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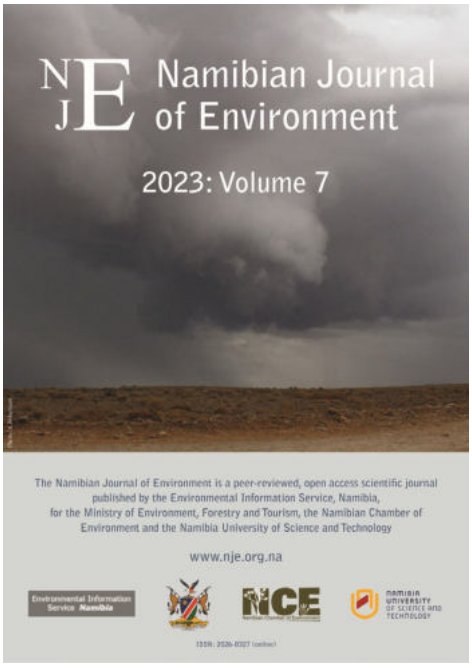

SECTION D: MONOGRAPHS AND MEMOIRS

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Mountain Wheatear *Myrmecocichla monticola*: comparative biometrics, moult and breeding data, and criteria for the determination of age and sex

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CONTENTS

ABSTRACT

In this article we present measurement and moult data from over 160 Mountain Wheatear (*Myrmecocichla monticola*) of the subspecies *atmorii* (Tristram, 1869) ringed in Namibia, as well as two individuals of the adjacent northerly subspecies *M. m. albipileata* (Bocage, 1867) from Angola, and discuss our findings from these subspecies. We gathered nesting, breeding and moulting records for Namibia from published literature and photographic records, and compared our observations of the moult process and our records of active brood patches with breeding records, gathered by Brown *et al*. (2017), to gain insight into the timeline of physical processes. On the basis of photographs, we describe the nestling and compare juvenile and immature plumage and other features which help to distinguish these age groups. We add notes on the overall numbers observed in the last fifteen years and notes on recaptures, site fidelity and parasites. We discuss the white covert-patch as an indicator of age and document undescribed plumage details such as signs of a second-year plumage, spots on the coverts of first-year birds, white supercilium in grey males, the occurrence of grey or black greater coverts in grey males and features from both sexes in one plumage. This article is intended to supplement published data and encourage further research and discussion.

Keywords: age; Angola; biometrics; bird-ringing; breeding; immature; juvenile; misidentification; *Muscicapidae;* moult; Namibia; plumage; sex; territory

1. INTRODUCTION

For many bird species and subspecies of southern Africa and especially Namibia there remain gaps in biometrics, moult data and the description of different plumages in research and literature. We have been ringing birds in Namibia and southern Africa for more than twenty years and are evaluating our data to expand the knowledge about less researched species and subspecies (Bryson & Paijmans 2021, 2022, 2023; Paijmans & Bryson 2023).

In this article we present our observations of the Mountain Wheatear *Myrmecocichla monticola* (Vieillot, 1818) and our results of measurement and moult data from more than 160 individuals of the ssp. *atmorii* from Namibia (Figure 1). We also include the data of two Mountain Wheatear (*M. m. albipileata* Bocage, 1867) from Angola and discuss our findings from these subspecies.

Published measurements for the Mountain Wheatear are scarce. Moult data are mostly absent (Dean in Hockey *et al.* 2005); only one unspecific record can be found in Friedmann & Northern (1975, p. 28).

2. DISTRIBUTION AND SITES

Mountain Wheatears are almost endemic to southern Africa (Figure 2) and occur mainly in South Africa and Namibia, with some records from southwest Botswana and close to the border with South Africa (Southern African Bird Atlas Project, SABAP 2022). In Angola they are found in the southwest up to Benguela inland from the coast. An isolated population lives on Mount Moco and on inselbergs of the central-west Angolan highlands (Dean 2000, p. 215).

Distribution maps from different sources differ considerably. This seems to be due to methodological issues, such as which research opportunities were available (Traylor 1963, p. 137), which methods were used to collect data, which routes were frequented by bird watchers and which data were reported in which data base. The changes in distribution might also be due to changes in range

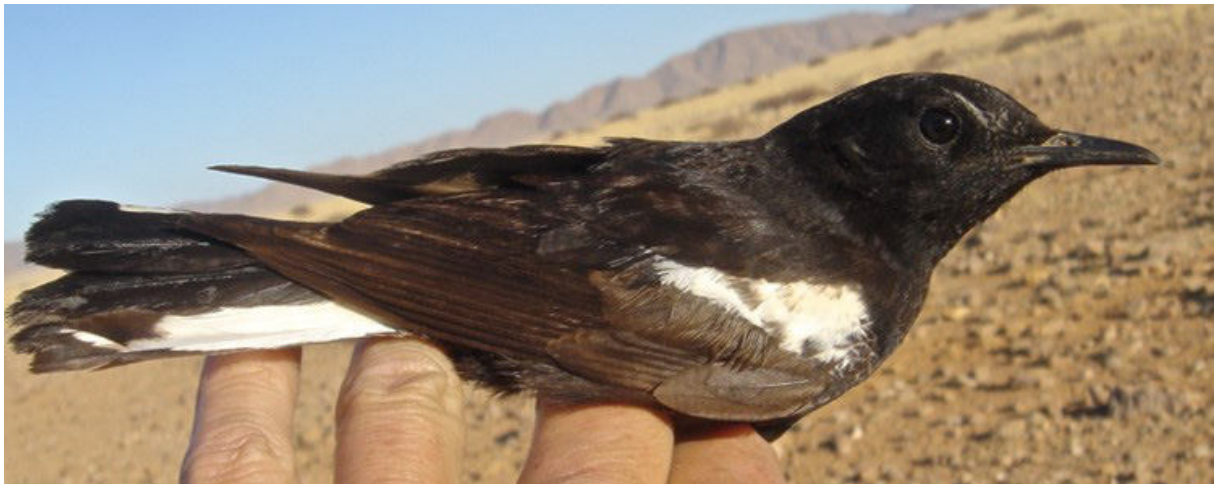

Figure 1*: Adult male Mountain Wheatear, presumably second-year; age determined by strongly bleached primaries and rectrices and slightly mottled covert-patch. Some all-black individuals of the subspecies* M. m. atmorii *show a more or less prominent white line over the eye, here only faintly expressed. SAFRING FH34712. Farm Sphinxblick, Erongo region, Namibia, January 2007.*

Figure 2: *Distribution map for the Mountain Wheatear (*Myrmecocichla monticola*) downloaded from www.iucnredlist.org on 19 August 2022. The green dots designate sites where the main data for the current study were gathered.*

over the last decades, or even to short-term changes in adaptation to drought and rainfall. For a detailed map of recorded sightings in southern Africa see the map of SABAP (https://sabap2.birdmap.africa/species/564).

