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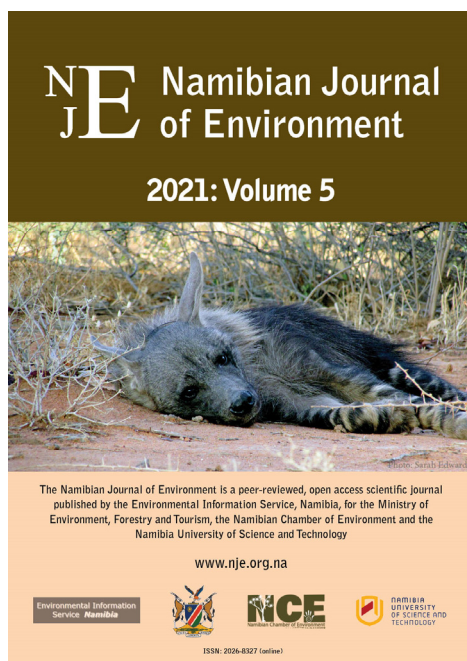
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Common Fiscal (*Lanius collaris*) Linnaeus, 1766: comparative biometrics, moult data and criteria for the determination of age and sex

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ABSTRACT

We present measurement and moult data for both subspecies groups of Common Fiscal (*Lanius collaris*) that occur in Namibia: for 235 Southern Fiscals (*L. c. subcoronatus*) ringed in Namibia and nine Northern Fiscals (*L. c. capelli*) in Zambia. We compare our observations of the moult process and our records of active brood patches with previous breeding records from Namibia (Brown *et al.* 2015) to gain a better understanding of the species' annual cycle. In addition to the account of moult data in adults, we give those of first-year birds and describe in detail the plumage development through the discernible age groups: from fledgling to juvenile and immature, as well as second-year birds and adults. Furthermore, we discuss the possibility of a second generation of juvenile feathers as described in Palaearctic passerines, including the *Laniinae*, which has not yet been reported in the literature on African birds. Based on photographic evidence, we discuss the different plumages that we observed during more than 15 years of ringing. We add notes on interrupted moult, bi-focal moult, residual feathers of former plumage, recaptures and site fidelity, and precipitation and related numbers of shrikes. This monograph supplements published data and is intended to encourage further discussion and research relating to: subspecies measurements and description of juveniles of different subspecies, the different phases of feather growth of the juvenile plumage and their developmental relation to post-juvenile moult, the occurrence of residual feathers from former plumages throughout the different age groups, and the complexities concerning the overlap of moult and breeding (including double and multiple broods).

Keywords: age; biometrics; brood patch; common fiscal; *Lanius collaris*; moult; northern fiscal; plumage; sex

1. INTRODUCTION

Species and subspecies of Namibian birds are underrepresented in research and literature of southern African birds. To help address this shortcoming, we present our measurement and moult data on the Common Fiscal (Figure 1), supplementing the information available for this data-deficient species and its various subspecies. Additionally, we compare our Namibian moult records with other recorded breeding events (Brown *et al.* 2015), to place the moult process into the annual life cycle of the species.

Between 2002 and 2020 we ringed Common Fiscals and collected data on their measurements and moult

in southern Africa. Our field excursions occurred mainly in Namibia, during the summer months between November to April. In this article, we present our observations on 235 Southern Fiscals (*L. c. subcoronatus*) and nine Northern Fiscals (*L. c. capelli*).

2. SITES AND METHODS

Our data on Southern Fiscals were collected in Namibia, mainly in the arid savanna along the eastern edge of the Namib-Naukluft Park (Farm Sphinxblick), at the Spitzkoppe, and in Swakopmund.



Figure 1: Adult male Common Fiscal (*L. c. subcoronatus*). Sossusvlei, October 2019. Photo courtesy of Eckart Demasius.

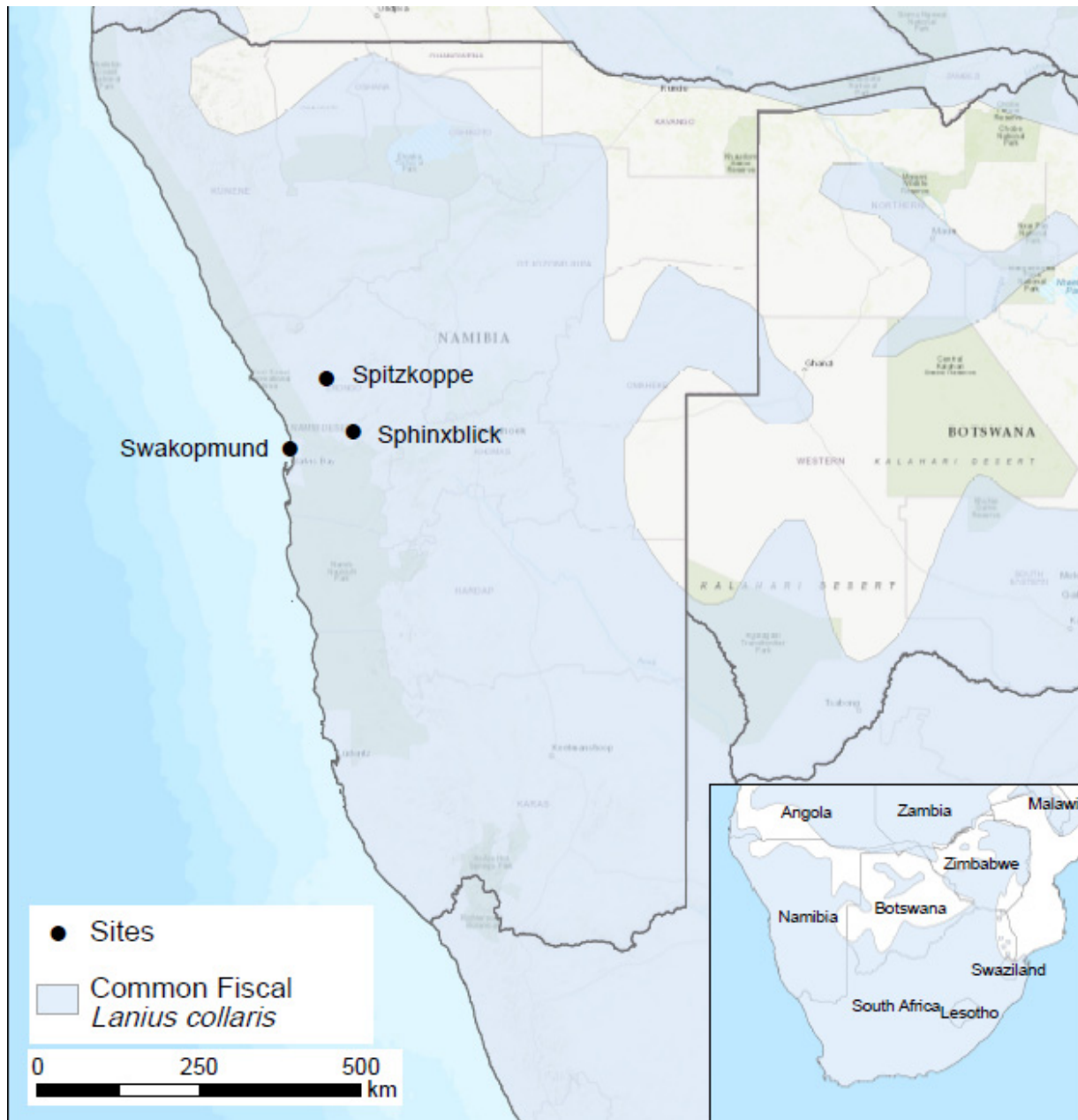


Figure 2: Distribution of the Common Fiscal in southern Africa, downloaded from www.iucnredlist.org on 18 May 2019. Black dots designate sites where data were gathered.

Our data of Northern Fiscals stem mostly from north-western Zambia. If not mentioned otherwise, all photographs were taken by the authors on the Farm Sphinxblick, in the Erongo region of Namibia, and show subspecies *L. c. subcoronatus* of the Southern Fiscal. Ringing localities are presented in Figure 2 and descriptions and photos of the sites can be found in Appendix 1.

2.1 Distribution and Sites

Southern Fiscals were mainly ringed at the Farm Sphinxblick (Figure 3; 22°29'S, 15°27'E), at Spitzkoppe (21°50'S, 15°09'E), and a few on the artificially watered golf course in Swakopmund (22°40'S, 14°35'E) (Figure 2).

2.2 Bird Ringing and Measurements

Birds were ringed, measured, and moult scores were taken in accordance with the guidelines of the South African Bird Ringing Unit's (SAFRING) Bird Ringing Manual (de Beer *et al.* 2001, based on Svensson 1984). The birds' sex was determined by following phenotypical characteristics described in the common literature (i.e. Harris & Franklin 2000, Hockey *et al.* 2005, del Hoyo *et al.* 2008). The literature describing Afrotropical species reveals considerable gaps in the description of plumage through different age classes and a lack of more detailed criteria and precise terminology for ageing Namibian shrikes. Thus, we relied on the Palearctic



Figure 3: Typical habitat at Farm Sphinxblick in the pre-Namib, a semi-arid desert and arid savanna. One Southern Fiscal is flying to the left, the other is sitting in the centre of the bush. April 2003.

literature, as regards ageing and age development (see Appendix 2.4.4 Glossary for ageing).

3. CHALLENGES FACED

3.1 Terminology

In general, the terminology to describe the age of birds is far from consistent or clearly defined. Several core terms are used arbitrarily in both a general and a restricted sense. Terminology is not standardised and differs within Africa, but also widely between continents (see Schulze-Hagen 2019). We tried to be consistent in the use of terms and as clear as possible, mainly following Harris & Franklin (2000, pp. 50-51), Jenni & Winkler (2012), Shirihihi & Svensson (2018, p. 17).

