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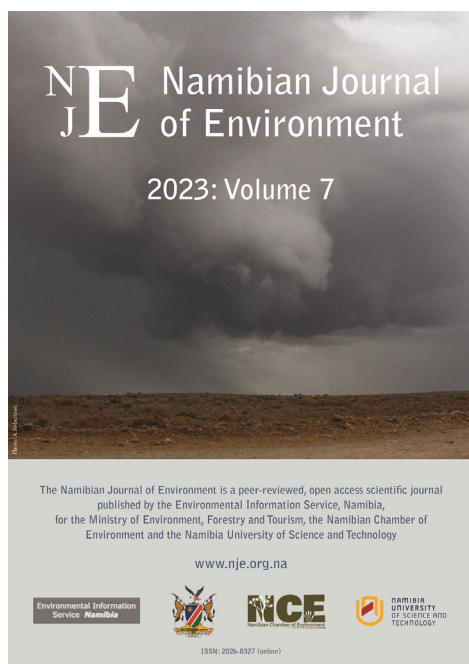
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Red-backed Shrike (*Lanius collurio*) Linnaeus, 1758 on its non-breeding grounds: comparative biometrics, moult data and criteria to determine age and sex

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ABSTRACT

Much is still unknown or unpublished in the Afrotropical literature concerning the complexity of the plumage features of the Red-backed Shrike (*Lanius collurio*). We present measurements, moult data and related observations for about 300 Red-backed Shrikes collected while ringing them in their non-breeding range in southern Africa. We discuss our findings on timing and progress of primary moult in adults and birds in their first year of life. We describe in detail plumage features for the determination of age and sex, and discuss colour and plumage variations in both sexes, especially females, and the occurrence of white wing patches in males. We give photographic evidence of the change of the bill colour during the non-breeding season and add notes on age and sex ratio, retraps and site fidelity. We also discuss the long-standing claims of Red-backed Shrike breeding in the southern hemisphere. Our field excursions between 2002 and 2022 were based mainly in Namibia during the Austral summer months, from November to April. We have included supplementary records of this species from Botswana and Zambia.

Keywords: Africa; age; breeding in wintering grounds; *Laniinae*; moult; Namibia; non-breeding; plumage; sex; Spiegel; white wing patch

1. INTRODUCTION

Much is still unknown or unpublished in the Afrotropical literature concerning the complexity of the plumage features of the Red-backed Shrike (*Lanius collurio*). These unknowns concern mainly plumage development from nestling to adult, variation in the colouration in young birds and adult females, and criteria to better distinguish between young and females (Figure 1).

Between 2002 and 2022 we undertook field excursions to southern Africa during the summer months from November to April. We present measurement and moult data from 102 adult and 197 first-year Red-backed Shrikes that we ringed in their non-breeding range.

2. SITES

Our data were collected in Namibia: in tree-and-shrub savanna on cattle farms (Farm Okatjerute near Witvlei and Farm Hamakari south of the Namibian Waterberg; Figure 2), in the Erongo Mountains and in the arid Nama Karoo on the eastern edge of the Namib-Naukluft Park (at Farm Sphinxblick). We also include records from Botswana and Zambia.

2.1 Distribution and sites

The Red-backed Shrike is a migratory species with a huge breeding range across Europe and into north-west Asia. The whole population spends the non-breeding season in southern and eastern Africa (Figure 3). For a detailed map of recorded sightings in the non-breeding grounds see the map of the Southern African Bird Atlas Project (<https://sabap2.birdmap.africa/species/708>).

Red-backed Shrikes were ringed in Namibia, Botswana and Zambia: in **Namibia**, on the farms Sphinxblick (22°29'S, 15°27'E), Hamakari (20°36'S, 17°20'E) and Okatjerute (22°21'S, 18°31'E), near

Otavi 19°37'S, 17°11'E), in the Erongo mountains (21°29'S, 15°52'E), in Omaruru (21°20'S, 16°04'E) and at Spitzkoppe (21°50'S, 15°09'E); in **Botswana** in Maun (19°59'S, 23°25'E), Gaborone (24°40'S, 25°50'E) and at Lake Ngami (20°26'S, 22°49'E); in **Zambia** in Mutinondo (12°27'S, 31°17'E), the Mwinilunga district (11°19'S, 25°06'E) and in Choma (16°39'S, 27°04'E).

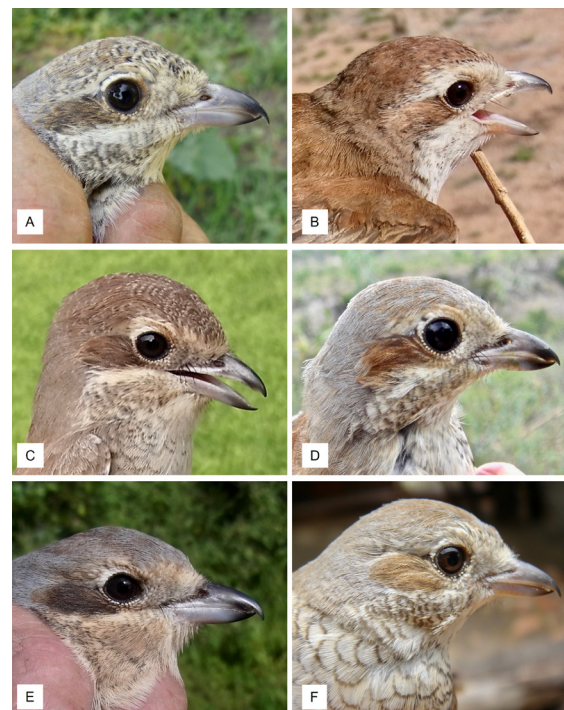


Figure 1: The enormous variation of adult female Red-backed Shrikes ringed in southern Africa which presumably indicates provenience over a wide range. Observe the diversity of markings and colouration on top of the head, the throat, ear coverts and the supercilium. (A): Botswana, 28 January 2015; (B): Farm Sphinxblick, Erongo region, 6 January 2011; (C): near Witvlei, 30 March 2015; (D): Botswana, 1 December 2007; (E): near Witvlei, 28 March 2014; (F): Waterberg, Namibia, 15 January 2006.

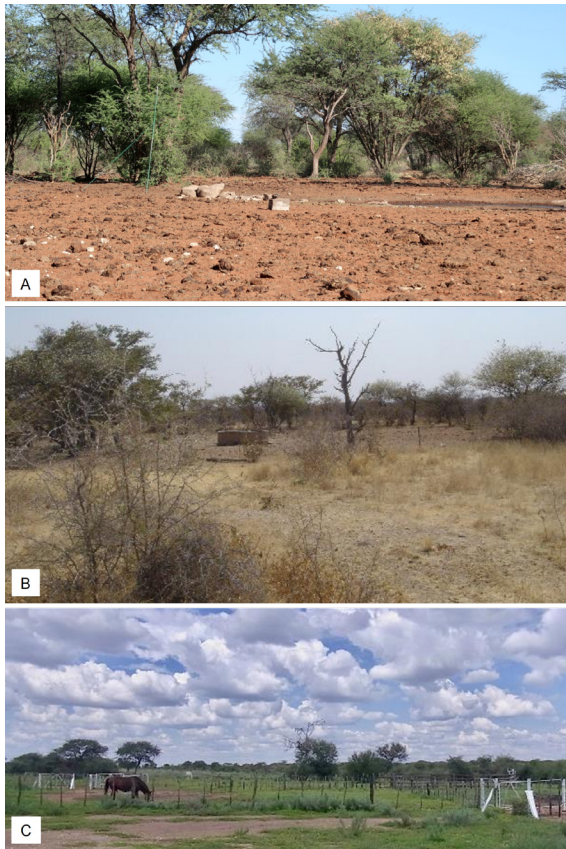


Figure 2: Typical habitat of Red-backed Shrikes on farmland in the Acacia savanna of Namibia. (A, B) before rains, November 2016; (C) after rains, April 2015.

