.5
2	0.0266	0.0212	10.2
3	0.0258	0.0223	10.3
4	0.0267	0.0240	10.9
5	0.0298	0.0258	11.9
6	0.0305	0.0267	12.3
7	0.0285	0.0265	11.8
8	0.0271	0.0239	11.0
9	0.0248	0.0223	10.1
10	0.0047	0.0042	1.9
Total	0.2484	0.2174	100.0

(a) Village Weaver, grid 2930 in KwaZulu-Natal.



(b) Yellow Weaver, KwaZulu-Natal.

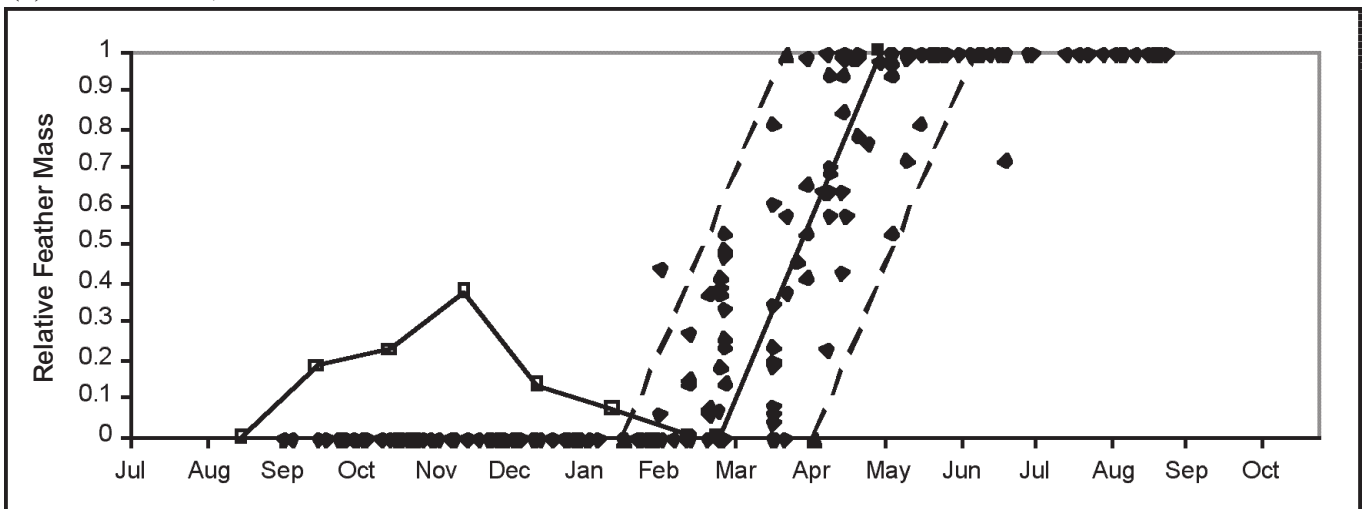
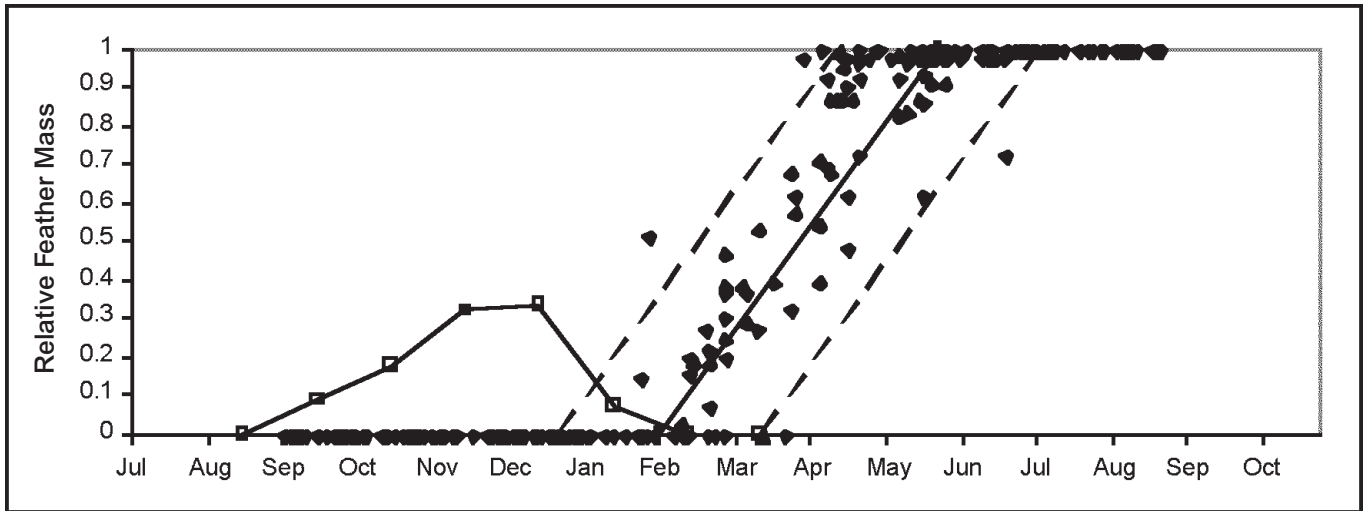
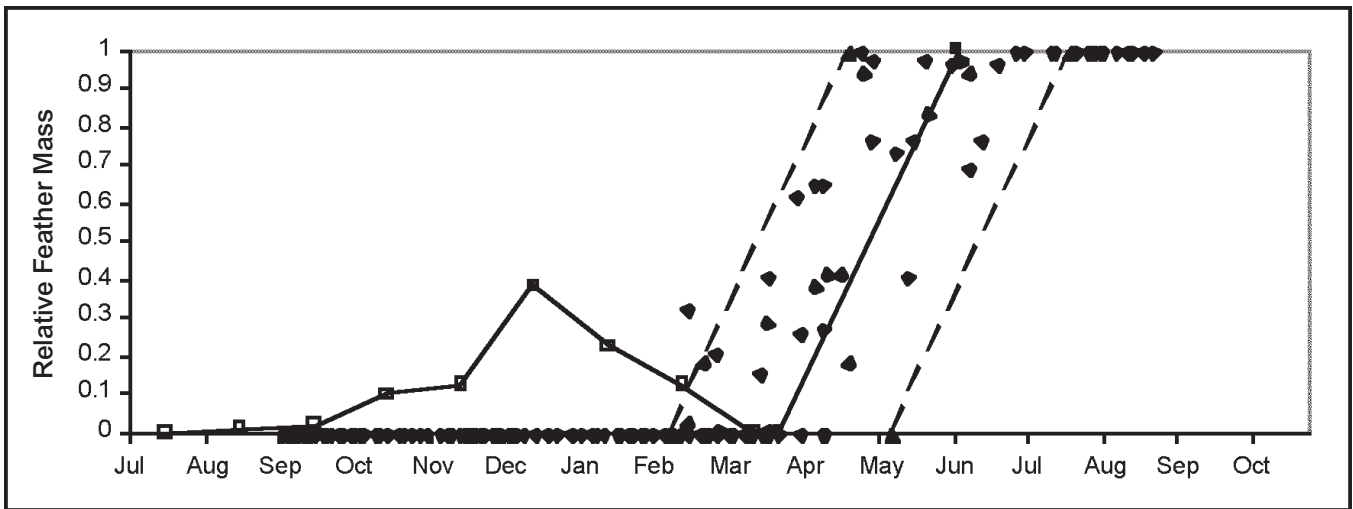