3.2 Age Categories in the Palearctic and in the Afrotropical Region

The description of the age of Palearctic birds falls into categories that follow the major seasonal changes. All Palearctic passerines breed during (northern) summer and start moulting thereafter. Using a clear distinction of summer and winter, a clear distinction of the age differences of plumage can be made and named. Young birds can be categorised according to calendar years and, at any stage of their young lives, be clearly distinguished from adults based on plumage differences.

In the Afrotropical realm, these categories cannot be applied since breeding times of many species are variable. Breeding often takes place in December / January but can occur during all calendar months. Precipitation may trigger breeding in nomadic birds in arid environments (Dean 2004, and pers. obs.) and active Common Fiscal nests are recorded almost all year round in Namibia (see Brown *et al.* 2015 in section 4.4. Moulting and breeding). An examination of the factors driving breeding needs more scientific attention. We are using the terms juvenile, immature (after the post-juvenile moulting) and sub-adult for birds in their first year of life, and second year of life for birds with features that allow this specification.

3.3 Description

Age determination, the plumages at different ages of Namibian birds, and African birds in general, are not yet sufficiently researched and described. Stresemann & Stresemann (1966, p. 10) point out that some species display a second, and even a third, plumage before adulthood, representing immature and subadult plumages.

3.4 Distinction

In the literature, the two, quite distinctive, plumages of juvenile and immature birds are not being differentiated, if two different plumages are described at all (Chittenden *et al.* 2016, Dean 2005, Harris & Franklin 2000, Lefranc & Worfolk 1997, Nijssen *et al.* 2008). We observed three distinct plumages of the Common Fiscal and describe them in detail.

3.5 Growth Patterns

The juvenile plumage in most passerine species grows in two phases, in some species three, making it difficult to distinguish later growth phases from the post-juvenile moulting. Beyond that, the post-juvenile moulting can start before the juvenile plumage has fully developed (Kasperek 1981, p. 10), a feature not yet researched in African birds. Additionally, such observations are not currently found in the African literature. We describe one Common Fiscal with feathers from a supposed second phase, and one with feathers from supposedly different, yet undescribed phases (see 4.5.2 Second generation of juvenile feathers and 4.5.3 Transition to immature plumage by post-juvenile moulting).

3.6 Moulting Time Frame

The moulting process is quite variable and seems to progress almost continuously in some species, in contrast to birds breeding in the northern hemisphere where there are more defined time frames for moulting. We describe several young birds in transitional plumages.

A glossary of terms is presented in Appendix 2.

4. SPECIES DETAILS

4.1 Taxonomy

In recent years, attempts to split the Common Fiscal into the Southern Fiscal (*L. collaris*) and the Northern Fiscal (*L. humeralis*) were made on the basis of distinct vocal differences (Harris & Franklin 2000a) and genetics (Fuchs *et al.* 2011). This distinction is still being discussed and, for the purpose of a clear distinction, we use the name Southern Fiscal for subspecies *L. c. subcoronatus* (our main research focus), Northern Fiscal (*L. c. capelli*) for the northern subspecies, and Common Fiscal (*L. collaris*) when we quote studies before the proposed split. Beyond that, there is much

discussion and contradiction about the number of subspecies, their phenomenological expression, and their range (see Lefranc & Worfolk 1997, Harris & Franklin 2000, Fry *et al.* 2000, Dean 2005, Chittenden *et al.* 2012, Yosef & International Shrike Working Group 2019).

Following Dean (2005), the subspecies in our research area in central western Namibia would be *L. c. aridicolus*. Elsewhere (del Hoyo *et al.* 2016, Yosef & International Shrike Working Group 2019), this subspecies is restricted to the dune-fog zone of the Namib Desert in south-west Angola and north-west Namibia, located further north-west of our ringing area. We consider the studied individuals to belong to subspecies *L. c. subcoronatus*, following Yosef & International Shrike Working Group (2019) as the most comprehensive and most recently published document on the topic. Their subspecies description also best matches our field observations. See the discussion on these subspecies under "5.8. Unresolved questions" below.

4.2 Subspecies

Of the five southern African subspecies of the Common Fiscal, four occur in Namibia. The first three of the Namibian subspecies listed below belong to the "Southern Fiscal", and the fourth, *L. c. capelli*, to the "Northern Fiscal".

Subspecies ringed and researched in this study include:

- *L. c. subcoronatus* (Smith 1941) is reported in Namibia (excluding the coastal NW and extreme south), the extreme SE of Angola, in Botswana, SW Zimbabwe and in the north of South Africa (south to the NW Northern Cape and central Free State) (del Hoyo *et al.* 2016).
- *L. c. aridicolus* (Clancey 1955) occurs in the dune-fog zone of the Namib Desert in the SW of Angola and NW of Namibia, and
- *L. c. collaris* (Linnaeus 1766) occurs in the extreme south of Namibia, in southern, central and eastern South Africa, Swaziland, Lesotho and southern Mozambique (Maputo) (Yosef & International Shrike Working Group 2019).
- *L. c. capelli* (Bocage 1879) occurs in the extreme NE of Namibia, the distribution starting in south Gabon and southern Congo, reaching east to south of the Democratic Republic of Congo, the extreme SW of Uganda, Rwanda and Burundi, and south to Angola (except its south), Zambia and northern Botswana, possibly also to the extreme SW of Tanzania. All measurements of this subspecies were collected in Zambia.

4.3 Measurements

Table 1 and Table 2 present the measurements of *L. c. subcoronatus* and *L. c. capelli* respectively.

4.3.1 Southern Fiscal (*L. c. subcoronatus*)

The data represent a large sample of measurements for *L. c. subcoronatus* (Table 1), which are not reported in standard publications, such as Dean (2005) or Harris & Franklin (2000). Our results confirm that variation between different subspecies plumage features is greater than size variation (Dean 2005). Our sample of *L. c. subcoronatus* was slightly lighter in weight than the nominate subspecies *L. c. collaris* (Dean 2005).

4.3.2 Northern Fiscal (*L. c. capelli*)

Subspecies *L. c. capelli* did not have considerably different measurements to that of *L. c. subcoronatus* (Tables 1 and 2). Harris & Franklin (2000) noted that the Northern Fiscal's (*L. c. humeralis*) tails were consistently longer than those of *L. c. subcoronatus* of the Southern Fiscal. Our sample was too small to allow further conclusions.

4.4 Moulting and Breeding

In Namibia, active nests of the Common Fiscal were observed during every month of the year except June (see Table 3). The young fledge at about 33 days after egg-laying, following 14-15 days incubation and an 18-19 days nestling period (Tarboton 2014).

4.4.1 Moulting and Breeding in Adults

4.4.1.1 Moulting of Adults: Post-breeding Moulting

Due to the extent of breeding activity throughout most of the year, the subsequent complete post-breeding moulting could be expected during all calendar months. Moulting studies concerning Common Fiscals are scarce; in 22 museum specimens studied in the Eastern Cape (covering all calendar months except October and November), Craig (1983, p. 54) observed wing moulting in February, March and April, suggesting a complete post-nuptial moulting.

In a study of Common Fiscals in Ghana, Macdonald (1980) found breeding activity almost all year long, speculating that breeding was "suspended during the moulting" (p. 69), and deduced from the observation of family groups that the Common Fiscal produced two or even three broods. In our sample, we found three peaks of moulting: in February, May, and August (Table 3). Since ringing was mainly undertaken during the southern summer, our sample sizes during May and August were much smaller, limiting our results.

Over the span of 16 years, we observed that moulting started in the peak months of breeding, as previously reported for Namibia by Brown *et al.* (2015). Moulting in the main cohort of about 125 individuals ringed

from December to March first developed slowly between December and February (with a moult score slightly above zero in December, two in January and six in February), followed by a sudden increase in March, with a moult score of 16 (Table 3). The latter moult event may be explained by a second brood and the subsequent moult.

4.4.1.2 Active Brood Patches

Brown *et al.* (2015) recorded active nests almost

year-round, with a peak from November to February. In our sample, females with a fully active brood patch were observed from the end of December until mid-February; one brood patch showed breeding activity starting at the end of January, and withdrawing brood patches were found both at the end of November and during first ten days of March (Table 3).

Table 1: Average adult and first-year body measurements (including standard deviation [SD], minimum and maximum) of *L. c. subcoronatus*. Measurements are grouped by age and sex of adult and first-year birds. SAFRING codes Age 5 and 6 refer to birds in their first year of life: Age 5 (0-6 months) considering birds still in mainly brown plumage, even after their post-juvenile moult; Age 6 (7-12 months) considering immature birds approaching full adult plumage.