3. METHODS

3.1 Bird ringing

Birds were ringed, and measurements 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). Sex was determined by plumage, following the phenotypical characteristics described in the common and specialised European literature (i.e. Blasco-Zumeta & Heinze 2019; Bub 1981; Cramp & Perrins 1993; Harris & Franklin 2000; Shirihihi & Svensson 2018; Yosef 2008; Yosef *et al.* 2019). All pictures were taken by the authors and in Namibia if not noted otherwise. See photographs of the locations in Bryson & Pajmans (2021, 2022).

3.2 Determination of age

The age description terminology is still not standardised, but differs across Africa and also widely between the continents (Schulze-Hagen 2019). We followed mainly Harris & Franklin (2000, pp. 50-51), Jenni & Winkler (2020b), Shirihihi & Svensson (2018, p. 17).

We want to point out especially that the use of the term “juvenile”, which is used in a wider sense for

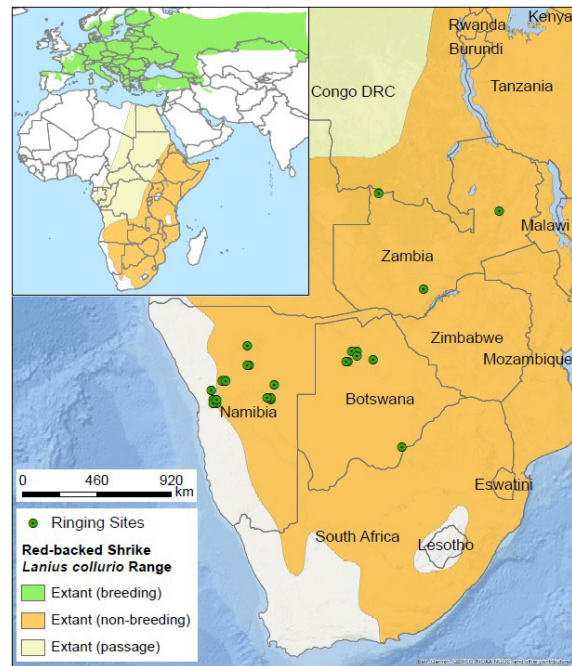


Figure 3: Distribution map for the Red-backed Shrike, downloaded from www.iucnredlist.org on 18 May 2019. Green dots designate sites where data were gathered in the current study.

any kind of young bird, creates much confusion when a precise and differentiated determination of age is required. We used the term “juvenile” in a restricted sense. It describes a bird in its first year and until its post-juvenile moult, which sets in at 3-4 weeks, latest at three months, and ends at about four to six months if not interrupted by migration (Heinroth & Heinroth 1924-1926, cited in Cramp & Perrins 1993 p. 476). After the post-juvenile moult a bird will, in the restricted sense, show an immature plumage.

Age was determined by the pattern of the feathers and confirmed by abrasion and quality of the feathers and the colouration, shape and wear of the beak. Since the exact age of a young bird cannot be defined precisely, as a convention, the SAFRING age code 5 is usually applied by experienced ringers for migratory birds up to 31st December, and the SAFRING code 6 for birds after the 1st of January of the year after hatching. This is to take into account the growing maturity of the birds. (For SAFRING codes see de Beer *et al.* 2001).

3.3 Measurements

Table 1 presents our measurements of Red-backed Shrikes. The culmen was measured to the indentation on the front of the skull following the convention for the measuring of passerines (Demongin 2016, p. IX). For the general description of methods and measurements see Bryson & Pajmans (2021, 2022).

Table 1: Average adult and first-year body measurements (incl. standard deviation, minimum and maximum measurements) of Red-backed Shrikes. Measurements are grouped by age, sex of adult birds and country. Sample sizes are shown in parentheses. We followed the convention of marking young individuals in the first calendar year with SAFRING Code 5, and in the second calendar year until the first northern migration with SAFRING Code 6, which enables us, with some uncertainty, to determine the age more precisely.

Grouping	Parameter	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Head (mm)	Mass (g)
Adults SAFRING Code Age 4	Mean \pm SD	91.8 \pm 3.7	77.7 \pm 3.4	23.9 \pm 1.0	19.9 \pm 1.0	38.7 \pm 1.2	27.4 \pm 2.3
	Min-max	80-104	70-93	21.6-27.2	16.2-22.2	31.7-40.8	19.7-37
	<i>n</i>	102	96	95	96	97	100
Adult Females	Mean \pm SD	91.6 \pm 2.6	77.2 \pm 3.8	23.7 \pm 1	19.9 \pm 0.9	38.4 \pm 1.5	27.1 \pm 2.2
	Min-max	80-96	72-93	21.6-27	17.5-22	31.7-40.2	19.7-30.8
	<i>n</i>	41	39	38	39	39	39
Adult Males	Mean \pm SD	92 \pm 4.2	78.1 \pm 3.1	24 \pm 0.9	20 \pm 1	38.8 \pm 1	27.5 \pm 2.4
	Min-max	82-104	70-92	22-27.2	16.2-22.2	34.1-40.8	23.4-37
	<i>n</i>	61	57	57	57	58	61
0-6 months SAFRING Code Age 5	Mean \pm SD	91.4 \pm 2.4	76.6 \pm 3	23.5 \pm 0.7	19.3 \pm 2.4	38.6 \pm 1.7	27.3 \pm 2.7
	Min-max	86-97	71-87	21.9-25.2	16-28.6	36.7-48.2	22.7-36
	<i>n</i>	47	44	42	44	44	45
7-12 months SAFRING Code Age 6	Mean \pm SD	91.5 \pm 2.9	76.9 \pm 3.3	23.7 \pm 0.8	20.2 \pm 1.4	38.7 \pm 1.5	28.2 \pm 3
	Min-max	82-101	69-88	20.6-25.3	16.4-29.8	29.2-41.3	21.5-39.7
	<i>n</i>	150	133	137	137	137	149
Namibian Adults only	Mean \pm SD	92.4 \pm 3.6	77.9 \pm 3.7	23.9 \pm 1	20.1 \pm 0.9	38.8 \pm 1	27.5 \pm 2.5
	Min-max	80-104	70-93	21.6-27.2	16.2-22.2	34.1-40.8	19.7-37
	<i>n</i>	70	66	63	64	65	69
Botswanan Adults only	Mean \pm SD	90.3 \pm 3.6	77.3 \pm 3	24 \pm 1.1	19.6 \pm 1.1	38.4 \pm 1.6	26.8 \pm 1.8
	Min-max	82-100	70-82	22-27	16.7-22.2	31.7-40	24.8-32.2
	<i>n</i>	29	27	29	29	29	28

4. TAXONOMY

Since the first descriptions by Linnaeus in 1758, several subspecies have been described, including *L. c. kobylini* (Buturlin), 1906 and *L. c. pallidifrons* Johansen, 1952 (1944) (Clancey 1973; Cramp & Perrins 1993; p. 459–460; Herremans 2005). In the empirical literature the species is considered to be monotypic (del Hoyo & Collar 2016; p. 340; Shirihaï & Svensson 2018, p. 187) as proposed earlier by Stepanjan, 1978 (cit. in Cramp & Perrins 1993, p. 477).