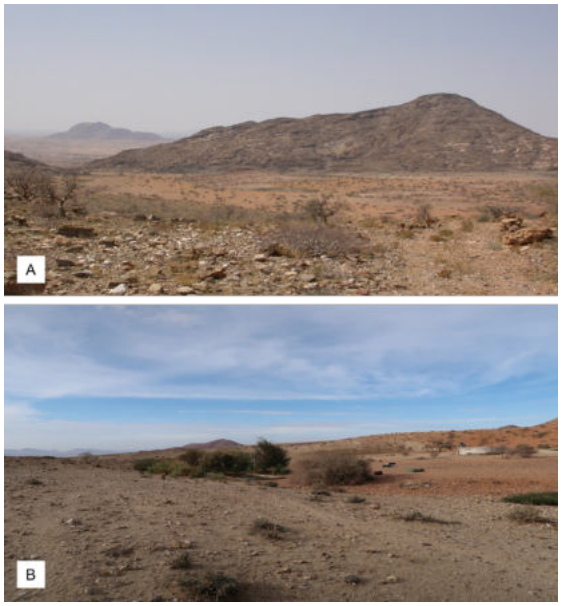

Figure 3: *(A) Typical arid habitat of Mountain Wheatear with rocky hills and plains. Erongo region, August 2004. (B) In arid areas Mountain Wheatear favour plains with waterholes and salt licks for game, whose droppings attract insect prey, and with trees or fences. Erongo region, January 2021.*

Our data from Mountain Wheatears were collected mainly in the arid savanna around the farmhouses at the eastern edge of the Namib-Naukluft Park (Farm Sphinxblick, 22°29'S, 15°27'E), with a few at Spitzkoppe (21°50'S, 15°09'E) and various locations along the Swakop River valley. Records from two ringing sites in the NamibRand Nature Reserve (25°06'S, 16°16'E and 24°53'S, 16°04'E) from 2020/2021 are well outside the range of IUCN and the *Birds of the World* (Collar & Boesman 2021, https://birdsoftheworld.org/bow/species/mouwhe1/cur/introduction). We presume that large areas in the region have not yet been assessed by observers and that our findings are not isolated populations, since the habitat serves the species well. However, one must also consider that these years had a good rainy season which facilitates a range extension. It is unknown how swiftly the species can adapt to habitat changes and expand its range.

In Angola, one female and one male were ringed at the beach in Namibe Province (14°57'S, 12°11'E). See the distribution map in Figure 2 and habitat depictions of our research area in Figures 3, 4 and 5.

Figure 4: *A more mountainous terrain is suitable for Mountain Wheatears as it provides opportunities for perching and nesting. Erongo region, January 2013.*

Figure 5: *Our research area with high grass cover after good rainfall. Erongo region, 30 May 2006.*

3. TAXONOMY AND SUBSPECIES

3.1 Taxonomy

When Vieillot (1818, p. 434) first classified the Mountain Chat after Levaillant's description and depiction in the "Histoire naturelle des oiseaux d'Afrique" (1805, p. 105), he placed it in the genus *Oenanthe.* Later it was moved into the genus *Saxicola* (see Hoesch & Niethammer 1940, p. 242), but based on genetic results it was finally grouped with *Myrmecocichla* (Collar & Boesman 2021; del Hoyo & Collar 2016, p. 658).

3.2 Subspecies

Of the four recognised subspecies, two occur in Namibia and two in Angola. We predominantly researched subspecies *M. m. atmorii* (Tristram, 1869) (Figures 6 and 7) which is smaller than the nominate subspecies. It lives in western Namibia northwards to the Kunene River, the border with Angola, that seems to separate it strictly from the more northern subspecies *M. m. albipileata* (Bocage, 1867).

Southern Namibia and South Africa is the home of the nominate subspecies *M. m. monticola* Vieillot, 1818, and central Angola of the subspecies *M. m. nigricauda* Traylor, 1961 (Dean 2005, p. 949).

In Angola we ringed *M. m. albipileata* which can be found in the coastal area of the Namibe Province south of Benguela in southwest Angola. Both female and male show plumage variations which seem to be unstudied. We depict two females: one with a brown, the second with a white covert-patch (see also Sections 8.5 and 11.7) and two black males: one with a fully black head and a faint white supercilium, the second with a light grey cap (Figures 8 and 9).

Figure 6: *Adult female of the subspecies* atmorii *in dark brown plumage and plain wing. SAFRING FB22180, 20 December 2013.*

Figure 7: *Adult black male of the subspecies* atmorii *with silver-grey cap. SAFRING FH31538, 28 May 2006.*

4. METHODS

4.1 Bird ringing

Birds were ringed and 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). Sex was determined by plumage.