Grouping	Parameter	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Head (mm)	Mass (g)
All adults SAFRING Code Age 4	Mean $\pm$ SD	97.5 $\pm$ 2.9	106.8 $\pm$ 5.3	26.8 $\pm$ 0.9	22.6 $\pm$ 1.4	43.9 $\pm$ 1.4	37 $\pm$ 3.1
	Min-max	90-107	92-118	24.9-28.8	19-26.9	39.8-48.6	29.4-51
	<i>n</i>	126	122	109	116	116	121
Adults Unknown Sex	Mean $\pm$ SD	100 $\pm$ 2.8	113 $\pm$ 2.8	26.7 $\pm$ 0.6	23.2 $\pm$ 1.2	44.4 $\pm$ 1.6	42.6 $\pm$ 4.2
	Min-max	98-102	111-115	26.2-27.1	22.3-24	43.2-45.5	39.6-45.5
	<i>n</i>	2	2	2	2	2	2
Adult Males	Mean $\pm$ SD	98.5 $\pm$ 2.6	108.5 $\pm$ 4.8	27.1 $\pm$ 0.8	22.9 $\pm$ 1.4	44.4 $\pm$ 1.3	37.9 $\pm$ 2.8
	Min-max	94-107	94-118	25.2-28.8	19.3-26.9	41.1-48.6	33.2-51
	<i>n</i>	75	73	67	70	70	72
Adult Females	Mean $\pm$ SD	95.7 $\pm$ 2.5	103.7 $\pm$ 4.5	26.1 $\pm$ 0.7	22.2 $\pm$ 1.4	43.1 $\pm$ 1	35.3 $\pm$ 2.5
	Min-max	90-101	92-118	24.9-27.4	19-24.7	39.8-45	29.4-40.8
	<i>n</i>	49	47	40	44	44	47
First-year birds SAFRING Code Age 5	Mean $\pm$ SD	95.7 $\pm$ 5	100.2 $\pm$ 5.5	26.3 $\pm$ 0.8	22.1 $\pm$ 1	43.1 $\pm$ 1.4	36.7 $\pm$ 6
	Min-max	82-108	90-109	25-27.7	20.5-24.5	40.3-45.3	28.8-53.4
	<i>n</i>	21	19	13	15	15	18
First-year birds SAFRING Code Age 6	Mean $\pm$ SD	96 $\pm$ 3.6	104.3 $\pm$ 5.4	26.5 $\pm$ 1.1	22.5 $\pm$ 1.2	43.6 $\pm$ 1.5	36.4 $\pm$ 3.8
	Min-max	88-106	92-116	22.1-28.3	19.4-25.7	36.6-46.4	29.8-58.2
	<i>n</i>	83	68	57	67	67	82

Table 2: Average adult and first-year body measurements (including standard deviation [SD], minimum and maximum) of the Northern Fiscal (*L. c. capelli*). Measurements are grouped by age and sex of adult and first-year birds. SAFRING codes Age 5 and 6 refer to birds in their first year of life: Age 5 (0-6 months) considering birds still in mainly brown plumage, even after their post-juvenile moult; Age 6 (7-12 months) considering immature birds approaching full adult plumage.

Grouping	Parameter	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Head (mm)	Mass (g)
All adults SAFRING Code Age 4	Mean $\pm$ SD	94.4 $\pm$ 1.5	120.2 $\pm$ 7.3	25.6 $\pm$ 0.8	21.5 $\pm$ 0.7	43 $\pm$ 1.2	39.3 $\pm$ 1.5
	Min-max	92-96	112-131	24.7-26.7	20.5-22.5	41.9-44.9	38-41.2
	<i>n</i>	5	5	5	5	5	5
Adults Unknown Sex	Mean $\pm$ SD	93 $\pm$ 1.4	113.5 $\pm$ 2.1	25.1 $\pm$ 0.5	20.9 $\pm$ 0.6	42.2 $\pm$ 0.4	39.5 $\pm$ 1.6
	Min-max	92-94	112-115	24.7-25.4	20.5-21.3	41.9-42.5	38.3-40.6
	<i>n</i>	2	2	2	2	2	2
Adult Males	Mean $\pm$ SD	95.3 $\pm$ 0.6	124.7 $\pm$ 5.5	26 $\pm$ 0.8	21.9 $\pm$ 0.5	43.5 $\pm$ 1.4	39.2 $\pm$ 1.7
	Min-max	95-96	121-131	25.1-26.7	21.5-22.5	42.2-44.9	38-41.2
	<i>n</i>	3	3	3	3	3	3
First-year birds SAFRING Code Age 5	Mean $\pm$ SD	90 $\pm$ 2.8	111.5 $\pm$ 0.7	25.1 $\pm$ 0.1	20.7 $\pm$ 0.8	40.3 $\pm$ 0.2	36.8 $\pm$ 1.3
	Min-max	88-92	111-112	25-25.2	20.1-21.3	40.1-40.4	35.9-37.7
	<i>n</i>	2	2	2	2	2	2
First-year birds SAFRING Code Age 6	Mean $\pm$ SD	91 $\pm$ 0	109 $\pm$ 1.4	24.2 $\pm$ 1.5	19.7 $\pm$ 0.4	40.4 $\pm$ 0.9	37.2 $\pm$ 0.5
	Min-max	91	108-110	23.1-25.2	19.4-20	39.7-41	36.8-37.5
	<i>n</i>	2	2	2	2	2	2

Table 3: Extent of primary feather moult of adult Southern Fiscals. Values are average moult scores of each primary for *n* number of birds per month sampled. The colour gradient is shown on the side. The tail (*t*), head (*h*), body (*b*) and brood patch (*bp*) are expressed as a percentage of birds assessed showing signs of moult. Nest count values of the Common Fiscal for Namibia are taken from Brown et al. (2015). No moult records were collected during the months marked grey.

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	t	h	b	bp	Nests	Moult Score
Jul	0															1	
Aug	11	0	0	0	0	0	0	0	0	0	0	0%	0%	0%		6	0
Sep	0															3	
Oct	0															5	1
Nov	1	0	0	0	0	0	0	0	0	0	0				100%	8	
Dec	48	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	4%	15	2
Jan	50	1	1	0	0	0	0	0	0	0	0	44%	10%	22%	10%	12	
Feb	27	2	2	1	1	0	0	0	0	0	0	0%	0%	0%		7	3
Mar	5	4	5	4	3	0	0	0	0	0	0	67%	0%	67%	20%	4	
Apr	0															2	4
May	2	2	2	2	2	2	2	2	1	0	0	50%	100%	100%		2	
Jun	15	3	3	3	3	4	4	4	3	3	3	75%	50%	20%		0	5

Table 4: Extent of primary feather moult of first-year Southern Fiscals (SAFRING code Age 5). Values are average moult scores of each primary for *n* number of birds per month sampled. The colour gradient is shown on the side. The tail (*t*), head (*h*), body (*b*) and brood patch (*bp*) are expressed as a percentage of birds assessed showing signs of moult. No moult records were collected during the months marked grey.

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	t	h	b	bp	Nests	Moult Score
Jul	0																
Aug	0																0
Sep	0																
Oct	0																1
Nov	0																
Dec	4	0	0	0	0	0	0	0	0	0	0						2
Jan	8	0	0	0	0	0	0	0	0	0	0	50%	0%	0%			
Feb	6	0	0	0	0	0	0	0	0	0	0	100%	0%	0%			3
Mar	1	0	0	0	0	0	0	0	0	0	0						
Apr	0																4
May	1	0	0	0	0	0	0	0	0	0	0	0%	0%	0%			
Jun	3	1	1	1	1	1	1	1	1	1	1	0%	0%	50%			5

Table 5: Extent of primary feather moult of immature (SAFRING code Age 6) Southern Fiscals. Values are average moult scores of each primary for *n* number of birds per month sampled. The colour gradient is shown on the side. The tail (*t*), head (*h*), body (*b*) and brood patch (*bp*) are expressed as a percentage of birds assessed showing signs of moult. No moult records were collected during the months marked grey.

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	t	h	b	bp	Nests	Moult Score
Jul	0																
Aug	9	1	1	1	1	1	1	1	1	1	1	0%	0%	0%			0
Sep	0																
Oct	0																1
Nov	0																
Dec	17	0	0	0	0	0	0	0	0	0	0						2
Jan	37	1	1	0	0	0	0	0	0	0	0	13%	13%	0%			
Feb	10	2	2	2	1	0	0	0	0	0	0						3
Mar	1	0	0	0	0	0	0	0	0	0	0	100%	0%	0%			
Apr	2	5	5	5	5	4	3	3	2	2	1	100%	0%	0%			4
May	2	2	2	2	2	2	1	2	2	1	0	100%	50%	0%			
Jun	6	3	3	3	3	3	3	3	3	3	3	20%	0%	0%			5

4.4.1.3 Timing of Breeding, Multiple Broods and Moulting

In his evaluation of 1147 records from south of the Kunene and Zambezi, Cooper (1971a) found only four definite examples of double and two cases of triple brooding. He concluded that there is rarely more than one successful brood per year. Cooper (in Marshall & Cooper 1969) mentions finding young birds in May and September. This could be interpreted as double brooding or indicate a long breeding period. Priest (1948) and Toschi (1950) recorded two, and Bütticker (1960) recorded two to five successful broods, the latter over a period of four subsequent years. More research is needed throughout the breeding range to clarify this question and local differences.

4.4.2 Moulting of First-year Birds

Harris & Franklin (2000) report post-juvenile moulting of the body feathers between January and June in South Africa, and wing and tail moulting between February and June. Our small sample of first-year, still brown Southern Fiscals showed tail moulting in January and February and some primary moulting in February and at the beginning of June, corresponding to birds hatched some months before (Table 4).

In immatures, the primary moulting shows three peaks: one beginning moulting in August, the main cohort starting in January, and a third in May, when the former group was completing its moulting (Table 5).

4.5 Plumage Development

We identified three distinct plumages after the nestling period: a finely barred brown juvenile plumage, a more uniform, blackish, brownish and white post-juvenile plumage that we refer to as immature plumage, and the black and white adult plumage. In a few cases, we observed a fourth, unbarred plumage after a second growth of the juvenile feathers. In the literature, the features of juveniles and immatures often seem to be merged and the term "juvenile" is being used for immature birds to distinguish a young bird from an adult. A detailed description of the development of hatchlings, including the plumage, is given in Marshall & Cooper (1969).

Like for other passerines in the region, more research is needed to describe moulting processes precisely, and their corresponding phenotypes at different ages, also to clarify which specific features distinguish birds in their second year of life from fully grown adults.