This taxonomy was controversial (Yosef *et al.* 2019) until recent whole-genome sequencing. The result revealed “two major groups, with no clear geographical separation” (Pârâu *et al.* 2019, p. 1) and in a more recent study (Pârâu *et al.* 2022) the results showed genetic variability, but no indication of a “genetic structure in the Red-backed Shrike, suggesting a panmictic population. Panmixia is the genetic legacy of the widespread and continuous distribution of the species, high locomotion capacities, and, most importantly, the numerous ice ages from the past few million years, which forced various populations to retract to refugia and expand their ranges several times, and to interbreed both in the glacial refugia and during warm periods in Eurasia” (ibid. p. 1).

These findings could explain the high variability of the phenotype in this species.

5. BREEDING

Breeding takes place in the northern hemisphere. Eggs are laid mainly from May to July, with a few records for August (Bub 1981, p. 105). The young fledge about 29 days after egg-laying, following 13-15 days incubation and a nestling period of 14-15 days, with a considerable variation for longer and shorter periods, and are independent about 14-35 days after hatching (Cramp & Perrins 1993). Birds in their first calendar year are under six months old when they arrive in southern Africa.

6. PLUMAGES AND MOULT

6.1 Plumages of the Red-backed Shrike

The exact number of distinguishable plumages of the Red-backed Shrike is still being discussed in the literature. Well researched and described are a first juvenile plumage, a post-juvenile plumage and an adult plumage. There is, though, a second (and possibly a third) growth phase of juvenile plumage, distinctly different in colour and quality, which can overlap with the post-juvenile moult (see Dorsch 1993; Berthold *et al.* 1970).

“The Red-backed Shrike is among the very few European passerines in which the feathers acquired during the post-juvenile moult are markedly different from those of adults (and hence called second juvenile plumage by Stresemann 1963)” (Jenni & Winkler 2020b, p. 102). In fact, which might be the wide-reaching cause of the confusion with the term “juvenile”, Stresemann himself called this plumage “juvenal” (i.e., first year) in contrast to the commonly used term “juvenile” (first feathering after down) plumage: This “second juvenal plumage differs from the first one only by its more durable structure. It becomes worn during migration from Europe to tropical Africa where it is replaced in December and January, thus after about four months, by the sexually dimorphic (and in the male quite differently colored) ... plumage of the adult bird. Its only reason for existence is that it is far better fit for long distance travel than the first juvenal plumage would be” (Stresemann 1963, p. 6).

Second year birds, on their second arrival in the non-breeding grounds, are not more than 18 months old. Birds at six months can be clearly distinguished, especially in the hand, from those at about 18 months on plumage criteria like abrasion and moult pattern. The question of a possibly distinct second-year plumage is discussed in section 8.2. Barring of the upperparts in females.

Migratory birds arrive on the non-breeding grounds with a varying number of feathers from the different phases. This should also be taken into consideration when defining the age. These processes have not been described in the southern literature and further research is needed.

6.2 Moulting of the Red-backed Shrike

Adult Red-backed Shrikes undergo one annual partial and one annual complete moult. Due to the timing, the partial moult is called post-breeding moult, while the process of a complete moult in the southern hemisphere before the north-migration is named pre-breeding moult. While the progression of the complete moult can be well observed in the non-breeding grounds, the partial moult is quite unobtrusive and in Red-backed Shrikes, as in other trans-Saharan migrants, highly complex and still not fully researched (Jenni & Winkler 2012, pp. 19, 22).

Generally, first-year passerines undergo a post-juvenile, mainly partial moult after a few weeks of life and tune into the adult moult cycle by the end of their first year of life. But variations from this rule occur.

Further investigation suggests that the phases of partial and complete moult do not seem as segregated as described in literature. The moult process is possibly continuous at a low level,

depending on the life circumstances and necessities of the different species (Jenni & Winkler 2020b, p. 183ff; Kees Roselaar, pers. comm. 2021).

The description of the moult process is summarised mainly from Bub (1981), Cramp & Perrins (1993), Harris & Franklin (2000), Jenni & Winkler (2012, 2020a, b) and Shirihai & Svensson (2018). See those papers for more details.

6.2.1 Moulting in the northern hemisphere

First-year Red-backed Shrikes undergo a post-juvenile moult while still on the breeding grounds. This partial moult starts at the early age of 3-4 weeks after fledging and is completed at 8-10 weeks (Heinroth & Heinroth 1924-1926). It begins before the flight feathers and the tail are fully grown (Figure 4) (Harris & Franklin 2000), but is highly variable (Cramp & Perrins 1993, p. 476) (Figure 5).



Figure 4: A juvenile of a few weeks old with yellow bill and yellow feet. The wing and tail feathers are still growing. The markings on the head and the underparts are still undefined and faint, the body feathers in general are “furry”. Germany, September. Photo courtesy of Axel Wellinghoff.



Figure 5: First-year bird after post-juvenile moult with strongly marked coverts, mantle and rump, still furry and barred underparts, plain brown tail, well-marked cap and brown ear coverts. The horn-coloured beak shows a clear hook, a darker upper mandible, a yellow base and a thick, still yellow, gape flange. Cantabria, Spain, 27 July. Photo courtesy of Miguel Martín Diego.

In adults, a partial moult also begins in July, and is often, like in first-year birds, not completed by September when the southern migration starts. If moult of the remiges starts already on the breeding grounds, it is then interrupted during migration. Other individuals do not start moult before migration, although they may begin to moult on stop-over sites before reaching non-breeding grounds.

Both adult and first-year Red-backed Shrikes complete their moult generally in the non-breeding grounds. In adults, it is timed after breeding. Exceptions occur: A complete moult during the breeding season observed in live birds and museum skins is associated with non-breeding adults and with individuals who lost their broods (Kramer 1950). This process is well documented for migratory shrikes. Heinroth & Heinroth (1924-1926) observed it in captive Red-backed Shrikes, Marc Galv  z in captive Lesser Grey Shrikes (*Lanius minor*) in Spain (2020, pers. comm.).

6.2.2 Moult in the southern hemisphere

Young Red-backed Shrikes hatched in June or July arrive in their non-breeding grounds when they are four or five months old as indicated by the first average arrival date of 24 October for Zambia between 1971 and 2000; one exceptionally early observation is from 25 September 1976 in the far north-east, in Mwinilunga (Bowen 1983, in Dowsett 2009, p. 87).

The time for the moult of the flight feathers has been estimated to cover about 80-90 days (Ginn & Melville 1983, p. 77). In southern Africa, the

complete moult of all individuals has been recorded to start between late December or January to March (Cramp & Perrins 1993, p. 476), in Zambia between late November and April (Snow 1965, p. 140; Fig. 3, *ibid.*, shows 108 records mainly from Dowsett from then Northern Rhodesia, now Zambia), with adults starting the primary moult before the first-year birds. This corresponds with our findings. In adults, the first three primaries showed signs of moult as early as November while the first-year birds were displaying similar values only in December. The results of our sample, collected over more than 15 years, are presented in Tables 2 and 3.

The primary moult is descending, as is typical for almost all passerines. The state and progress of moult is expressed by the moult score. The moult score is the sum of the feather codes, with 0 for old to 5 for fully grown, newly moulted primaries. The numbers in between show the stage of growth. A fresh, completed wing thus has a moult score of 50.

Our data suggest that tail moult starts earlier in adults than in first-year birds, while both age groups complete tail moult after four months.

In northern Botswana, between October and early November, Traylor (1965, p. 372) found the same pattern in two adults "in mixed fresh and worn contour plumage, but no active moult". Four immatures in January showed various stages of (complete) pre-breeding moult, while one adult was just finishing its "annual moult", which appears to be very early. We found fully moulted adults in Namibia only in April and in Botswana from mid-March on, in time for the migration northwards.