Figure 8: *Adults of the subspecies* albipileata. *(A) Female in graduated, lighter brown plumage with extensive white vent. SAFRING FH39110. (B) Male with a fine white line above the eye which also can be found in some individuals of the southern subspecies* M. m. atmorii. *SAFRING FH39109. Praia das Pipas, Namibe, Angola, 26 July 2010.*

Figure 9: *A pair of adults of the subspecies* albipileata. *The male has a white crown and the female has a small white covert-patch. Namibe, Angola, 5 July 2018. Photo courtesy of Dubi Shapiro.*

Table 1: *Measurement data from this study. Average adult measurement data (including standard deviation, minimum and maximum measurements) of adult Mountain Wheatear (*Myrmecocichla monticola atmorii*) from Namibia and of adult Mountain Wheatear (*M. m. albipileata*) from Angola. Measurements are grouped by sex.*

Grouping	Parameter	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Head (mm)	Mass (g)
***M. m. atmorii* Namibia**							
All Adults SAFRING Code Age 4	Mean ± SD	105.5 ± 4.3	69.8 ± 3.6	29.9 ± 1.1	22.3 ± 1.6	43.4 ± 1.1	29.1 ± 2.4
	Min–max	89–117	60–86	25.4–34	18.2–29.8	40.7–48.1	24.5–39.5
	n	164	159	149	150	152	153
Adult Unknown Sex	Mean ± SD	106 ± 3.2	69.5 ± 2.7	30.3 ± 1	22.7 ± 1	43.7 ± 0.9	30.4 ± 1.9
	Min–max	103–111	68–76	29–31.8	21.5–24.2	42.4–44.9	28.5–33.4
	n	8	8	8	8	8	7
Adult Females	Mean ± SD	103.1 ± 2.9	68.5 ± 3.8	29.7 ± 1	21.9 ± 1.9	42.9 ± 0.9	28.5 ± 2.2
	Min–max	94–117	61–76	27.4–34	18.2–29.8	40.7–45.4	24.5–35
	n	79	75	71	72	72	75
Adult Males	Mean ± SD	108 ± 4.3	71 ± 2.9	30.2 ± 1.2	22.6 ± 1.3	44 ± 1	29.7 ± 2.5
	Min–max	89–117	60–78	25.4–32.9	18.9–26.5	42.2–48.1	25.5–39.5
	n	77	76	70	70	72	71
***M. m. albipileata* Angola**							
All Adults SAFRING Code Age 4	Mean ± SD	107 ± 4.2	70.5 ± 0.7	31.3 ± 0.7	22.8 ± 0.1	44.2 ± 0.1	34.6 ± 2.1
	Min–max	104–110	70–71	30.8–31.8	22.7–22.9	44.1–44.2	33.1–36
	n	2	2	2	2	2	2
Adult Female	Value	104	70	30.8	22.7	44.2	33.1
	n	1	1	1	1	1	1
Adult Male	Value	110	71	31.8	22.9	44.1	36
	n	1	1	1	1	1	1

All photographs were taken by the authors on Farm Sphinxblick in the Erongo region if not given otherwise. See photographs of ringing sites in Bryson & Paijmans (2021, 2022).

4.2 Measurements

Table 1 presents the measurements of our samples of the Mountain Wheatear from Namibia (ssp. *atmorii*) and from Angola (ssp. *albipileata*), Table 2 those of *M. m. atmorii* and *M. m. albipileata* in the literature. At a subspecies level we tried to compare the data from our sample and from literature.

A comparison of our restricted sample with published general data (for example Rose *et al.* 2020) proves almost impossible, as sets of measurements are lacking, subspecies and even sex are not always defined, some samples are too small, or the methods are not declared or not consistent. On comparing the results, it became clear that the methods must have differed between the researchers (see Paijmans & Bryson 2023).

The measurement of the culmen was taken to the indentation on the front of the skull following the convention for the measuring of passerines (Demongin 2016, p. IX).

The measurements for the ssp. *M. m. atmorii* in Keith *et al.* (1992, p. 507) correspond with our findings (Table 2).

Our results show that all measurement averages of females are smaller than those of males, especially those of wing and tail as in Maclean (1993, p. 508), Keith *et al*. (1992, p. 507) and Rose *et al.* (2020). The measurements of females have a greater range (minimum to maximum) than the males for wing, tail, tarsus and culmen (including a greater maximum value), while the males have a larger head and mass average and maximum.

Like in all desert birds, the mass is highly variable. Friedmann & Northern (1975, p. 28) collected of *M. m. atmorii* one male weighing 38 g, and five females from 30–38 g (33.2 g), both sexes being in the high range of our sample with a range between 24.5 g and 39.5 g and a median value of 29.1 g.

M. m. albipileata is claimed to be smaller than the nominate (Keith *et al.* 1992, p. 507). However, all measurements (excluding mass) of the two Angolan birds we ringed are greater than those published (ibid.) and even greater than the average Namibian values in our sample (excluding head). Also, the first description of *albipileata* by Bocage has all measurements bigger than the averages of

Table 2: *Measurement data from the literature: Average measurement data (including minimum and maximum measurements) of adult Mountain Wheatear* M. m. atmorii *(Dean 2005, p. 949; Keith* et al*. 1992, p. 507; mass from Friedmann & Northern 1975, p. 28) and of* M. m. albipileata *(Keith* et al*. 1992, p. 507). Measurements are grouped by sex.*

Grouping	Parameter	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Mass (g)
***M. m. atmorii* Namibia**						
Adult Females	Mean	103	67.5	28.8	21.5	33.2
	Min–max	99–107	62–73	28–30	20–24	30–38
	n	11	11	11	11	4
Adult Males	Mean	108	70.2	29.9	21.6	38.0
	Min–max	105–111	65–76	28–32	20 –23	
	n	15	15	14	14	1
***M. m. albipileata* Angola**						
Adult Females	Mean	101	67	28.8	20	30
	Min–max	100–106	65–70	28–29	20–20	
	n	6	6	6	6	1
Adult Males	Mean	102	67.7	29.6	20	30.7
	Min–max	99–107	66–69	29–30	19–21	28–35
	n	7	7	7	7	4

monticola: bill 23 mm, wing 107 mm, tail 80 mm, tarsus 30 mm (Bocage 1867, p. 429).

5. BREEDING: EGG-LAYING, INCUBATION AND FLEDGING

The observed and published egg-laying dates of the Mountain Wheatear vary widely between September and March, depending on the area. Furthermore, in arid areas eggs are laid opportunistically after rain (Dean unpubl., in Dean 2005; Keith *et al.* 1992, p. 508).

In South Africa, a winter-rainfall area, breeding activity peaks in September to November (range from June to March) (Keith *et al.* 1992, p. 508) or mainly in October (range from September to November) (Winterbottom 1968, quoted in Harrison 1997, pp. 172–173; Tarboton 2014, p. 294).