Fig. 2. Timing of egg-laying and primary moult for adult weavers of four species in different parts of South Africa; the open circles with thin solid line shows the proportion of eggs laid per month (from the Nest Record Cards summary by Prÿs-Jones & Newton unpubl. data); the solid symbols represent relative feather mass values by date; the solid diagonal line joins the estimated mean start and end dates of moult, while the diagonal dotted lines show the approximate 95% confidence intervals of moult scores on any given date.

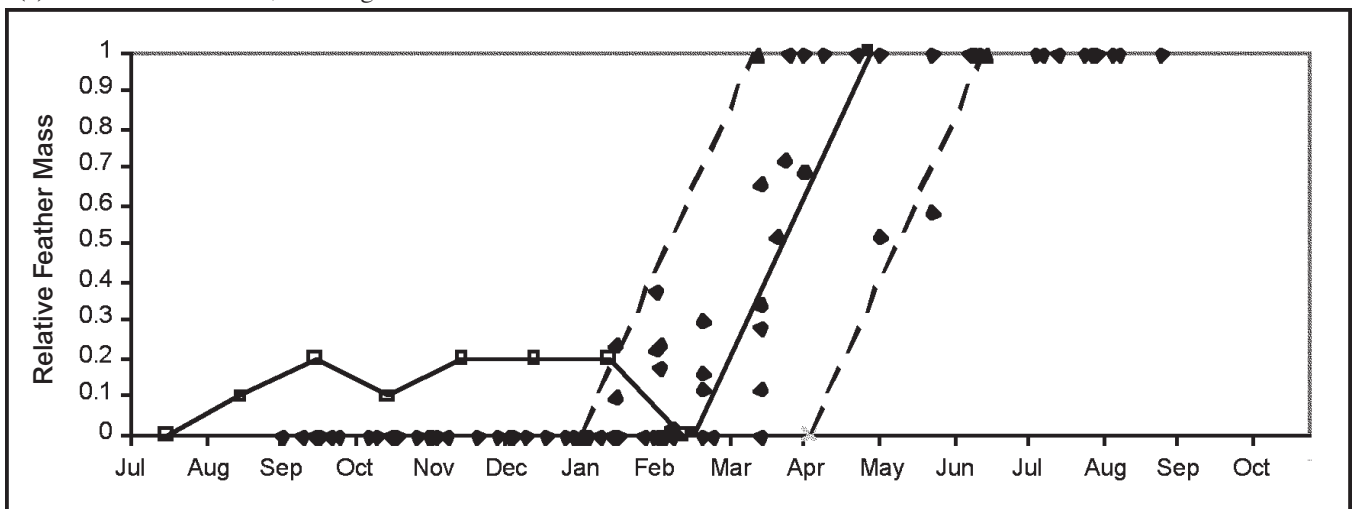
(c) Spectacled Weaver, KwaZulu-Natal.



(d) Thick-billed Weaver, KwaZulu-Natal.



(e) Thick-billed Weaver, Gauteng



There were sufficient data for Village Weaver to estimate different starting dates for moult in three years, while imposing a constant duration and standard deviation on all years. This is valid because there was no significant difference in moult duration in the three years (likelihood ratio test, $\chi^2_3=3.58$, $p>0.05$). The starting date varied between 2 February and 14 February between years (Table 3). These differences were

significant (likelihood ratio test, $\chi^2_3=173.8$, $p<0.001$).

The Thick-billed Weaver had a similar duration of moult in Gauteng and KwaZulu-Natal of 2.4 months, but the start date was five weeks earlier in Gauteng. The difference in start date was highly significant (likelihood ratio test, $\chi^2_2=77.9$, $p<0.001$).

The numbers of primary feathers growing

Table 3. Estimates of the primary moult parameters of adult Spectacled, Yellow, Village and Thick-billed weavers in KwaZulu-Natal (KZN), Eastern Cape (EC) and Gauteng (GP), South Africa. For annual results for the Village Weaver, a dataset containing 673 records for three years was used; mean starting dates were estimated for each year, with a common duration and standard deviation. Data for Village Weaver in the Eastern Cape are from Craig *et al.* (2001).

Locality /year	Mean starting date	Standard error (days)	Standard deviation (days)	Standard error (days)	Duration (days)	Duration (months)	Standard error (days)	Mean completion date	Standard error (days)	n=
Spectacled Weaver										
KZN	3 Feb	3.4	21.0	1.3	114.1	3.8	4.3	28 May	2.3	388
Yellow Weaver										
KZN	27 Feb	2.6	19.7	1.4	65.8	2.2	3.9	4 May	2.8	653
Village Weaver , in the one-degree grid cell with 29°S 30°E in the northwestern corner										
KZN	12 Feb	2.4	28.5	1.1	96.1	3.2	3.4	19 May	2.1	1215
2001	2 Feb	4.7						18 May	4.2	
2002	7 Feb	4.0	31.5	1.6	106.1	3.5	4.9	24 May	3.8	673
2003	14 Feb	5.5	-	-	-	-	-	31 May	8.7	-
Village Weaver										
EC	17 Feb	5	40.1	2.4	109	3.6	6	5 Jun	3.7	436
Thick-billed Weaver										
GP	20 Feb	4.3	23.8	2.6	71.2	2.4	6.8	2 May	5.4	179
KZN	26 Mar	3.9	22.9	2.2	73.3	2.4	6.4	8 Jun	5.2	462

simultaneously were similar; the means were 1.6 for Village Weaver, 1.7 for both Spectacled and Yellow weavers, 1.8 for Thick-billed Weaver in KwaZulu-Natal, and 1.9 for Thick-billed Weaver in Gauteng.