4.5.1 Juveniles

During its 2.5 weeks as a nestling chick, the Common Fiscal grows into its adult size and acquires its first feathered plumage. As the quantity

of available nutrition is limited and the growth very fast, the number of feathers is reduced to the amount necessary to cover the bird with a low density of barbs and feathers (Figure 4).

Feather quality improves with the post-juvenile moulting, as shown in the comparison of a recently fledged juvenile (Figure 5A) and an immature (Figure 5B). The fluffy, "hairy" body cover is being replaced by "real" feathers, the indistinct grey barring on the chest is replaced by a light vermiculation on plain whitish underparts. The colour of the legs turns from pink to blackish, the colour of the bill from horn to blackish.

4.5.2 Second Generation of Juvenile Feathers

In most passerine species, the juvenile plumage grows in two (or even three) distinct and separate phases (Jenni & Winkler 2012, p. 29). This transition in feather growth is described in detail for passerines: for several warbler species observed in captivity on a daily basis (Gwinner 1969, Berthold *et al.* 1970, p. 311) and for 50 wild, resident and short and long distance migratory passerines (Dorsch 1993).

The juvenile feathers grow in veins, starting in the back and following a distinct sequence. The second and third feather sets grow in lines along the outside of these veins, adding parallel veins covering the body almost fully. "These late growing feathers were downy along the veins on the belly and chest, and contour feathers on the sides of the neck, chest and belly, and upper middle and lower back" (Berthold *et al.* 1970, p. 314).

Of the *Lanius* family, this process is known for the Lesser Grey Shrike (*L. minor*): "A second generation of juvenile feathers starts sprouting from the fourteenth day of life. This process encompasses almost all body feathers and takes at least two weeks for keratinisation" (Thiede in Bub 1981, p. 119). Our observations point toward a parallel development in the Common Fiscal, which had not previously been described.

We did not find any photographic or published documentation of this process to compare our findings. Our hypothesis is that the individual shown in Figure 7 is in transition between juvenile and immature plumages, showing two different age groups of juvenile plumage. Patches of unmarked brown feathers can be seen on the mantle, beside the barred feathers of the first phase (*cf.* Figure 4B). We hypothesise that these feathers belong to the second growth phase. At the same time, this individual is already in its post-juvenile moulting. The throat and the eyebrow are in the process of turning fully white, the white wing bar is forming, and the first black lesser coverts have appeared.

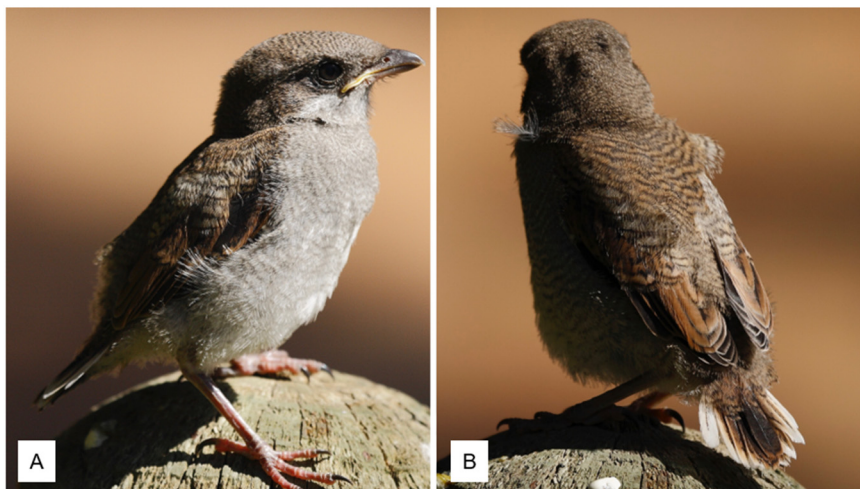


Figure 4: A recently fledged Common Fiscal of the subspecies *L. c. collaris* with finely barred plumage. (A) Horn coloured bill and prominent yellow gape flange, loose feather barbs and "baby face". (B) Barred back and growing wing and tail. Cape Town, October 2012. Photo courtesy of Loutjie Steenberg.

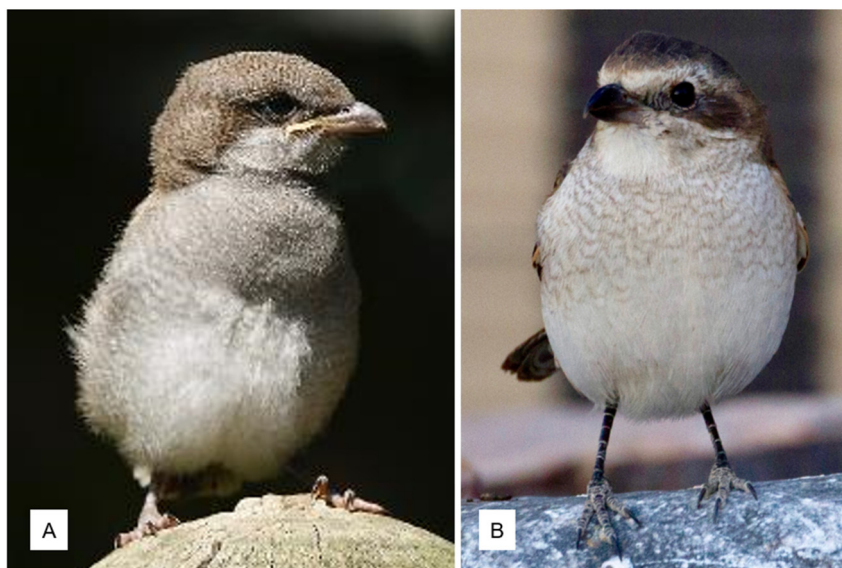


Figure 5: Comparison of juvenile and immature colouration and quality of the plumage on the chest of Southern Fiscals. (A) Juvenile *L. c. collaris* in its first plumage. Cape Town, October 2012. Photo courtesy of Loutjie Steenberg. (B) Immature *L. c. subcoronatus* after post-juvenile moult, with plain white throat and white underparts, and expressed mask and crown. Betesda Lodge, Naukluft, July 2011. Photo courtesy of Peter Lankhorst.

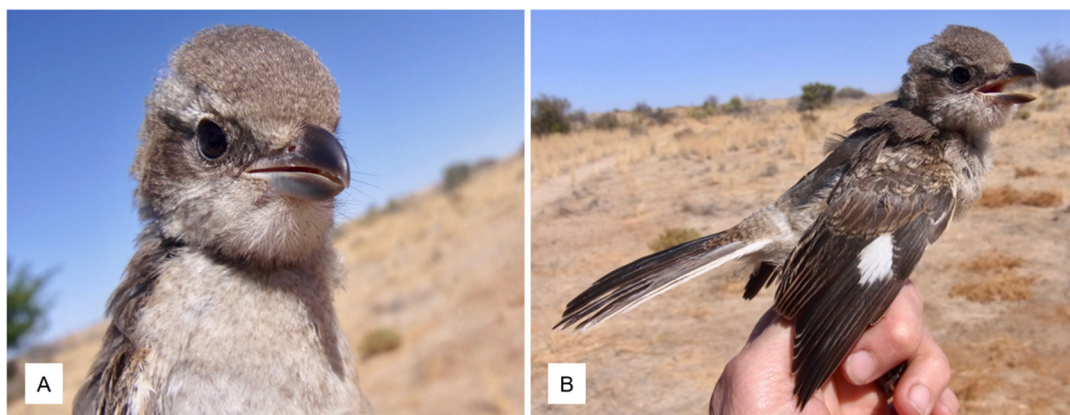


Figure 6: Very young juvenile *L. c. subcoronatus* in its first plumage: (A) Close-up showing the "furry" chest, horn coloured beak, pale at the base, dark towards the tip, pink gape, no mask, and (B) plain brown nape and head (only hints of the white eyebrow), coverts edged buff with black sub-terminal band, barred rump and upper tail coverts, and brownish underparts (here upper chest visible). Farm Sphinxblick, Erongo region, December 2014.

There is a clear difference in the colouration and quality of the feathers on the head, throat, chest and mantle, and the general impression of the young juvenile shown in Figure 6 with that of the more advanced juvenile individual in Figure 7, with feathers considered to be from the second juvenile phase. Note that similar features are still apparent in the immature birds in Figures 8 and 9.

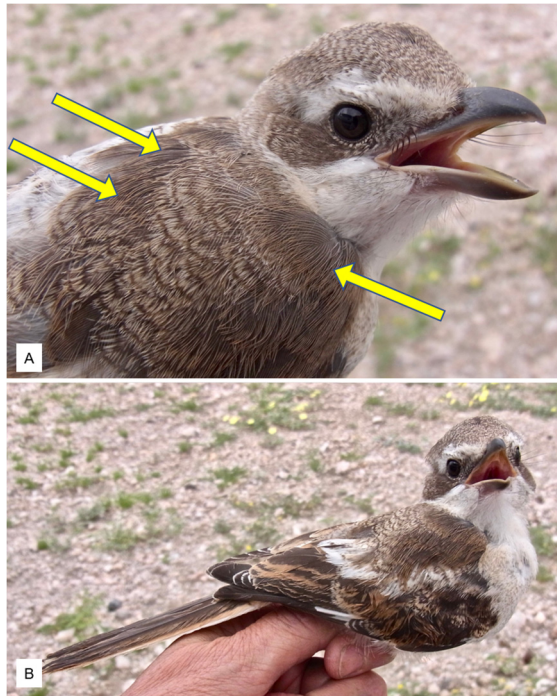


Figure 7: Common Fiscal with feathers of the two phases of the juvenile plumage and first feathers of the immature plumage. (A) Close-up showing barred feathers of the first phase, and plain brown feathers of the second phase of the juvenile plumage; tiny "tooth". (B) Uniform brown parts of the second phase on mantle and mask; white supercilium, wing bar and first blackish coverts of immature plumage; yellow-pink palate. Farm Sphinxblick, Erongo region, February 2014.