In Namibia, a summer-rainfall area, egg-laying takes place later, usually between January and early March (ibid.). Besides the moult process, Figure 10 shows Namibia's nesting data for the Mountain Wheatear (Brown *et al.* 2017). The peak of the curve is December and January, but nests have been recorded in all months of the year, excluding June.

Matching these data, Hoesch and Niethammer found two complete clutches in Namibia with two and three eggs on 21 January and 10 February 1939, respectively (Hoesch & Niethammer 1940, p. 243).

The young fledge about 21 days after egg-laying (after 13 days of incubation and 14–16 days of nestling period) (Tarboton 2014, p. 294) and are kept under parental care for about one month after leaving the nest (Dean, unpubl. data, in Dean 2005).

In 2009, we ringed two chicks in the nest on 13 February and two on 22 December. Throughout 2006 to 2020 we ringed visibly young birds (within their first six months of age: SAFRING code 5) from early January to mid-March, and one at the end of May.

6. BREEDING AND MOULT

The available energy of a bird is typically used sequentially for establishing a territory, mating, egg-laying, breeding and feeding the young, and migration, when applicable. The quite costly complete moult begins in most songbirds immediately after completing the breeding process (Svensson & Hedenström 1999, p. 264) and mostly indicates the actual status of the bird in its annual cycle (Perrins 1970; see also the discussion in Jenni & Winkler 2020, pp. 178–179).

7. MOULT OF THE MOUNTAIN WHEATEAR

The Mountain Wheatear follows the general passerine pattern of a complete post-breeding moult. The order of the primary moult is descendent, and the secondary moult starts with the outermost S1 (Figure 11). The code 0 designates an old primary, the code 1 a sprouting or missing feather, code 2 a growing feather of less than 1/3 of its final length, and code 3 2 a growing feather of less than 2/3 of its final length (see de Beer *et al. 2*001). For a detailed description of the moult sequence of passerines see Kasparek (1981, p. 6f.).

Month	n	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	bp	Nests
Jul	2	0	0	0	0	0	0	0	0	0	0		0
Aug	9	1	1	1	1	1	1	1	1	1	1		2
Sep	2	2	2	2	2	2	2	2	2	2	2	1	7
Oct	0												6
Nov	2	0	0	0	0	0	0	0	0	0	0	2	8
Dec	39	0	0	0	0	0	0	0	0	0	0	5	22
Jan	68	0	0	0	0	0	0	0	0	0	0	10	29
Feb	10	0	0	0	0	0	0	0	0	0	0	4	15
Mar	2	2	2	2	0	0	0	0	0	0	0		10
Apr	2	5	5	5	5	5	5	5	4	4	1		5
May	11	2	2	2	2	2	2	2	2	2	2		1
Jun	20	3	3	3	3	3	3	3	3	3	3		1

Moult Score: 0, 1, 2, 3, 4, 5

Figure 10: *Extent of primary feather moult (P1 to P10) of adult Mountain Wheatear (*M. m. atmorii*). Values are average moult scores of each primary for the number (n) of birds per month sampled. The colour gradient is shown on the side. Counts of birds displaying a full brood patch (bp) are given, as well as nest count values for Namibia from Brown* et al. *(2017). No data were collected for the cells marked in grey.*

7.1 Moult data for the Mountain Wheatear in the literature

In the literature "no data" is recorded for the moult of the Mountain Wheatear (Dean 2005; Clement & Rose 2015) although the latter mention "several females of the race *atmorii* in active moult in October in Namibia". In the original source we found that only "one of the females still had some of the outer primaries basally enclosed in sheaths" (Friedmann & Northern 1975, p. 28), thus she was finishing the primary moult in October.

7.2 Moult data of the Mountain Wheatear ssp. *atmorii* in Namibia

Our moult data of the primaries gathered from more than 160 Mountain Wheatears of the ssp. *atmorii* are presented in Figure 10. We also compare our recorded brood patch data per month with the numbers of active nests from Brown *et al.* (2017).

Figure 11: *Descendent primary moult of an adult male Mountain Wheatear. Primary moult score 17 (5543000000). The innermost secondary, the first to moult, has already been shed. Secondary moult 100000. SAFRING FH63920, 6 February 2012.*

The data in Figure 10 reflect that moult was recorded in Mountain Wheatears almost throughout the year. The constant low scores do not indicate short feathers, but result from the mean being calculated from few moulting feathers and numerous feathers which were not moulting. This fact also leads to the lighter red fields marked with "0" in the months December, January and February.

Of 17 examined immature Mountain Wheatears, three underwent their first primary moult, extending from January (4300000000, 5554410000) to March (5432000000) (Figure 12).

Figure 12: *Black male after the pre-breeding partial moult at the end of his first year of life. The fresh black upperparts contrast with the juvenile brown wing and the tail. Both are well abraded and will be moulted only a few months later in a complete moult after the adult breeding season. SAFRING FH33993, 7 January 2007.*

7.3 Record of brood patches

Brood patches indicate the timing of breeding. In birds that start incubating with the first egg, they usually develop at the beginning of the laying period and in birds that start incubating with the last egg they develop towards the end of the laying period (Brown & Franke-Bryson 2016). Mountain Wheatears, like most passerines, start incubating when the clutch is (almost) completed (Stanford 2022; R Bijlsma, pers. comm. 2022).

Not all of our captured birds were checked for brood patches. Even so, we found a total of 16 brood patches in females, all of them during the southern summer months and the favourable rainy season between the end of November and early February (see Figure 10).

7.4 Overlap of breeding and moult

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 did not observe any overlap of active brood patch and moult in the Mountain Wheatear. This feature is regularly found in other bird species, like Southern Fiscal (*Lanius collaris*), White-crowned Shrike (*Lanius anguitimens*) (Bryson & Paijmans 2021, 2022) or Namaqua and Burchell's Sandgrouse (*Pterocles namaqua* and *P. burchelli*) (Bryson unpubl. data**).**

7.5 Interrupted and irregular primary moult

The term "**interrupted** moult" encompasses **suspended** and **arrested** moult. Both occur in the same sequence as a regular wing moult but may temporarily be discontinued during breeding (or migration). If the moult is **suspended** it will later resume at the same location where it stopped. With **arrested** moult, in contrast, moulting does not continue but will restart from the normal site of initiation, usually P1 (Harper 1984, p. 101; Shirihai & Svensson 2018, p. 24; Jenni & Winkler 2020, p. 63).