Table 2: Extent of primary feather moult (P1 to P10) of **adult** Red-backed Shrikes in the non-breeding grounds in Namibia, Botswana and Zambia. The average moult scores between 0 and 1 result from a few individuals with two sprouting primaries (moult score 2). Values are average moult scores of each primary for the *n* birds per month sampled. The colour gradient is shown at the side. The tail (*t*), head (*h*), and body (*b*) are expressed as a percentage of birds assessed showing signs of moult. No data were collected for the cells marked in grey.

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	t	h	b	Moult Score
Jul	0														
Aug	0														0
Sep	0														1
Oct	0														1
Nov	11	0	0	0	0	0	0	0	0	0	0	33%	0%	0%	2
Dec	27	2	1	1	0	0	0	0	0	0	0	12%	0%	12%	2
Jan	30	4	4	4	4	3	2	1	0	0	0	75%	25%	56%	3
Feb	16	5	5	4	5	4	4	4	3	1	0	100%	40%	40%	3
Mar	23	3	3	3	3	3	3	3	3	3	3	70%	100%	100%	3
Apr	1	5	5	5	5	5	5	5	5	5	5				4
May	0														
Jun	0														5

Table 3: Extent of primary feather moult (P1 to P10) of Red-backed Shrikes in their **first year** of life in the non-breeding grounds in Namibia, Botswana and Zambia. The average moult scores between 0 and 1 result from a few individuals with two sprouting primaries (moult score 2). Values are average moult scores of each primary for the *n* birds per month sampled. The colour gradient is shown at the side. The tail (t), head (h), and body (b) are expressed as a percentage of birds assessed showing signs of active moult. No data were collected during the months marked in grey.

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	t	h	b	Moult Score
Jul	0														
Aug	0														0
Sep	0														
Oct	0														1
Nov	6	0	0	0	0	0	0	0	0	0	0	0%	0%	0%	
Dec	44	1	1	0	0	0	0	0	0	0	0	10%	0%	3%	2
Jan	79	4	4	3	2	1	1	0	0	0	0	67%	16%	29%	
Feb	32	4	4	4	4	4	3	2	0	0	0	95%	37%	50%	3
Mar	44	4	4	4	4	4	4	4	4	3	2	83%	91%	82%	
Apr	0														4
May	0														
Jun	0														5

Maybe not all Red-backed Shrikes complete their moult in mid-April before the northern migration (as stated in Harris & Franklin 2000, p. 198; Hidalgo 2022, pers. comm.) but the majority do, as shown in Tables 2 and 3. Still, some have been recorded to depart with inner secondaries still growing (Herremans, unpubl. data, cit. in Herremans 2005).

7. PLUMAGE OF ADULT FEMALES AND MALES

Age and sex can be determined by plumage. Red-backed Shrikes are dimorphic i.e. adult females and males have differing plumages. They are, however, highly variable, mainly in females. While males are mostly well recognisable by their plumage, the differentiation of females and young birds often requires closer inspection.



Figure 6: Adult female with uniform coverts, mantle and cheek, arrow-marked underparts, plain brown tail, slightly grey nape, brown ear coverts and horn-coloured beak with darker culmen and tip. Aragón, Spain, mid-July. Photo courtesy of Javier Blasco-Zumeta.

A reliable criterion, at least for the identification of the sex of adults, is the colour and the pattern of the tail. Females can be identified by their entirely brown tail (Bub 1981, p. 111; Figures 6 and 7). See also Ringers DigiGuide (2022).

Females in general have chevrons (arrow-like markings) on the underparts which are absent in adult males. Further, although quite variable, criteria for the distinction of females and males are the brown vs. grey top of the head and the brown vs. grey rump.

7.1 Described colour variations of female and male plumage

Most field guides depict Red-backed Shrikes in their full adult plumage with clearly distinguishable female and male features of head, nape and underparts which unfortunately do not match our observations.



Figure 7: Freshly moulted male arriving in Italy in mid-May, with plain, unbarred mantle and rump, distinctive black and white tail, uniformly grey cap and neck, well defined black mask and all black beak as depicted in most field guides. Ventotene Island, Italy, mid-May.

An extensive plumage variation between individuals during the same season comprises all ages and both sexes in colour, gender features and moult progress (Stresemann 1920; Bub 1981).

This plumage variation arises from multiple elements. It reflects individual factors like annual wear and bleach, different timing of onset and end of moult and/or different proveniences. The geographical variation must be taken into consideration, too, with different speed of moult for different geographic regions (Gwinner & Biebach 1977), introgression by hybrids in adjacent zones (Panow 1983, pp. 83-88, with Isabelline Shrike *L. isabellinus* and Brown Shrike *L. cristatus* [Cramp & Perrins 1993, p. 477] and with Turkestan Shrike *L. phoenicuroides* [Shirihai & Svensson 2018, p. 185]), and differing expressions of colour (and size) throughout the distribution area. In their vast breeding range from western Europe to 85 degrees east in Siberia, birds are described as getting paler from west to east, and being smaller in the south east (Bub 1981, p. 102).

7.2 Observed variations of plumage and bill colouration

Table 4 presents a summary of plumage and bill colouration through the different age groups,

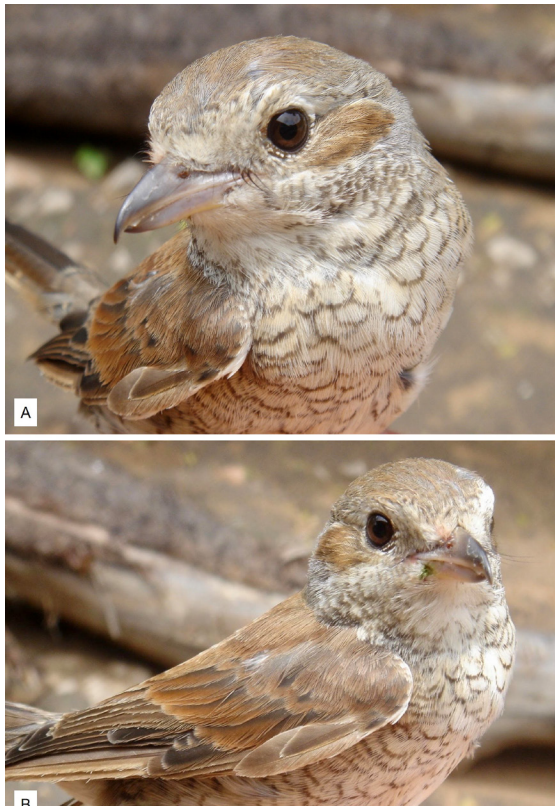


Figure 8: Adult female in pale plumage with female rufous ear coverts, markings on the cheeks and grey tinge on the head. The tail is uniformly dark brown. Primary moult score 27 (5555430000). Waterberg, 15 January 2006.

gathered from literature and in the field. Due to a wide timespan of breeding, the time categories can fluctuate.

8. ADULT FEMALE RED-BACKED SHRIKES

In females, the colour variation concerns mainly the upperparts, often the whole body. Furthermore, several females show male features (see Table 4). This frequently creates confusion especially when age but also sex is being determined.

8.1 Variable plumage of adult females

Figures 8, 9 and 10 depict three different colour types of adult females. The adult age was determined by the plain mantle and wing coverts without any barring which still would be seen in birds in their first year of life in January (as discussed in Section 10).