Figure 8: Young Common Fiscal (*Lanius c. collaris*) presumably in transition to adult plumage. South Africa, February 2013. Photo courtesy of Loutjie Steenberg.

4.5.3 Transition to Immature Plumage by Post-juvenile Moul

A partial post-juvenile moult in Southern Fiscals involving the body feathers, but not remiges and rectrices, starts at 2-3 months of age and is completed by 4-7 months (Harris & Franklin 2000, p. 174). As the Common Fiscal breeds almost year-round (Brown *et al.* 2015b), we expected a post-



Figure 9: Complaining juvenile Southern Fiscal in transition to immature plumage: (A) throat and chest slightly barred; primaries with white tips and secondaries with buffy edges; some tail feathers replaced, now black with white tips and contrasting white edges on outer rectrices; rump turning white. (B) With fresh plain underwing, juvenile barred chest and flanks with immature white new patches. Often young birds held in the hand to be ringed complain as a defence strategy. Adults would eagerly bite. Farm Sphinxblick, Erongo region, December 2009.



Figure 10: The wing with finely marbled inner webs at the wing patch and a first plain white, adult scapular between vermiculated juvenile ones. Moul score 0. December 2009.

juvenile moult to occur any time of the year. However, we found in our time-restricted sample, individuals in post-juvenile body moult only from December to February (see also Cooper 1971b).

We observed that young moulting Southern Fiscals do not moult from juvenile plumage into adult plumage but go through a distinct stage of immature plumage. The transition from juvenile to immature plumage seems to be variable, as described below.

The Southern Fiscal in Figure 8 has plain colouration. We did not find any comparable appearance depicted or described in any publications. Our hypothesis is that this individual is moulting from a second, plain, set of juvenile feathers into its adult plumage. It is not an adult yet, showing a mixture of features from different age groups, but only very fine barring and without vermiculation. The plain light brown upperparts turn into (immature) grey on top of the head and in the centre of the mantle, while the beak without a visible "tooth" is still horn coloured with the lighter base of a juvenile. The wing bar is completely immature/adult white, while the visible secondary shows a broad buff fringe that is entirely black in adults. The underparts are still slightly marked, with two spots of rufous on the flanks, which can be seen in juveniles of both sexes, but consistently only in females of subspecies *L. c. subcoronatus* (see also Figure 11).

As stated by Kasperek (1981, p. 10), the post-juvenile moult can start before the juvenile plumage is fully grown. We hypothesise that this is the case with the individual shown in Figure 9 and Figure 10. It seems to moult directly from the first, vermiculated plumage into the white and blackish immature plumage, in contrast to the bird in Figure 8. Head and mantle still have the "furry" quality and the underparts are clearly barred and buff with fresh white areas. The secondaries are edged rufous-buff, the beak is blackening, apart from the base, and the palate turns pink, losing its yellow tinge.

"The partial post-juvenile moult starts on the upper- and underparts and soon includes the marginal (lesser) coverts and feathers on the head. The under and upper tail coverts, as well as the median coverts, are shed next, followed by the greater coverts and later by the alula, tertials and rectrices" (Jenni & Winkler 2012, p. 32).

This short period of post-juvenile moult at the age of 2-5 months might explain the immaculate tips of flight feathers and coverts of the wing when the first adult-like plumage starts to appear with the first pre-breeding moult (Figure 11). Here, a row of black median coverts is visible as the first sign of the starting moult.

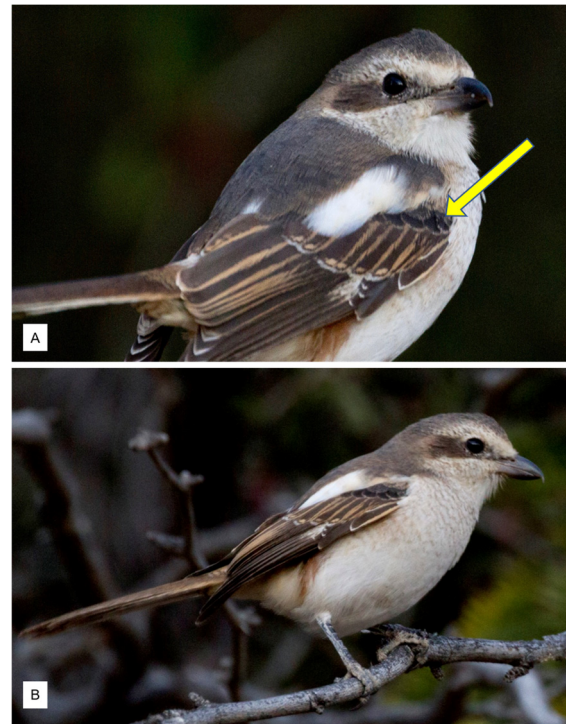


Figure 11: Upperparts (A) and underparts (B) of an immature Common Fiscal starting its pre-breeding moult into adult plumage with fresh adult black median coverts and plain white scapulars. Secondaries and greater coverts are edged rufous-buff. The plain grey mantle and crown, the brown ear coverts, the creamy underparts, and the vermiculated whitish chest are from the immature plumage. The greater coverts show a simple pattern of a rufous fringe, subterminal dot and white tip. In young birds, rufous flanks may occur in both sexes. The beak is becoming darker. Betesda Lodge, Naukluft, July 2011. Photo courtesy of Peter Lankhorst.

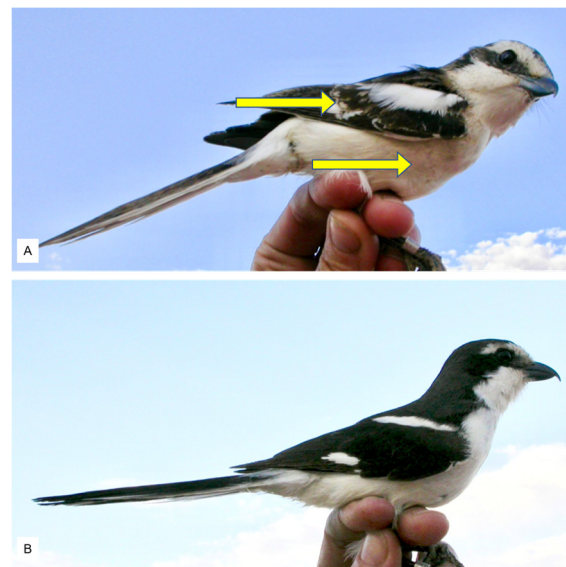


Figure 12: Comparison of immature and adult male Common Fiscals. (A) Immature male, with buff terminal spots on greater coverts, mask turning black, and a few vermiculated marks on the underparts. (B) Fully adult male, all black and white. Both Farm Sphinxblick, Erongo region, December 2003.

4.5.4 Transition to Adult Plumage

During the transition into adult plumage, the last signs of immature plumage, such as vermiculated feathers on the belly, buff tips of the coverts and mixed colouration of the face mask, disappear. The bird now exhibits a clear black and white plumage (Figure 12).

4.5.5 Individuals in their Second Year of Life

Some second-year birds have changed entirely into a plumage resembling that of adults and only feather quality gives an indication of their age (Figure 13). We observed that some individuals in their adult plumage retain first-year feathers on the flanks (Figure 13D), the head (Figure 13C) and on the secondary coverts. Up until now, this has been described for the primary coverts and flanks of individuals of up to 18 months of age, after the immature stage and their pre-breeding moult (Harris & Franklin 2000). Rufous flanks may occur in both sexes (Harris & Franklin 2000, p. 173). Thus, the

colouration of flanks alone cannot be used as a criterion to identify females reliably, but must be substantiated with other features like the grey colouration of the head and mantle in comparison with the black found in males.

Unlike the description in Harris & Franklin (2000), adult females in our sample always had plain white or slightly dull underparts. The underparts "tinged greyish with fine flecking (vermiculated)" (ibid., p. 173) belong to the immature plumage. This is apparent when comparing individuals in transition (Figures 8, 9 and 11) and second-year females (Figure 13).

4.5.6 Adults

Adults undergo a complete post-breeding moult with flight feathers replaced from January to April, and body feathers from January to October (Craig 1983, Harris & Franklin 2000, Dean 2005, see Table 4).