Discussion

Our analysis of breeding records indicates that breeding in the summer-rainfall region for these four weavers starts in September or October, and ends in January or February. This corresponds well with the published peak breeding season in KwaZulu-Natal of September to January (Harrison *et al.* 1997). Peak breeding corresponds to the summer-rainfall period; rainfall generally starts in September or October and peaks in December to January in KwaZulu-Natal (Figure 15 in Allan *et al.* 1997).

Moult has not been analysed for Yellow and Spectacled weavers previously (Craig 1983), although Britton & Britton (1986) published a figure with eight moult records for Spectacled Weavers in Mombasa, Kenya. The duration of primary moult for Village Weavers has been estimated previously. It was estimated to last an average of 109 days, from 17 February to 5 June, in the Eastern Cape (Craig *et al.* 2001); in KwaZulu-Natal primary moult started an average of five days earlier and lasted two weeks less (Table 3). Craig *et al.* (2001) also used the Underhill-Zucchini method of moult analysis, so the results are comparable. The difference

in moult parameters in the Eastern Cape and KwaZulu-Natal are most likely due to slight differences in breeding seasonality and the birds' physiological state in different years. In KwaZulu-Natal, Village Weavers varied the start date of moult by up to two weeks in different years. Annual variation in moult may also explain the difference between birds in the Eastern Cape and in KwaZulu-Natal because the data was collected in different time periods (before 2001 and 1977-2004 respectively).

Moult in Thick-billed Weavers has been studied in KwaZulu-Natal by estimating duration of moult visually from plots of moult score versus date. Laycock (1982) described moult in the population from December to June; this includes secondary moult which finishes a little later than primary moult. Brown *et al.* (2001) found primary moult from April to June. The present analysis gives a shorter duration of moult (2.4 months), as it is based on a rigorous statistical analysis that provides mean data, and not the total extent of moult (i.e. earliest date to last date that moult was recorded in a population).

No studies of Thick-billed Weavers in Gauteng exist; there are only published sightings showing that the species has expanded its range to this province (Harrison *et al.* 1997). This study shows breeding and moulting starting five weeks earlier in Gauteng compared to KwaZulu-Natal. Gauteng is a summer-rainfall region, thus it is not obvious why Thick-billed Weavers breed and moult earlier in this province than

in KwaZulu-Natal. In Gauteng the breeding season appears to be more spread out than in KwaZulu-Natal, allowing an earlier start. The Gauteng sample sizes are small, and this represents an opportunity to collect more breeding and moult data from Gauteng to improve the sample size and further investigate the apparent earlier breeding and moult patterns.

The monogamous species, the Spectacled Weaver, has a similar peak breeding season (November) to the two polygynous *Ploceus* species, Yellow and Village weavers. Primary moult in the Spectacled Weaver starts 1–3 weeks earlier, and ends 1–3 weeks later, than the other two species. This species is resident while the polygynous *Ploceus* species may show local wandering (Harrison et al. 1997); the polygynous weavers may expend energy in searching for food in different localities, requiring them to complete moult sooner than a resident species that is familiar with its feeding area. The longer moult duration in the Spectacled Weaver may also have been influenced by the larger area that data were collected from; more data need to be collected and Spectacled Weaver primary feathers need to be weighed to confirm the results presented here.

The numbers of primary feathers growing simultaneously were similar in all four species in KwaZulu-Natal at 1.6–1.8, and 1.9 in Gauteng Thick-billed Weavers. The number of feathers growing simultaneously appears to be related broadly to environment, with weavers in arid regions growing fewer feathers simultaneously (1.0–1.2; Oschadleus 2005). Moult follows soon after breeding in all four species studied here, as is normal in passerines (e.g. Marini & Durães 2001). These weavers have well-defined breeding and moulting seasons, which seem to be related to the mesic environment they occupy, rather than being related to their mating system.

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