8.2 Barring of the upperparts in females

Even after more than a hundred years of intensive research, there are quite frequently females in both hemispheres that escape precise age determination; they show plumage features of different age groups that do not allow a conclusive determination of age.

Barring on the upperparts is usually one of the signs of first-year individuals, and birds with more than one year of life are considered as adults.

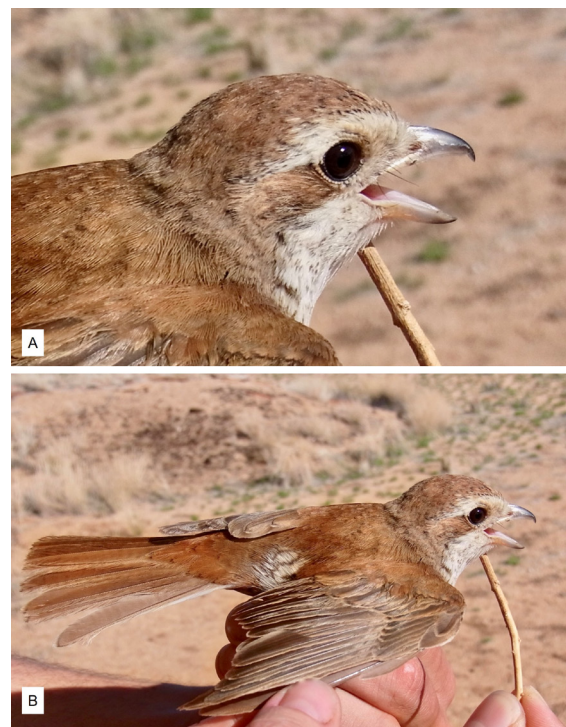


Figure 9: Rufous adult female with plain rufous rump and tail, plain head and cheeks and broad white supercilium. Primary moult score 11 (4430000000). Farm Sphinxblick, Erongo region, 6 January 2011.

It has been discussed in the literature that there might be a plumage phase between first-year birds and adults, represented in second-year birds. In the northern hemisphere, some plumage patterns of Red-backed Shrikes have left researchers in doubt, mainly about features of two age groups: It “is unknown” whether “...females with many barred tertials and retained, heavily worn tertials with dark subterminal bars (juvenile pattern) are invariable first-summer” birds (Shirihai & Svensson 2018, p. 187); likewise it is unknown if “all females with juvenile-like pattern are invariably 2nd year birds” which makes aging impossible “after pre-breeding moult ... using plumage pattern” (Blasco-Zumeta & Heinze 2019).

Blasco-Zumeta & Heinze (2019) describe in detail the two phenotypes as adult-like and juvenile-like females, juvenile here being used in the wider sense for the first year. The adult-like female can be “recognized by tertials with pale brown tips without dark subterminal bars (often with just a dark mark)”. The upperparts show no bars “except very slight barred on uppertail coverts”, while the juvenile-like female has “tertials with pale tips and blackish subterminal bars and bars on upperparts from crown to uppertail coverts”. First-year birds have upperpart feathers with a dark subterminal bar, an overall fresh plumage and wing coverts with a dark subterminal line (Figure 11).



Figure 10: Dark adult female, almost no supercilium. Despite white tips on the freshly moulted feathers on the head, the plain scapulars and ear coverts and the markings of the underparts define it as an adult. It had finished its primary moult. Molt score 50 (5555555555). Near Witvlei, March 2015.

Currently, the question of whether this plumage is a variation of adult plumage or a separable intermediate plumage in the development of the females is being studied by Hidalgo *et al.* in Spain (pers. comm., 2022). The results to date show, through retraps, a constant pattern in the plumage: the barred “juvenile-like” females keep their markings throughout the (known) years. Interestingly, no similar feature for males has been described.

The significance of these results is that Red-backed Shrikes with barred upperparts are not necessarily first- or second-year individuals, but more criteria have to be applied to allow a correct determination of sex and age.

In our research area in southern Africa we recorded a low number of adult females with all plain upperparts. Almost all had markings on the rump, the mantle or coverts and scapulars. The variations are inconsistent and complex, possibly due to different breeding grounds, resulting in different times of hatching and subsequent start of partial

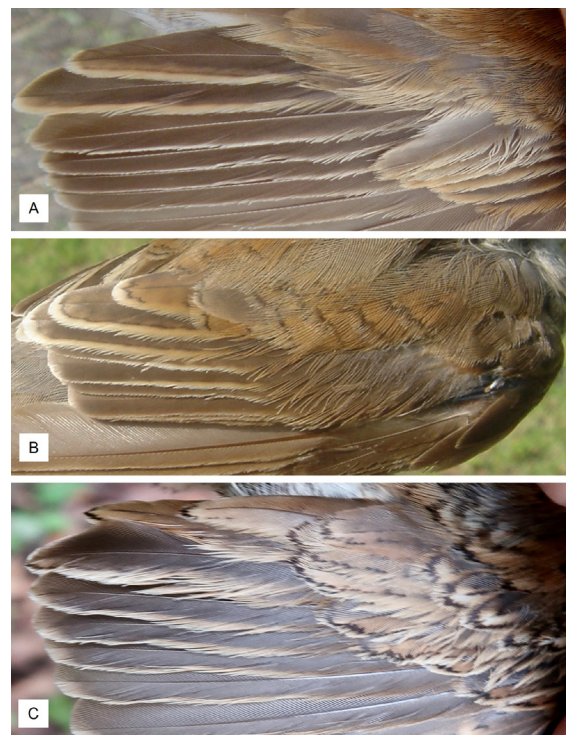


Figure 11: Pattern of tertials and scapulars of female and first-year Red-backed Shrikes. All pictures were taken in Namibia in December. (A) adult female with plain scapulars and tertials, light edges and only a faint subterminal band; 30 December 2021; (B) “juvenile-like” female with faintly barred tertials with broader, light edge and a distinct, dark subterminal band and a vermiculated bar with paler fringe on the scapulars; 13 December 2007; (C) unsexed juvenile/first-year bird with prominent black subterminal band on the tertials, scapulars and coverts; 4 December 2005. (Compare with Blasco-Zumeta and Heinze 2019.)

Table 4: Summary of basic phenotypical differences of Red-backed Shrikes in the different age groups. The poorly researched second plumage of the first year (Jenni & Winkler 2020b, p. 102) is not taken into consideration.