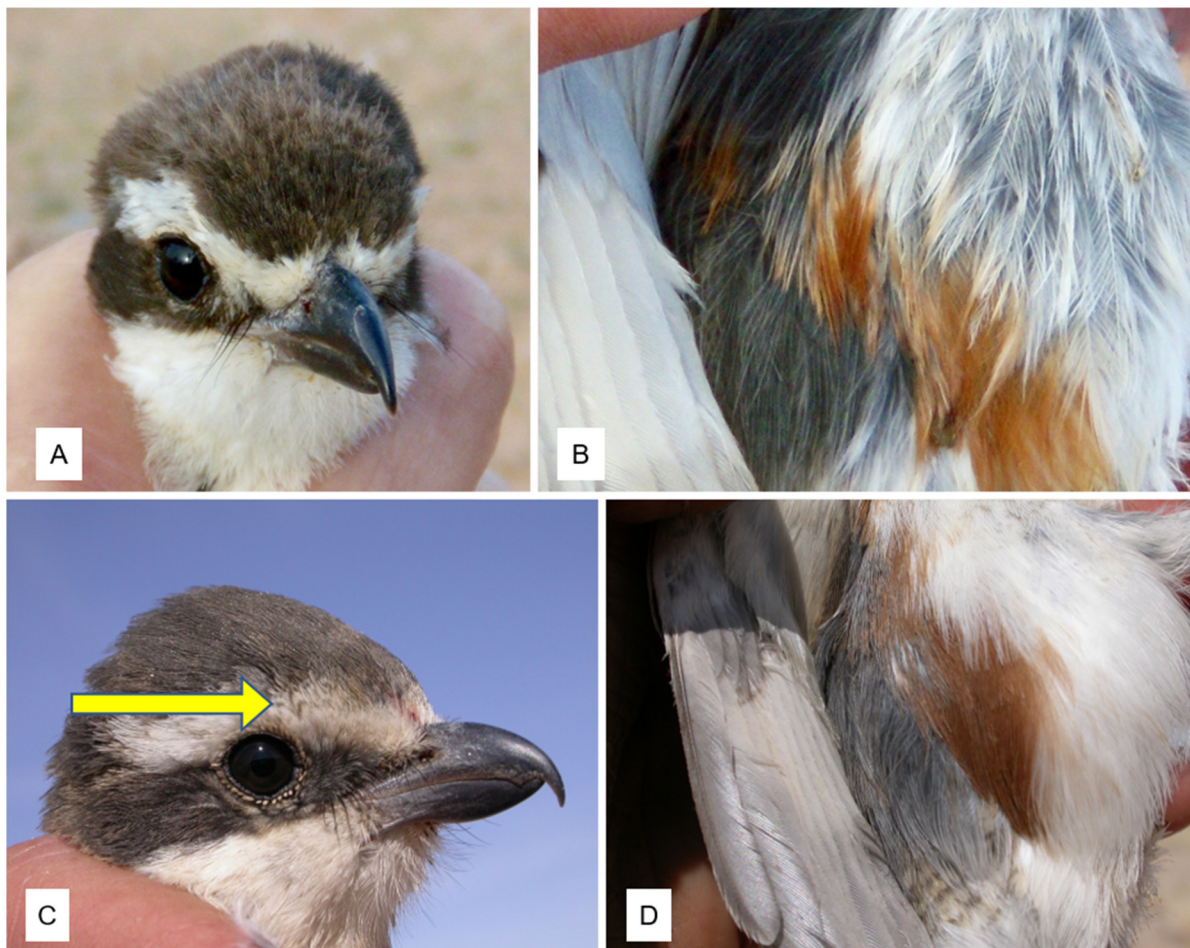


Figure 13: Second-year female. In January (A) with head moult. Note the different feather qualities between moulted forehead and un-moulted crown, blackish and compact resp. greyish and with loose barbs; (B) Flanks unevenly light and dark chestnut coloured, and chest with fewer feathers of lighter brown and of poorer quality with fewer barbs compared to the female seven months later in the year (D), January 2011. In August (C), with plain grey on the head and some residual first-year markings above the eye; and (D) uniform dark chestnut coloured sides and some barred body feathers, retained from juvenile plumage. August 2004. Farm Sphinxblick, Erongo region.

In *L. c. subcoronatus*, the intensity of head and body colouration give an indication of the individual's sex, grey for females and intense black for males (Figure 14).

5. NOTES AND OBSERVATIONS

5.1 Interrupted Moul

On several occasions, we observed an interrupted moult in Common Fiscals. The term "interrupted moult" encompasses suspended and arrested moult. Both occur in the same sequence as a regular complete moult, but may temporarily be discontinued during migration or breeding. If the moult is suspended it will later resume, contrary to arrested moult, when moulting does not continue (Shirihai & Svensson 2018, p. 24).

During the year's cycle, only a certain amount of energy is available for development. Both breeding and moulting are energetically demanding and, thus, rarely overlap in their timing. We found that Common Fiscals started moulting instead of breeding if there was a shortage of rain during the time of the "normal" breeding season, resulting in adverse conditions for raising chicks.

In arid environments, birds often show interrupted moult. As soon as rain falls, breeding begins. The shedding of feathers stops. Those feathers in active moult will continue to grow to their full length. Thus, the wing will show fully grown new flight feathers beside old ones of full length. We observed this over 20 years in many species, including Red-billed Spurfowl (*Pternistis adspersus*), Namaqua Sandgrouse (*Pterocles namaqua*), Cape Turtle Dove (*Streptopelia capicola*) Laughing Dove (*Spilopelia senegalensis*), Namaqua Dove (*Oena capensis*), Dusky Sunbird (*Cinnyris fuscus*) and numerous other passerine and non-passerine species.

Due to our restricted ringing season between November and March, we were not able to follow up if the moult was definitely interrupted and a new moult cycle would be started after breeding, or if the moult was resumed after a time of suspension during breeding activity.

5.2 Bi-focal Moul

On very rare occasions, we also recorded *L. collaris* moult at two locations of the wing at the same time (Figure 15).

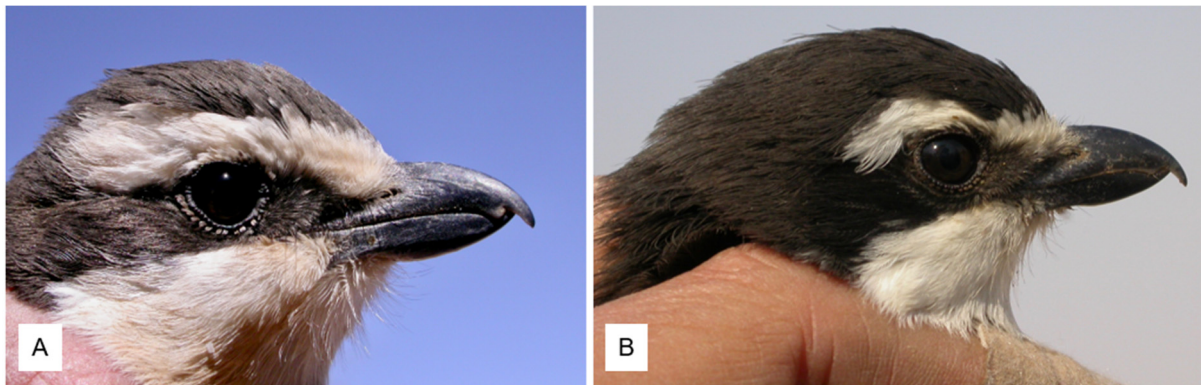


Figure 14: Colour-based comparison of both sexes of Southern Fiscal: (A) head of adult female with greyish head markings, August 2004, and (B) head of adult male with black head markings. August 2003. Both Farm Sphinxblick, Erongo region.

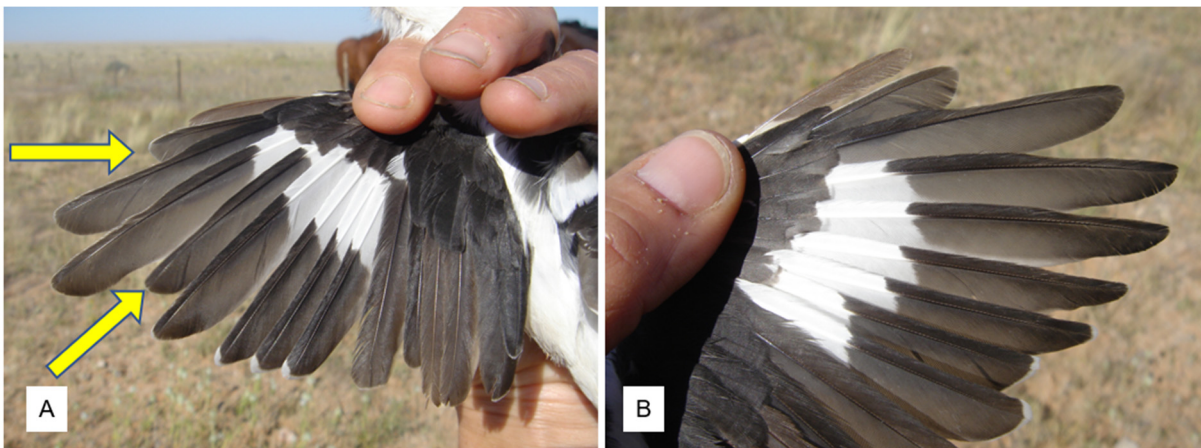


Figure 15: Exceptional moult on one individual with two moult foci on both wings: (A) left wing with primary moult score of 5555425430; (B) right wing with primary moult score of 5455555320. May 2006.

5.3 Residual Feathers from a Former Plumage

Harris & Franklin (2000, pp. 173-174) point out that buff-tipped primary coverts (and sometimes rufous flanks) of the juvenile plumage are retained up to about 18 months of age. We found not only buff- or white-tipped primary coverts, but mainly greater coverts of a former plumage.

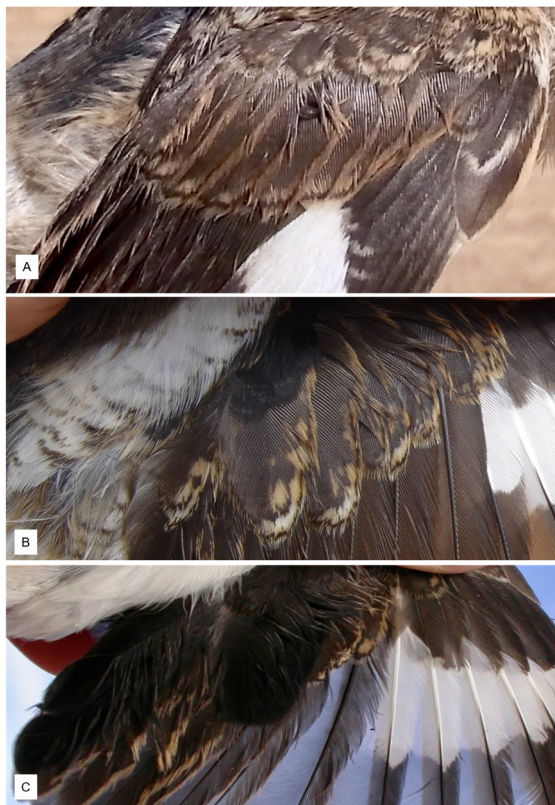


Figure 16: (A) Juvenile from Figure 5: markings on the edge of the coverts dull and little distinct. December 2014. (B) Immature after post-juvenile moult displaying three-coloured markings with light rufous, white and buff on dark coverts. January 2005. (C) Adult in its second year with white belly, fresh black greater coverts, secondaries retained from immature plumage with rufous edges and residual coverts with vermiculation. December 2003.