Interrupted moult is a common feature of birds in arid habitats. Although there is a general breeding season and thereafter the period for moulting, the features of the annual cycle are adapted to the circumstances. Without precipitation, and the subsequent adverse conditions for raising chicks, the birds tend to start moulting instead of breeding. But 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 and the fully grown wing will then show new flight feathers next to old ones.

Not much is known yet about **suspended** and **arrested** moult in Namibian species. During our study period of 20 years, we observed **interrupted** moult in numerous species we examined in our research area of arid habitat in the west of Namibia. Examples are Common Fiscal (Bryson & Paijmans 2021); Tractrac Chat *Emarginata tractrac*, Karoo Chat *Emarginata schlegelii,* Namaqua and Burchell's Sandgrouse *Pterocles namaqua and P. burchelli*, Temminck´s Courser *Cursorius temminckii* and others (Bryson & Paijmans, unpubl. data). Also, in Red-billed Spurfowl *Pternistis adspersus*, Cape Turtle Dove *Streptopelia capicola*, Laughing Dove *Spilopelia senegalensis*, Namaqua Dove *Oena capensis*, Dusky Sunbird *Cinnyris fuscus*, Bokmakiri *Telophorus zeylonus*, White-throated Canary *Serinus albogularis*, Sabota Lark *Mirafra sabota*, Karoo Long-billed Lark *Certhilauda subcoronata* and in other species we found this feature, as we did in other ringing areas in Namibia. For both Tractrac Chat and Karoo Chat, we could ascertain **suspended** moult (ibid.), a feature not yet recorded.

In the Mountain Wheatears we checked for moult, we did not observe any irregular primary moult. However, we recorded 11 individuals with **interrupted** primary moult, all of them between December and March.

We did retrap one of those individuals four months later when moult was completed (SAFRING FH31312: ringed on 19 January 2006 with 5000000000, retrapped on 30 May 2006 with all new wing 5555555555). The subtle colour difference between P1 and the following primaries served as an indicator of **suspended** moult. Thus, the replacement of nine primaries (P2 to P10) occurred in less than 130 days.

We recorded one individual (SAFRING FH21245) on 27 August 2004 also with **suspended** and then completed primary moult. The four inner primaries were older and six outer primaries new (0000555555) (Figure 13).

Figure 13: *Remiges with perfectly shaped tips and edges after the completion of the moult. The four inner primaries are lighter, since they were grown before the moult suspension. The primary coverts of P1 to P4 and the greater coverts are of the same age while the outer primary coverts are fresh. SAFRING FH21245, 27 August 2004.*

8. AGE DEVELOPMENT IN THE FIRST YEAR

For age terms see the Glossary for Ageing in Bryson & Paijmans (2021, pp. 21-22).

First-year birds comprise individuals from nestling and fledgling to juvenile birds, and, after the post-juvenile moult, immature birds. Passerines reach adulthood and maturity when entering their second year of life (Bub & Dorsch 1988, p. 7), and then adopt the breeding cycle of adults.

8.1 Nestling

In the beginning of 2009, we found a nest on an empty shelf inside an abandoned farmhouse. On the shelf below was an old nest from former breeding activity (see also Plowes 1948, p. 80). At the end of January the new nest contained two eggs, and on 13 February, when we checked next, the young had hatched. In the meantime, the nest had been reinforced and re-upholstered (Figure 14).

Figure 15 shows one of the nestlings, which must have been less than a week old: according to Plowes, who followed the development of the breeding and

Figure 14: *A Mountain Wheatear nest on a shelf in an abandoned farmhouse. (A) and (B) With two eggs. (C) With the hatched young two weeks later. The nest by then had been refurbished with dry grass stalks and finer, soft material inside the nest. 28 January and 13 February 2009.*

Figure 15: *Nestling a few days after hatching with very first downs on head, back and, to a lesser extent, on the lateral vane. 13 February 2009.*

hatching minutely (1948, p. 84), the first primaries become visible at about one week old – at this stage we could not see any traces of these. At a few days old, the nestling's body is almost naked, with brown downs growing only on the crown and along the vane on the spine, and starting to appear on the lateral vane. The gape flange is bright, but pale yellow, as is the beak. The eyes are still closed.

8.2 Juvenile

In an astoundingly short period of two weeks the young passerines reach full size and the first feathering covers the whole body. The quality of the feathers, though, is poor and the density low due to the restriction in food supply during this fast-paced development.

Young Mountain Wheatears can be discerned by a prominent, now dark yellow gape flange (Figure 16) and a drab, loose plumage with low numbers of barbs.

8.3 Spots on the wing of juveniles and immatures

In some juvenile males of the black morph we observed white dots on the marginal and lesser coverts (Figure 17) and in the grey morph white terminal spots along the marginal coverts (Figure 18). This feature seems not have to been described before, but "the uniform head and upperparts [of juveniles are claimed to be] lacking any pale spots" (Clement & Rose 2015, p. 646).

In the grey morph, the transition of males from the uniform juvenile dark brown to the grey plumage results in a mottled appearance, as can be seen in Figure 18 on the sides of the head and on the chest.

8.4 Post-juvenile moult and distinction of the sexes in early age

Within the first two months of life (Dean 2005, p. 948) the juvenile plumage is replaced during the

Figure 16: *Juvenile Mountain Wheatear. (A) Close up of the head with yellow gape flange and (B) body with loose drab plumage of mantle and coverts and almost translucent primaries and secondaries. See also on the rectrices the juvenile pale rufous tinge above the terminal black band. SAFRING FB22183, 20 December 2013.*

Figure 17: *Juvenile male Mountain Wheatear with dark black plumage. (A) Close-up of the head with the prominent yellow gape flange and yellowish edges on the beak. (B) Marginal coverts with white spots. The second outer primary is still in the sheath which indicates a very young bird still growing the primaries and corresponding secondaries. SAFRING FH63208, 22 January 2010.*

partial post-juvenile moult by an immature first-year plumage. In most chat species this is still distinct from the adult plumage (Clement & Rose 2015, p. 15, but no further description given for Mountain Wheatear).