Feature	Adult		Juvenile (until post-juvenile moult, mostly up to 2 - 3 months).	Immature (1 st calendar year, after post-juvenile moult).	Immature (2 nd calendar year)
	Male	Female			
Crown	Plain grey, sometimes white above the black of the frontal mask.	Rufous, brown, sometimes slightly or all grey like male; sometimes barred.	Greyish brown with undefined, faint markings.	Pale brown, rufous or dark brown with or without strong black bars. When already in transition, males are mottled grey and brown.	While in transition: mottled and/or still barred.
Hind-neck	Medium-grey.	Brown to grey; greyer than crown and body; sometimes grey like males and/or barred.	Greyish brown with faint barring.	In transition: pale to rufous-brown or grey, sometimes still with barring.	While in transition: mottled and/or still barred.
Ear-coverts	Black.	Brown in varying shades, rarely black like males.	Pale brown to dark brown.	Pale-brown (fresh or old), rufous- or dark-brown, sometimes with black markings. Males in transition with first black specks in varying degrees.	Intensifying black in males, reducing over time old brown or pale feathers.
Bill	Non-breeding with brown-grey, blue-slate or dark horn-brown bill from base outwards, becoming uniformly black at the end of the pre-breeding moult.	Horn-, deep- or slate-brown or pink, some all black while breeding, in average paler than males. Horn-coloured upper mandible, pink lower mandible, small black tip, both becoming darker to blackish with pink base and black tip towards the breeding season.	Yellow when very young, also pale or dark horn or pink, always with yellow gape flange; bill becoming horn-coloured with yellow or pink tinge and darker upper mandible and tip.	Pale horn with pink, flesh, whitish or yellow tinge, culmen and tip darker.	In transition to colouration of breeding adults.
Mantle	Rufous-brown in varying darkness.	Plain brown (pale, rufous or dark) with or without barring.	Similar to females, but mostly close, black barring.	Brown with mostly dark bars and/or light fringes; moult starting.	In transition: often mottled, without or with dark bars and light fringes.
Rump	Grey.	Mostly brown, in male-coloured birds mostly grey.	Mostly rufous with strong black bars.	Often mottled old and fresh brown in females, with grey in males with or without light fringes and with or without faint or black bars.	Mottled old and fresh brown in females, with grey in males, with or without light fringes and with or without faint or black bars.
Underparts	Plain with often pink.	Light with distinct vermiculations.	Buff grey with faint bars.	Light with dark irregular vermiculations.	Transition to adult.
Tail	Black and white with white terminal fringes.	Plain, mostly uniformly rufous, brown or dark brown with white edge on outer rectrix, sometimes with dark subterminal band, black bar or/and slim light tips.	Brown with white edge on outer rectrix, slim white tips, often variable dusky sub-terminal mark.	By moulting, some start to differentiate into female and male plumage.	By moulting differentiating into female and male plumage.

moult. We discerned in the same months various stages from freshly moulted vs. heavily worn tail, and a diversity of plain back and barred rump or barred mantle and plain rump or barred mantle and barred rump.

Figures 12 and 13 show a varying number of these barred feathers on the mantle, the scapulars and/or on the rump. The adult age of these females was determined first by the plain areas on the upperparts, then confirmed by markings or lack thereof of the tertials, the coverts and the head and signs of primary moult.

9. TAIL

The quality of the first tail feathers is poor and thus the white tips of the rectrices are easily abraded. To distinguish adult females and first-year young the



Figure 12: Adult female with plain back and wing coverts and barred rump. Only the middle tertial shows a faint dark subterminal band while all the primaries are heavily worn. Lake Ngami, Botswana, 4 December 2005.



Figure 13: Adult female, possibly second year of life, with barred mantle and mainly plain rump, and male-like features: grey rump, grey on head and neck and the outer tail feather showing white marking. The tail moult has, quite early, been almost completed while the wing was still in moult: moult score of primaries 26 (5555420000) and of secondaries 405555. Otavi, 26 January 2007.

earlier onset of tail moult in adults might be a helpful criterion. For timing see Table 2 and 3.

In females the tail is plain rufous or brown, or dark brown (with a rufous tinge in “normally” coloured birds), sometimes almost black towards the tips, and shows a white outer fringe on the outermost tail feather (see Figures 15 and 19). The colour is mostly corresponding with the overall plumage colouration (Figure 19) but varying in darkness and shade.

Our male-coloured females always had a plain tail (see Figures 22 and 27) although Harris & Franklin (2000, p. 197) mention for females occasional male-like tails (see Section 12. Male-like plumage features in females and vice versa).



Figure 14: Tail of a first-year bird: thin, worn uppertail coverts, and almost transparent rectrices; white edge of the left outer rectrix with white tip and faint black subterminal bar. Witvlei, 31 December 2021.



Figure 15: Tail of an adult female. The feathers are of thicker quality and stronger colour. Witvlei, 20 December 2021.



Figure 16: Tail of a male Red-backed Shrike with typical black and white pattern. Witvlei, 17 December 2020.



Figure 17: First-year male growing its first adult tail, starting, as is common, with the central rectrices. Witvlei, 13 January 2020.



Figure 18: First-year male growing its first adult tail, presumably a replacement of lost rectrices. Witvlei, 31 December 2021.

Figures 14, 15 and 16 show the tails and uppertail coverts of an unsexed first-year bird, an adult female and an adult male.

At least in first-year birds, the moult process of the tail does not seem to follow a fixed sequence. It can start by growing the middle or also non-sequential rectrices (Figures 17 and 18).

10. COLOUR VARIATIONS IN FEMALE AND YOUNG RED-BACKED SHRIKES

As in many bird species, the young birds wear a “female-coloured”, brown and barred plumage which provides better camouflage than the often more eye-catching adult male plumage and protects young males from adult male aggression.

Already in immatures, different colouration types (Färbungstypen) are found which continue into adulthood after the complete moult. Siblings in one nest can belong to different types (Stauber in litt. in Bub 1981, p. 113). Stauber describes distinctly red and grey young and “normal” birds in shades in between. The colour variation is not related to the sex of the birds.

We found three colour types during our studies (Figure 19).



Figure 19: Colouration types: (A) Pale first-year individual, unsexed, still showing buff tips and a blackish subterminal band on tail and coverts. Maun, Botswana, 9 December 2005; (B) Rufous adult female in “juvenile-like” plumage. Erongo region, 1 January 2011. (C) Dark grey-brown adult female with blackish flight feathers and end of tail. Farm Hamakari, 25 February 2022.

11. ADULT MALE RED-BACKED SHRIKES

Males are recognisable by their grey head and nape, black mask, rufous mantle and the typical black and white tail pattern. The rectrices show much white with long black tips, except for the entirely black central feathers (Cramp & Perrins 1993, p. 475).

We found considerable variation in mainly the plumage colour of adult males, which not yet have been described in the southern literature.

11.1 Neck and mantle

While some males have a clearly confined grey neck (Figure 20), in others the grey area extends into the mantle, ending diffusely (Figure 21). Intermediate features occur.

11.2 White primary patch (Spiegel)

Stresemann (1920) described the white primary patch as the white base at the inner web on P4 or P5 to P9, found in "many males from Macedonia". Other authors report this feature from different European countries, in males as well as in a few females (in Bub 1981, p. 115).

Information about a white primary patch (Spiegel) is not conclusive. It is claimed generally not to be visible. While some individuals have little hidden white patches, visible patches are reported especially from British, French and Finnish birds, although localised more in the eastern parts of the range (Shirihai & Svensson 2018, p. 185). In the field, in the Czech Republic, Kauzal claims that



Figure 20: Adult male. The grey of head and neck ends in a distinct line. Lake Ngami, Botswana, 10 December 2005.



Figure 21: Adult male. The grey of head and neck disperses downwards into the mantle. Witvlei, Namibia, 4 March 2019.

about a quarter of the trapped males show small signs of white on the coverts (pers. comm. 2022). In our sample, an aggregation of possibly highly diverse origins (compare Figure 3), several individuals (at least 15% of 164 males) showed a primary patch of varying size.

With one exception (Figure 22), we found primary patches only in males. It could be seen in some individuals from P1 onwards, and in some it was



Figure 22: Adult female with small white wing patch. Near Witvlei, 9 December 2022.