Figure 17: Adult female, see rufous on flanks, with 11 primaries. The arrow marks the place between primaries and secondaries. All primaries are fully grown. January 2016.

We surmise that a distinction must be made between residual feathers of the juvenile and the immature plumages. While juvenile greater coverts have a brownish edge, the greater coverts of the immature, post-juvenile plumage show light rufous edges on the outer vane of the feathers with dark markings and one or several vermiculated subterminal dark bars between white or buff stripes on the tips (Figure 16).

5.4 Eleven Primaries

Only once did we find an extra primary in both wings, with a total of 11 instead of the usual 10 primaries (Figure 17).

5.5 Recaptures and Site Fidelity

Out of 235 ringed individuals in our study in Namibia, 25 were recaptured (9.6%) and four were caught three times. All occurred at the same location and waterhole of the original ringing, except for two birds that moved several hundred meters. The longest tracking record for any individual in our sample was almost 8 years (14 February 2005 to 10 January 2013, SAFRING number CC70573), followed by four individuals of 6 years (19 December 2009 to 26 December 2015, SAFRING number CV25884; 11 December 2009 to 27 December 2015, SAFRING number BH22151; 19 December 2009 to 26 December 2015, SAFRING number CV25884), two with 5 and one with 4 years.

5.6 Parasites

Of 300 Common Fiscals we examined all over southern Africa, about 2% were infected by parasites: mites, feather flies and ticks. Two individuals in Namibia hosted great numbers of ticks: One adult in January 2006 had 20 ticks, and one juvenile in December 2014 hosted more than 30 ticks (Figure 18). We were not able to identify the species with certainty. Species identification was narrowed down to the "cattle tick" *Rhipicephalus (Boophilus) microplus* and *Hyalomma marginatum* or *H. rufipes*. All three belong to the family of Ixodidae, or 'hard ticks' that display a hard shield on the front of their body.



Figure 18: Some of the ticks removed from a Common Fiscal in December 2014.

They feed on the blood of reptiles, mammals and birds. In a survey of ixodid tick diversity in the Etosha National Park, Namibia, twelve different species were recorded (Turner *et al.* 2017) of which only *H. rufipes* was found in birds. *Hyalomma* ticks are recognisable by their striped legs, a feature we did not observe in our sample. Thus, we assume that the species removed was *R. (B.) microplus*.

5.7 Precipitation and Shrike Numbers

Unlike the fluctuation of numbers of migratory Lesser Grey Shrike (*L. minor*) and Red-backed Shrike (*L. collurio*) in response to substantial rainfall arriving from the north and (especially) the east, the numbers of sedentary Southern Fiscals appeared more stable. Numbers increased a year or two following peak rains in 2007, 2010, and 2015 respectively (Figure 19), presumably due to favourable food and breeding conditions. These lags in abundance are also seen in other species, lag length depending on the size and rate of increase of prey after good rains (Chris Brown pers. com. 2021).

5.8 Unresolved Questions: Discussion and Distribution of Subspecies

Our main research location for Common Fiscals was in the arid savanna of central western Namibia, about 65 km SE of Usakos, 100 km east of the coast and at an altitude of 1000 m above sea level (see Figure 2). In this area, we recorded subspecies *L. c. subcoronatus*, while *L. c. aridicolus* is found in the "dune-fog zone of the Namib Desert in SW Angola and NW Namibia" (Yosef & International Shrike Working Group 2019). Fog from the Atlantic, encroaching only during distinctive weather patterns, rarely reaches the research area and is



Figure 20: One of the rare occasions when fog occurred in the morning at the edge of our research area. Farm Sphinxblick, Erongo region, about 65 km SE of Usakos, 100 km east of the coast and at an altitude of 1,000 m above sea level, December 2009.

found more in the depression of the nearby Swakop River and lower lying areas descending towards the coast (Figure 20).

One female shrike at the Spitzkoppe research site drew our attention, as she appeared particularly pale grey compared with all other Common Fiscals we had ringed in our area, just 80 km south of the Spitzkoppe (Figure 21).

L. c. aridicolus is considered as the palest of the subspecies (Dean 2005); see also depiction in Chittenden *et al.* (2012, p. 123), being paler and greyer above and having a whiter tail and purer silky white underparts (Yosef & International Shrike Working Group 2019). Based on plumage features, we speculate that this individual represents *L. c. aridicolus*.

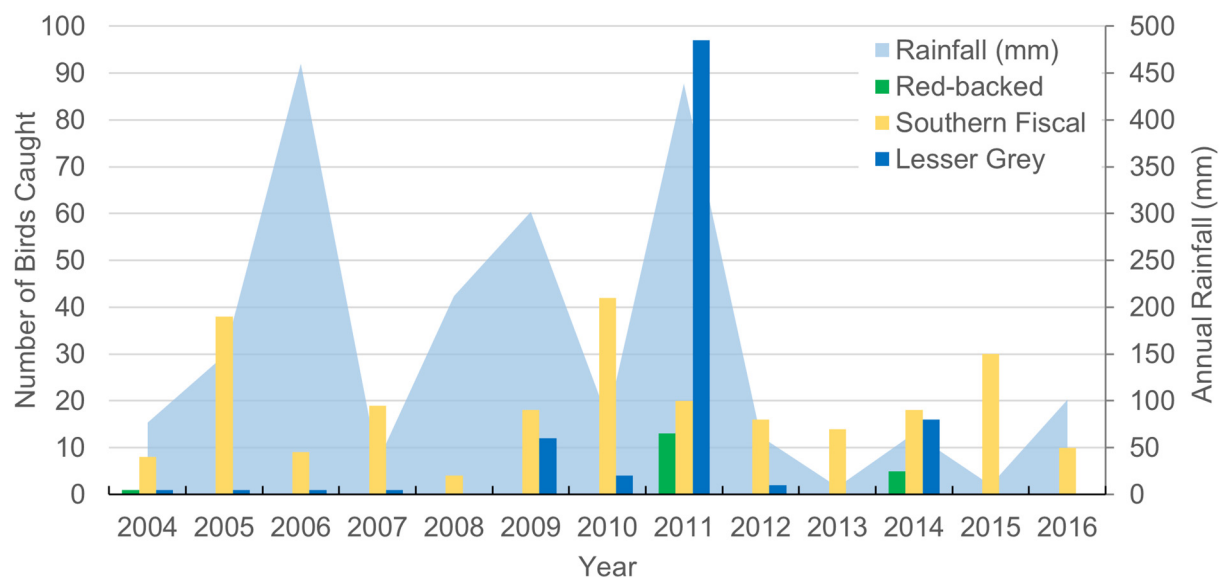


Figure 19: The numbers of Lesser Grey Shrike (*L. minor*), Red-backed Shrike (*L. collurio*) and Southern Fiscal ringed per year in the pre-Namib savannah (22°25'S, 15°25'E) in relation to annual rainfall fluctuations. Rain data extracted by Tony Robertson from: <http://earlywarning.usgs.gov/fews/product/48#download>.

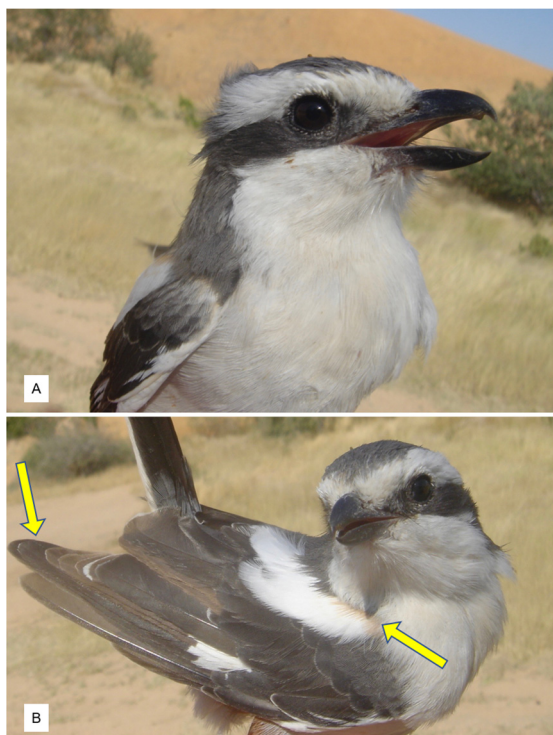


Figure 21: Very light grey adult showing freshly moulted, finely fringed median coverts and white edges on the alula; grey mask and neck; broad supercilium. A well-developed "tooth" points towards an adult. Also, this individual was a recapture (SAFRING BC56499). Unfortunately, no primary records could be found in the data base for this bird to be more specific about its age and possible movements. (A) Close-up. (B) It showed a few rufous feathers on the shoulder (see arrow). The moult, also, was exceptional: 0000555444, meaning that the first four innermost primaries were old, and the subsequent moult had started in the centre of the wing (see arrow). Spitzkoppe, June 2006.