The colouration of the juvenile plumage is said to resemble that of the female (Taylor 1946, p. 248; Dean 2005, p. 948).

We found that the sexes are distinguishable at an early age and can be determined by the overall colouration of the plumage (Figure 19). There is a distinct colour difference between the brownish or slate colouration of the female and the shiny pitch-black males. Females show a plain wing, males a blurry white patch of the marginal and lesser coverts (Figure 20) as described in Davies (1910, p. 36) who "shot a young male, hardly fledged, with white shoulders, this skin is now in the Transvaal Museum".

8.5 White covert-patch as indicator of age

The covert-patch of adult males, formed by the marginal and lesser coverts, is considered to be all white (Keith *et al.* 1992, p. 506; Dean 2005, p. 948) (Figure 21). It is sometimes called "shoulder-patch" for convenience, but it is located around the joint between ulna and metacarpus.

Figure 18: *Juvenile grey male, two months old at most, with decreasing yellow gape flange at the beginning of his post-juvenile (partial) moult. The primary and secondary coverts and the alula still show fine pale fringes, the dark marginal and lesser coverts show white spots. SAFRING BH17854, 27 November 2003.*

We have observed that an all-white patch is a sign of a fully adult bird only. Younger birds show dark markings on white. The markings consist of several dark brown or black feathers of the distal marginal coverts in both morphs and dark streaks in the grey morph. It is unknown how long it takes for a Mountain Wheatear to accomplish its full adult plumage and at what exact age the coverts turn all-white.

In juveniles, the covert-patch is faint and only slightly expressed (Figures 19B and 20B). It develops fully during the first pre-breeding moult around the end of the first year of life. In the black morph, black markings on the distal marginal coverts (Figure 22) seem to be a quite common feature from an early age onwards. Reviewing our photographs, from 34 males we recorded 16 with substantial and 10 with minor markings, while on eight individuals, the marginal and lesser coverts

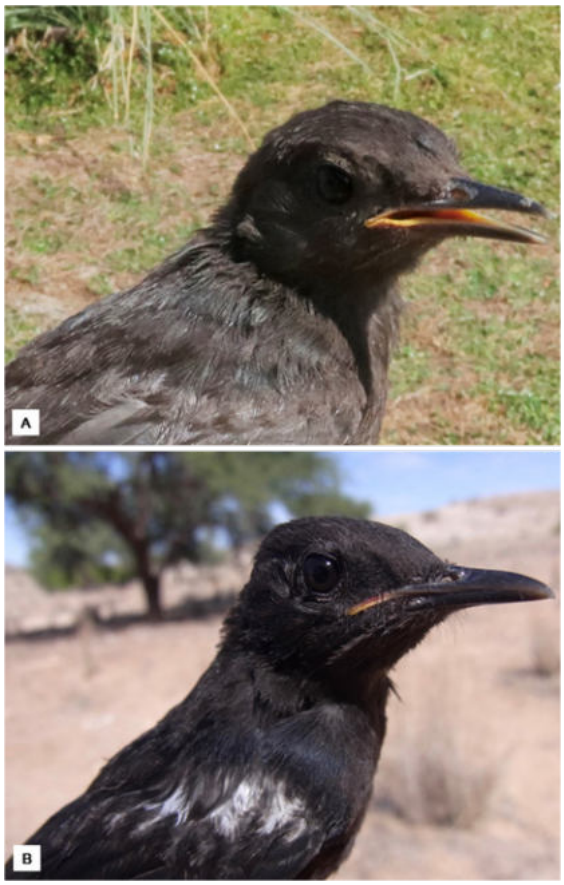

Figure 19: *Juvenile Mountain Wheatears (*M. m. atmorii*) within their first two months of age and during their post-juvenile (partial) moult. Note the prominent yellow gape flange. (A) Female in dark brown-grey plumage of light quality. The mantle shows first single darker feathers, the coverts are still paler, and the wing is plain without white patch. The yellow inner mouth can be seen. SAFRING FH79579, 27 February 2020. (B) Male in soft black plumage. The white covert-patch is already well visible, as is a dark shine of the new generation of feathers. SAFRING FB22182, 20 December 2013.*

Figure 20: *First-year birds in fresh plumage. (A) Juvenile dark-brown female. SAFRING FH79579, 27 February 2020. (B) Pitch-black young male after its post-juvenile moult. The white, faint covert-patch is almost hidden, the mantle and head feathers are opulent and uniform. SAFRING FB22296, 7 January 2014.*

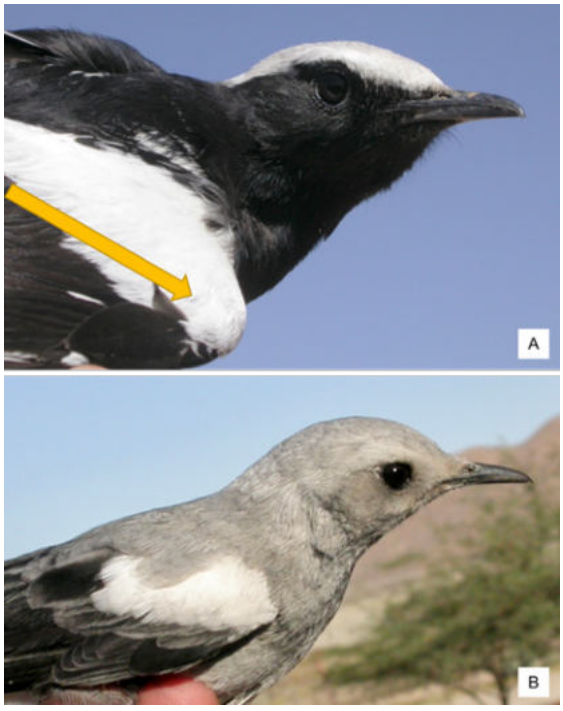

Figure 21: *Adult males with plain white marginal and lesser coverts. (A) Black morph, SAFRING FH21245, 27 August 2004. (B) Grey morph, SAFRING FH13705, 21 June 2003.*

were all white. Since the birds otherwise were recognisable as adults by plumage abrasion and bleaching and dark gape flange, it must be a feature continuing from the first year into the second or even third year.