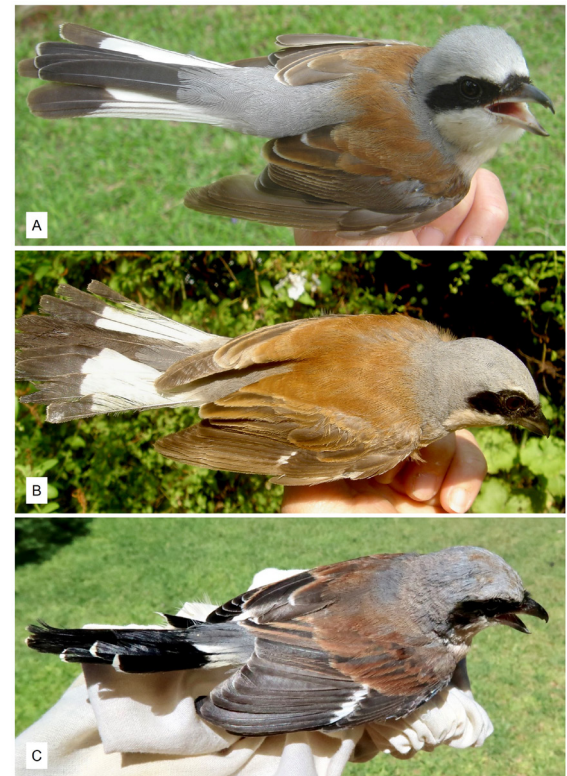


Figure 23: Variation of wing patch, general plumage wear and moult status of two males, ringed on the same day. (A) "Normal" adult male without white primary patch. Head, body, tail and primary moult have progressed already in mid-December. See the striking difference of colouration compared to (B). Moult score 16 (5533000000). (B) Adult male with fine primary patch below coverts. Moult score 0. Both Gaborone, Botswana, 13 December 2007. It is not clear if these two individuals belonged to different populations with different origins with different onset of moult, if there is an age difference with older birds starting moult earlier than younger ones or if there are other reasons. (C) Adult male with primary patch forming a white wing bar; tail growing after almost completed wing moult. Moult score 47 (5555555435). Near Witvlei, 4 March 2019.

extending over the inner and outer web (Figure 23). This feature, as far as we can determine, has not yet been described for southern Africa.



Figure 24: Adult female with grey head, greyish rump and uncommon dark, plain tail with faint marks. The second outer rectrix shows a light, buff window which reminds of the tail pattern of a male. Otavi, 26 January 2007.



Figure 25: Adult female with plain back and greyish rump. Near Maun, Botswana, 24 February 2006.



Figure 26: Adult female with unmarked male-like grey nape and crown (compare Shirihihi & Svensson 2018, p. 186) and dark mantle, but female-coloured, uniformly brown tail and ear coverts and typical female vermiculation of the underparts. Botswana, 1 December 2007.

12. MALE-LIKE PLUMAGE FEATURES IN FEMALES AND VICE VERSA

Females can show varying amounts of male features, from pronounced grey on the head or a grey rump (Figures 24, 25 and 26) to even a black-brown mask through the eye. Studies by Stegmann (1930, cit. in Bub 1981, p. 115) on living and dead specimens showed that male features in females were not related to age or the “extinction of the reproductive instinct”.



Figure 27: Tail of adult female with one single male-like rectrix (T3 left). Witvlei, 27 March 2016.



Figure 28: Undertail of adult female with one single male-like rectrix (T6 right, above). Witvlei, 19 December 2021.



Figure 29: Adult male with female-like features: (A) Upperparts with typical adult male black and white tail pattern, but mostly brown ear coverts and brown top of the head. The mask is not fully formed black, while the rump was slaty-grey. (B) Mantle and underparts showed few faint markings that are strongly expressed in young birds. Otavi, 26 January 2007.

Males can show features of typical female plumage also, but this occurs infrequently. The crucial criterion to determine the sexes is tail colour: the tail is plain and predominantly brown in the female and black and white in the male.

Although Harris & Franklin (2000) mention occasional male-like tails in females, in the literature and in the extensive photo data base of the Macaulay Library (https://search.macaulaylibrary.org/catalog?taxonCode=rebsrl&mediaType=photo&sort=rating_rank_desc) we could find only one single depiction of a single male-coloured rectrix (T5) in a tail of a female (Bub 1981, p. 111, picture on p. 112 by Stauber, who *ibid.* claimed, though, to find this feature multiple times [vielfach]).

In our sample we photographed two females with one male-like rectrix (Figures 27 and 28).

Only occasionally we came across males with deviant features (Figure 29) as mentioned in the literature (Stauber in litt. in Bub 1981, p. 115).

13. COLOURATION OF THE BILL

The colouration of the bill provides information about age, sex and breeding status. The bill



Figure 30: First-year Red-backed Shrike with yellow gape flange, still yellow on the lower mandible and indistinct bill colouration. Head and ear coverts are darker than in the adult female of Figure 31. Near Witvlei, 28 December 2019.



Figure 31: Adult female in December with pale upper and pink lower mandible and small black tip. Botswana, 4 December 2005.

colouration differs between young and adults and females and males and also during the breeding and non-breeding season.

In first-year individuals the gape flange is yellow, as is the base of the lower mandible of the indistinctly pale-grey coloured bill (Figure 30).

In the African literature, the bill of the male is always depicted in black, sometimes also the bill of the female. Though, in July/August the bills of adults start getting pale, beginning at the base, and only after the complete moult in the non-breeding area does it turn fully black again, starting from the tip (Figures 31 and 32) (Harris & Franklin 2000; Jenni & Winkler 2012). The colour change is more evident in males (Figure 33), while the bill of the female “never becomes as dark black as in males” (Kramer 1950, pp. 21-22). Also, during the non-



Figure 32: Adult female in February with blackish upper mandible and lower mandible with pink base and black tip. Waterberg, 25 February 2022.

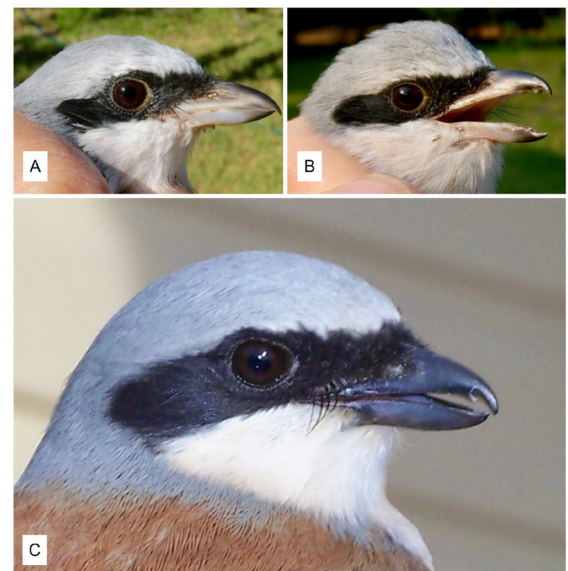


Figure 33: Bill colouration of adult males. In the non-breeding grounds the bill is bluish or pinkish pale with black on the upper mandible and the tip. (A) Botswana, 9 March 2011 and (B) 12 March 2011. (C) shows a male after the arrival in Europe with fully black bill. Ventotene Island, Italy, 15 May 2012.

breeding season, the bill of the adult never turns as pale as in young birds (ibid.).

Adult males in the non-breeding grounds show pale bills with black on the upper mandible and the tip of the lower mandible and acquire the black bill of a breeding male shortly before or during migration.

14. EARLIEST DISTINCTION OF SEXES BY HEAD, BILL, RUMP AND TAIL

The first distinction between sexes in juvenile birds is claimed to be generally possible by February (Harris & Franklin 2000; Shirihi & Svensson 2018, p. 186); of 50% of 302 mainly South African birds, mostly specimens, “towards the end of January and for most birds before mid-February” (Bruderer 2007, p. 557).

In our Namibian sample we generally could determine the sex from the end of December and early January onwards, when the head moult started progressing. With the birds in the hand, we could see females intensifying the rufous on crown and cheeks, with the bill typically lighter than in males (Figure 34). Males in early January showed prominent black feathers in the mask, especially in front of the eyes, first fresh blackish primaries and tail, and blackish upper mandible and tip of the lower mandible. Still, huge variability is possible due to different populations and age differences in first year birds.