Occasionally, extensive movements of *L. c. subcoronatus* have been recorded (Forsberg 1992, Fraser & McMahon 1994, both cited in Dean 2005). It remains uncertain whether similar movements occur in other subspecies, in our case *L. c. aridicolus*, moving south through the desert to find suitable shrike habitat at the Spitzkoppe?

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APPENDIX 1: SITE DESCRIPTIONS

The locations are sorted by country, then in alphabetical order. Site descriptions and dates are noted below each photograph.

1.1. NAMIBIA

1.1.1. Farm Sphinxblick, between Usakos and the Namib-Naukluft Park, Erongo region (22°29'S, 15°27'E) and surroundings.



Landscape 1: Arid plains savanna of the pre-Namib at the edge of the Namib-Naukluft Park after little rain. January 2011.



Landscape 2: Dry riverbed in the arid savanna of the pre-Namib at the edge of the Namib-Naukluft Park. February 2017.



Landscape 3: Arid plains savanna of the pre-Namib at the edge of the Namib-Naukluft Park following good rains. February 2005.

1.1.2. Spitzkoppe (21°50'S, 15°09'E)



Landscape 4: Mountains and arid savanna. January 2011.



Landscape 5: Mountains with sparse vegetation where water accumulates. January 2011.

1.1.3. Swakopmund (22°40'S, 14°35'E). Artificially watered golf course in coastal desert.

1.2. ZAMBIA

1.2.1. Kanyama, Mwinilunga District (11°26'S, 24°39'E)



Landscape 6: Grassland with trees and bushes and riverine forest. December 2017.

APPENDIX 2: METHODS

For more detailed descriptions see Svensson (1984) and de Beer *et al.* (2001).

2.1. MEASUREMENTS

The following biometric measurements were taken:

- Wing:** Stop rule used to measure longest extent of the flattened wing (mm).
- Tail:** Rule used to measure from the tip of the rectrices to the root of the central pair (mm).
- Head:** Callipers were used to measure from the back of the head to the tip of the beak (mm).
- Culmen:** Callipers were used to measure from the skull to the tip of the beak (mm).
- Tarsus:** Callipers were used to measure from the notch of the intertarsal joint to the end of the tarsometatarsal bone, bending the foot downwards to approximately 90 degrees to the tarsus (mm).
- Mass:** An electronic gem scale was used (to the nearest 0.1 g).

For biometric measurements, recaptures are not reported.

2.2 MOULT

The following moult scores were recorded whenever possible:

Active moult of the 10 primary feathers, given by a score of 0 to 5.

Active moult of head, tail and body, based on absence or presence of moult (yes/no).

Whenever birds were recaptured during the same climatic season, we did not take them into account for moult scores. Recaptures after a time of one year or more were included in moult calculations.

2.3 SEX

Sex was determined by plumage colouration, and, if possible, cloacal shape, distance and shape of the pelvic bones, and occurrence and size of a female or male brood patch. We only considered the data of fully developed, active brood patches.

The brood patch is likely to develop shortly before incubation starts, in females always, but also in males to an extent that corresponds with their active participation in breeding. The skin of the body surface with which the adult bird has contact with the eggs, is naked and looks swollen and, as the blood vessels increase in size and number, the skin turns dark red. When the young have hatched, the area starts returning to normal conditions. The naked patch shrinks, the skin becomes paler and finely wrinkled, then dry scales appear. Shortly after the young fledge, the skin returns to normal, while the new feathering on the belly will occur only during the next complete, post-breeding moult, which might start soon after breeding (Svensson 1984, pp. 38-39, and pers. obs.).

Birds were classified as either male, female, or unknown. Due to uncertainty, those identified as 'possibly male' or 'possibly female' (as per de Beer *et al.* 2001) were grouped into the unknown category.

2.4 AGE

2.4.1 General Determination of Age

Age was determined by plumage features (colour and pattern of feathers; moult features, abrasion, feather quality, shape of remiges and rectrices); eye colouration; beak colouration, shape and wear; gape flange colour, extent and quality; leg skin colouration and softness/dryness, and mainly by a combination of the above features.

2.4.2 Additional Criteria for Ageing Young Birds

In addition to the common age markers mentioned above, young birds show subtle features that help to define their age. Considering the wide variability of individual expression, none of these features is sufficient to serve as a stand-alone criterion for accurate ageing. Nevertheless, these features considerably support the accurate ageing of individuals.

Feather Quality

The first plumage, in its first and second feather generation, is often still of lower quality. This reflects in higher transparency of the flight feathers and in feather shafts that are less stiff than those of adult birds. The body plumage is softer and silkier, on the head or chest fluffy (“hairy”), thinner and shorter in the neck, the barbs are looser.

Baby Face

The proportions of head and beak give the impression of a “baby face”.

2.4.3 Specific Ageing Criteria for *Laniidae*

Generally, it is assumed that it is not possible to distinguish different age groups if birds have already undergone their first complete moult. Birds with residual feathers from the juvenile plumage are an exception.

“Most juvenile Laniids are known to retain some of their greater primary coverts on the upper wing until the second complete moult” (Yosef 2008, p. 378). Examining the birds in detail, we found some individuals with single residual feathers not only on the greater primary coverts, but also in other body parts, like their flanks or on the head. We determined these birds as second-year individuals, relying on an evaluation of the quality and age of the general plumage and following ageing criteria.

2.4.4 Glossary for Ageing

Our glossary is a summary, among others, of Stresemann & Stresemann (1966), Bub (1981), Kasperek (1981), Shirihihi & Svensson (2018). For more details, also see Jenni & Winkler (2020).

“**Adult**” describes a mature bird with clearly defined plumage. This term corresponds to the SAFRING ageing code of 4.

“**Juvenile**” refers to an individual with its first feathered plumage after down plumage, or as Pittaway (2000) puts it: “Juvenile has a precise meaning: It is the first immature plumage.” In passerines, the term “juvenile” corresponds to the SAFRING ageing code of 2. The post-juvenile moult is reputedly completed within about two to three months (Harris & Franklin 2000, p. 173), latest at 6 months of age (Dean 2005).

In the process of acquiring their plumage, birds can grow a **second generation of juvenile** or non-breeding plumage (Bub 1981, p. 119, Jenni & Winkler 2012, p. 29). In a more general sense, as often found in the literature, the term “juvenile” is also used to distinguish young from adult plumage.

We used the term only for birds before the post-juvenile moult.

Post-juvenile moult refers to the first moult of a bird, when the plumage, grown during nestling or juvenile period, is moulted. This moult may start even before the juvenile plumage has fully grown. In most *Laniinae* the post-juvenile moult is a partial moult (Cramp & Perrins 1993).

“**Immature**” describes a young bird of unspecified age, but before reaching adulthood. This term is used to describe a variety of plumage stages following juvenile plumage *sensu stricto*. It can include the juvenile stage if the accurate age is not known. In passerines, this term mainly corresponds to the SAFRING ageing code of 6 (i.e. 7 to 12 months) and 3 (immature, i.e. the recognisable age between juvenile and reaching adulthood).

We used the term only for a distinct plumage that occurs after the juvenile plumage (with its possible two or three growth phases).

“**Sub-adult**” describes the last stage of the immature plumage before reaching full adulthood.

Calendar years and years of life

In the northern hemisphere, moult processes are linked and related to climatic seasons: the summer season when breeding takes place and the winter season when birds possibly migrate.

In this context, **first calendar year** means from hatching, which occurs sometime during the middle of the year, to the 31st of December of the same year. **Second calendar year** means from the 1st of January of the year after hatching to the 31st of December of the same year.

During northern summer, individuals, especially the migratory ones, can clearly be categorised into these age groups by plumage features.

This classification cannot simply be transferred to Afrotropical species occurring in the southern hemisphere where the breeding season coincides with the northern winter and young birds may fledge, despite of a certain seasonality, during any month of the year. This is especially the case in areas where breeding is triggered by and depends on precipitation.

The SAFRING codes propose that ageing should be categorised by months and years of life, which often is based on estimation, following criteria such as plumage features and eye or beak colour. However, very little is known and published about the development of African birds during the first 24 months of their lives.

In general, the onset of the first complete moult occurs around the age of one year, when birds reach sexual maturity and enter the adult breeding cycle. There are, however, many exceptions to this general rule. Nomadic and smaller species in particular might complete their moult within a few months, as described for Red-billed Quelea (*Quelea quelea*) (Craig 2005) and possibly also in Lark-like Bunting (*Emberiza impetuana*) (pers. obs.). In species that display breeding plumage, the young often develop their first full adult breeding plumage after about 18 months (Kobie Raijmakers, pers. com. 1993, and pers. obs.).

According to our results and observations, the end of the **first year of life** of Afrotropical birds cannot be marked clearly using calendar terms.

We use the term **second-year bird** for individuals that are already in their (first) adult plumage but still show obvious signs of either juvenile or immature plumages, displaying characteristics that have not disappeared in a complete moult. In passerines, this mainly corresponds with the SAFRING ageing code of 7 (i.e. 1 to 2 years). Other features of ageing second-year birds, as described in sections 2.4.1 and 2.4.2, are taken into consideration to support our delineation.

In rare cases, we expect residual feathers of a former plumage to still be present during subsequent age stages, as is the case with adult Palearctic birds, which retain individual feathers up to the second next moult cycle. This feature needs to be examined and considered case-specifically.

2.5 SAFRING CODES

Age 0 = Age unknown

Age 1 = Pullus

Age 2 = Juvenile

Age 3 = Immature

Age 4 = Adult

Age 5 = 0 to 1/2 year

Age 6 = 1/2 to 1 year

Age 7 = 1 to 2 years

Age 8 = 2 to 3 years

Age 9 = > 3 years