In the grey morph, we found first-year birds that had prominent dark shafts on the white covert-patch (Figures 23 and 24A) and faint grey shafts after the first complete moult (Figure 24B). Also, the bill changes colour with age, from horn-coloured to black.

The plumage differences between first-year males and older ones are depicted in Figure 25: The brown tinges of all parts changes to grey and black colours.

Figure 22: *Black markings on the distal marginal coverts on a sub-adult male. No gape flange is visible anymore, the feathers with dark markings are fresh. SAFRING FH33993, 9 January 2007.*

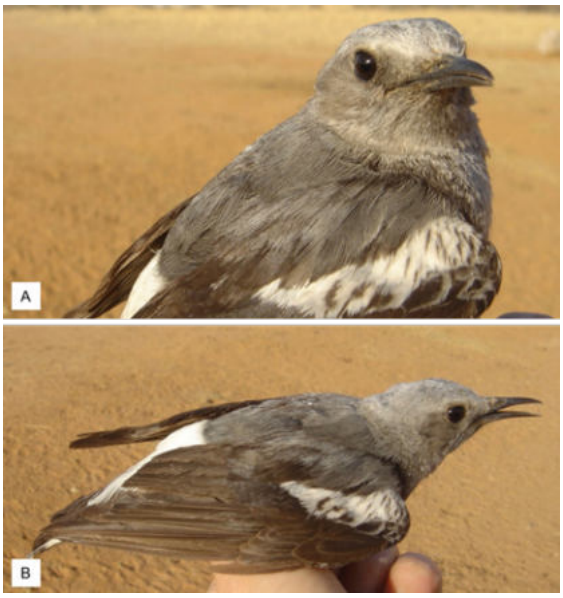

Figure 23: *Signs of a first-year male Mountain Wheatear: horn-coloured bill, strong dark shafts on the covert-patch and dark markings on its distal edge. (A) Close-up and (B) mainly grey mantle compared to the brown wings of the first plumage. SAFRING FH33709, 6 January 2007.*

8.6 Colouration of the inside of the mouth and colouration of the beak of female and male

The colouration of the inside of the mouth undergoes a change during ageing, corresponding to the gape flange and outer bill. Juveniles have light yellow inner mandibles that get darker yellow in immatures and finally turn dark, greyish and blackish, in adults (Figures 26 and 27).

Figure 24: *With age, the bill and the gape flange become black and the dark shafts and markings become paler. (A) First-year male, still with brown wing and dark distal marginal coverts. SAFRING FH38192, 19 January 2009. (B) Presumed second-year (of life) male with cold-grey plumage and blackish wings. SAFRING FH44463, 22 January 2008.*

Figure 25: *A comparison of the males from Figure 24. (A) First-year male, the brown wing and the tail are worn. SAFRING FH38192, 19 January 2009. (B) Presumed second-year (of life) male with fresh, blackish wings, coverts and tail. SAFRING FH44463, 22 January 2008.*

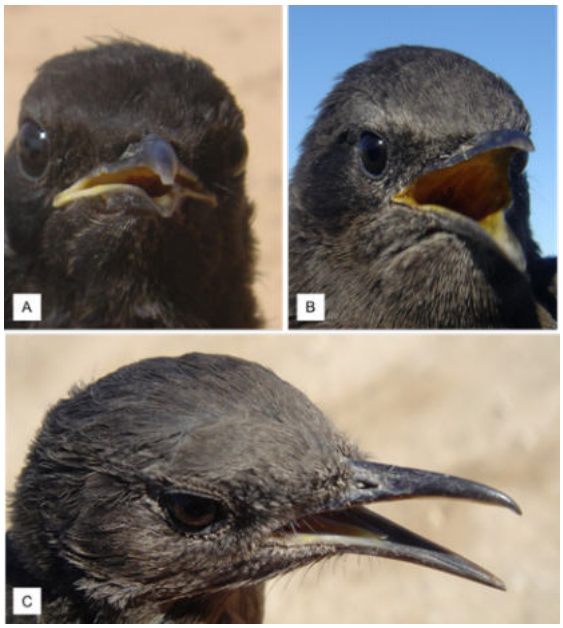

Figure 26: *Comparison of gape flange and inner mouth of (A) juvenile, (B) immature and (C) sub-adult Mountain Wheatear. The juvenile (A) shows an extensive, light gape flange which colour extends to the inside of the mouth, in the immature (B) the gape flange has receded and has become darker and in the sub-adult (C) the gape flange and inside of the mouth are greyish-yellow. SAFRING FH39430, February 2009; SAFRING FH33530, May 2006; SAFRING FH33538, May 2006.*

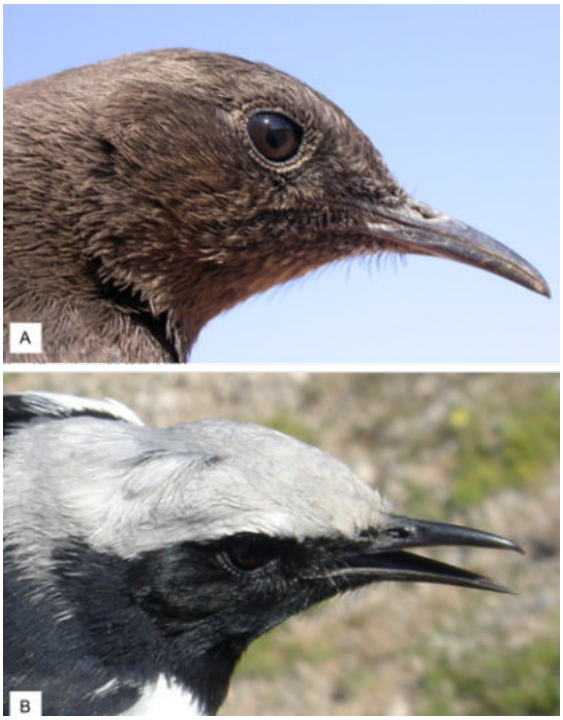

Figure 27: *(A) Dark horn-coloured beak of an adult female. SAFRING FH31538, August 2004. (B) Black gape flange and beak of an adult male. SAFRING FH31538, May 2006.*