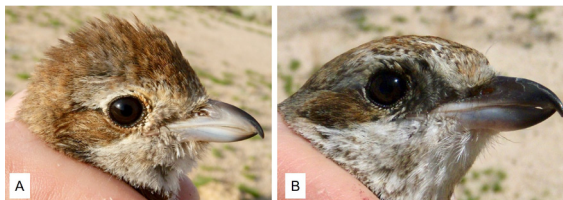


Figure 34: Earliest possible distinction of sexes of first-year Red-backed Shrikes by plumage features on the head and the colouration of the bill: (A) Female with rufous ear coverts and crown, (B) male with first black grey feathers showing on ear coverts and mask, and first grey ones on the forehead. From the Erongo region, 9 January 2011.

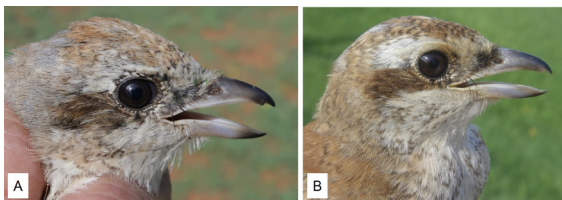


Figure 35: Two first-year males at the end of the year of hatching show black feathers between bill and eye indicating the sex: (A) showing grey on the back of his head. Near Witvlei, Namibia, 22 December 2019. (B) with mask clearly starting from the bill. Gaborone, Botswana, 5 December 2007.

Some males could be recognised as such at close quarters even earlier, when the first black feathers appeared between the bill and eye and the grey of the head expanded (Figure 35). Females at this time did not show any black feathers in this area.

15. NOTES AND OBSERVATIONS

15.1 Sex ratio

Our sample comprised similar numbers of female and male birds (136 and 131 respectively). However, more males have been reported on the non-breeding grounds in other studies, with Bruderer & Bruderer (1994) quoting Becker's (1974) male-female ratio of 30:1 and Ludwig (in litt.) of 5:1, both for Namibia, and Mundy (in litt.) for Zimbabwe of 10:1.

15.2 Age ratio

In our sample, the age ratio of adults to young (first and second calendar year) Red-backed Shrikes was about 1:3 (82:249 individuals, not all of them were measured fully). These numbers correspond to the relation of age groups in the post-breeding/post-fledging period when naturally the numbers of young birds are about twice as high as those of adults (Ondrej Kauzal, pers. comm. 2022). Also, adult birds are more experienced and possibly less prone to take a bait as used in the flap traps.

15.3 Retraps and site fidelity

Red-backed Shrikes show high site fidelity in the non-breeding grounds (Harris & Franklin 2000, p. 199). The records of the SAFRING data base from September 2021 show that in their non-breeding grounds 169 out of 2604 Red-backed Shrikes were retrapped, which corresponds to a remarkable 6.49%. In comparison, for the resident White-crowned Shrike (*Eurocephalus anguiformis*), the SAFRING data base holds data on 460 individuals (ringed prior to 2020) and 19 retraps of which 16 (3.48%) were found at the very same location of the first capture (Bryson & Pajmans 2022).

A few earlier individual records of retraps in Africa are published: Ludwig (1978, p. 4) mentioned that one Red-backed Shrike in Namibia was retrapped at the same location after one year and again after three years. Skead (1973, p. 81) reported two retraps out of eight Red-backed Shrikes ringed during 40 months at one trapping site in the Transvaal. Two intercontinental recaptures from and to Africa are recorded in Harris and Arnott (1988, p. 50).

Over more than 15 years we retrapped seven out of 248 individuals: one each after one, two and seven days, one after 42 days, but only two birds after almost exactly one year (365 days and 368 days) and one after two years (730 days). These latter three were ringed in January and February as second

calendar year birds and retrapped in adult plumage after one and two migrations respectively to the breeding grounds. One individual was recaptured in an adjacent pentad, all others at the original location.

15.4 Reported numbers

The South African Bird Atlas Project 2 (SABAP2) hosts statistical data about the birds of southern Africa. In the database, the average reporting rate of Red-backed Shrike has declined over the years. In Namibia since SABAP1 (1981-1998), there is a decline in reporting rate to SABAP2 (2007-present) of over 10% (SABAP2 2022).

It is not known if this decrease reflects real change of Red-backed Shrike numbers or if it is related to a change in observation. Although there are differences in methodology between SABAP1 and SABAP2 (i.e. survey protocol, spatial unit and no measure of effort), this is still a notable decrease in reporting rate for the Red-backed Shrike in Namibia and Botswana.

15.5 Precipitation and shrike numbers

We found a strong positive relationship between rainfall in the pre-Namib and numbers of Southern Fiscal (*Lanius collaris*) and Lesser Grey Shrike (*Lanius minor*). The numbers of Red-backed Shrikes did not follow this curve, but did rise noticeably in 2011 following exceptional precipitation (see graph in Bryson & Pajmans 2021, p. 15).

15.6 Parasites

Out of more than 250 individuals ringed, a tick was detected in only one bird ringed in mid-March. No other ecto-parasites like feather flies, mites or pox were observed.

15.7 Does the Red-backed Shrike breed in Namibia?

Migratory Palearctic bird species have been found breeding in southern Africa, including the White Stork (*Ciconia ciconia*) and the European Bee-eater (*Merops apiaster*). During the past 150 years, there have been notes that claim breeding of the Red-backed Shrike in the southern hemisphere. Andersson (1872, p. 136) thought that it bred in Okavango, Roberts (1940, p. 299) mentions that “it has been reported to [breed] once in Rhodesia”. Macdonald (1957, p. 143) (erroneously) deduced a post-breeding status from the finishing of the (complete) moult in mid-March.

For Namibia, we found two reports of Red-backed Shrike behaviour that resembled breeding behaviour in Europe:

Sauer and Sauer (1960a), who in 1958 first had documented that birds navigate by stars during nocturnal migration, described in their report on



Figure 36: Red-backed Shrike in plumage that looks like that of a juvenile, ringed in May in Europe. It was aged as second-year. It is unclear if a major part of the plumage was retained from the year before or if this shows a bird bred in Africa. Czech Republic, 10 July 2022. Photo courtesy of Ondrej Kauzal.

migratory birds in Namibia that a pair of Red-backed Shrikes alarmed each other (and other conspecifics) when the researchers intruded into their territory. Furthermore: “The territorial behaviour of some pairs and males was sometimes so pronounced that we were gladly tempted - but in vain - to look for nest sites or ‘play nests’” (1960b, p. 73).

Becker (1974) reported: “On 26.1.65 I observed a pair near Windhoek who became very excited at my approach and warned violently. The pair was fully coloured (ausgefärbt), kept close together, and could be observed in the same place for several days at a time. The behaviour was the same as that of a breeding pair.” From this observation and familiar with the description of Sauer and Sauer, he considers breeding of this European species in Namibia as possible.

Potentially, the occurrence of breeding in Africa goes undetected because it is not considered an option by field workers and does not match the knowledge we have about this species. One individual was trapped in the Czech Republic in May 2020 by Ondrej Kauzal (Figure 36). It “looked like a bird in juvenile plumage. But considering the date of capture (beginning of May, actually it was at the time Shrikes began to appear that year), a bird in juvenile plumage is very unlikely” (2022, http://ondrejkauzal.org/gallery/_spec173-lan_col.html, individual CZE20-149). The bird was aged “as a second year because of that much retained juvenile contour feathers” (ibid.). More research is needed to answer this question.

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