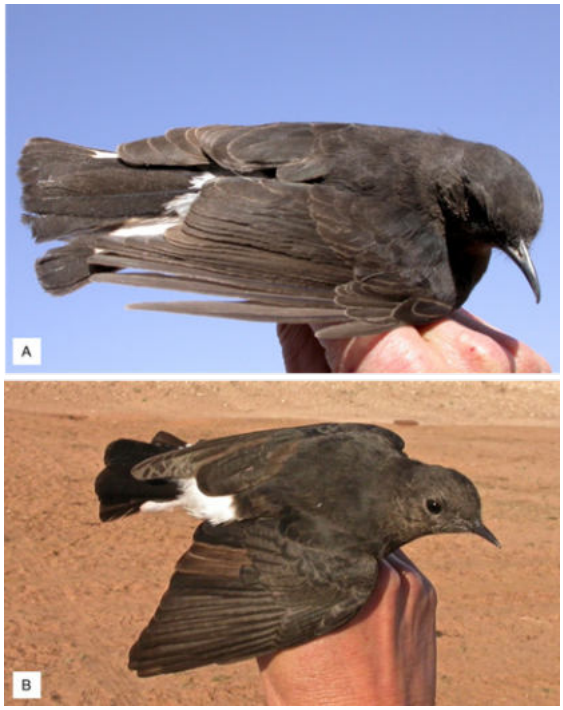

Figure 28: *(A) Uniform dark brown plumage of an adult female, with signs of the partial moult on the marginal coverts. SAFRING FH21054, August 2004. (B) Adult female, presumed second-year, with freshly moulted primaries and tertials. Of the secondaries, the three lighter ones are still old. SAFRING BD07552, 21 April 2003.*

Figure 29: *This adult female has finished her yearly complete moult. (A) Close-up of the head with dark gape flange and marginal coverts with fine lighter fringes. (B) The tips of the freshly moulted primaries and secondaries are in perfect shape. The residual light rufous, not white, tail areas indicate a second-year bird. SAFRING FH34959, 17 June 2007.*

9. ADULT FEMALES

Adult females have a dark horn-coloured beak and a slaty-grey to blackish-brown plumage. The beak never seems to become as dark as in males. During the year the dark plumage turns lighter brown which creates a notable contrast during the following active moult (Figure 28).

Some individuals show feathers of the previous plumage, for example the adult female in Figure 29B. The lighter area in the tail is not white as in fully mature birds, but buff, as the upper-tail cover peeking out from under the wing (B). It is unexplored if these are residual feathers or consistent, overlooked signs of second-year birds.

Older females can show some white on marginal and lesser coverts (as mentioned in Clement & Rose 2015, p. 646). Unfortunately, there is no original reference or a further description of this feature in males. On one of the females we ringed, though, a light white hue was visible at the covert-patch and above the eye (Figure 30). It is undetermined if these features result from hormonal changes in advanced age, which we can regularly observe in other species: older females of the Southern Masked Weaver (*Ploceus velatus*), for example, are likely to display marbled orange, not brown eyes, while older males of the Southern Red Bishop (*Euplectes orix*)

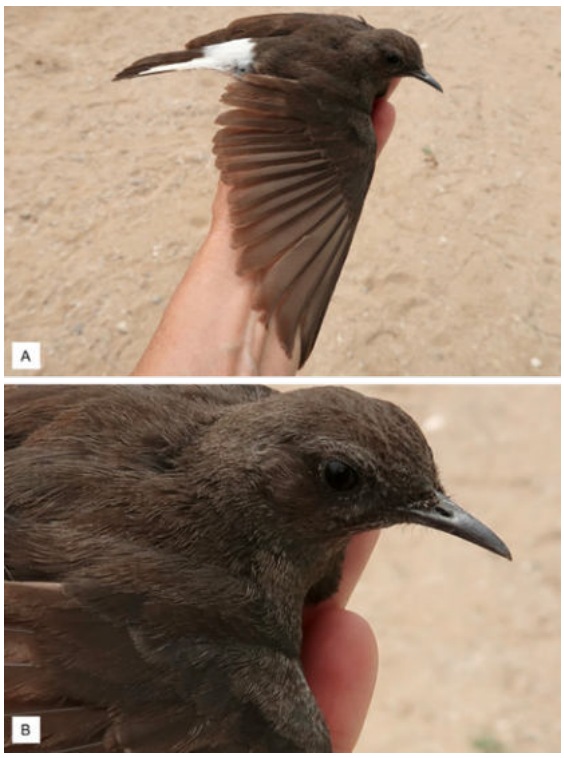

Figure 30: *Adult female Mountain Wheatear with slight male features. (A) Full view and (B) Close-up showing a hint of white on the supercilium and on the marginal and lesser coverts. SAFRING FH84811, 11 January 2021.*

Figure 31: *Levaillant´s depiction of the Mountain Wheatear (1805, Plate 185), taking the grey morph for a young bird, and a black male for "middle age" for his grey cap. https://www.biodiversitylibrary.org/page/41414789#page/182/mode/1up.*

lose the brightness of their red plumage, which turns more pale and orange.

10. ADULT MALES

The black and the grey colour morphs of adult males show a great variability of colouration of the upper- and underparts. Males can mostly be recognised by the white marginal and lesser coverts.

Describing the species, Levaillant erroneously considered the grey morph as "jeune age... avec son plumage au sortir du nid", "of young age ... with its plumage when leaving the nest" (1805, p. 106; see Plate 185 in Fig. 6) (Figure 31) which was repeated by Vieillot when he described the species (1818, p. 434-435).

This discussion how to categorise the colour variations went on for many years until Davies (1910) proposed two different morphs with extensive variability in the amount of black, white and grey.

10.1 Black morph

A great array of variation occurs even in small areas of distribution. In our study area, the grey morph occurs beside the dominant black morph sometimes

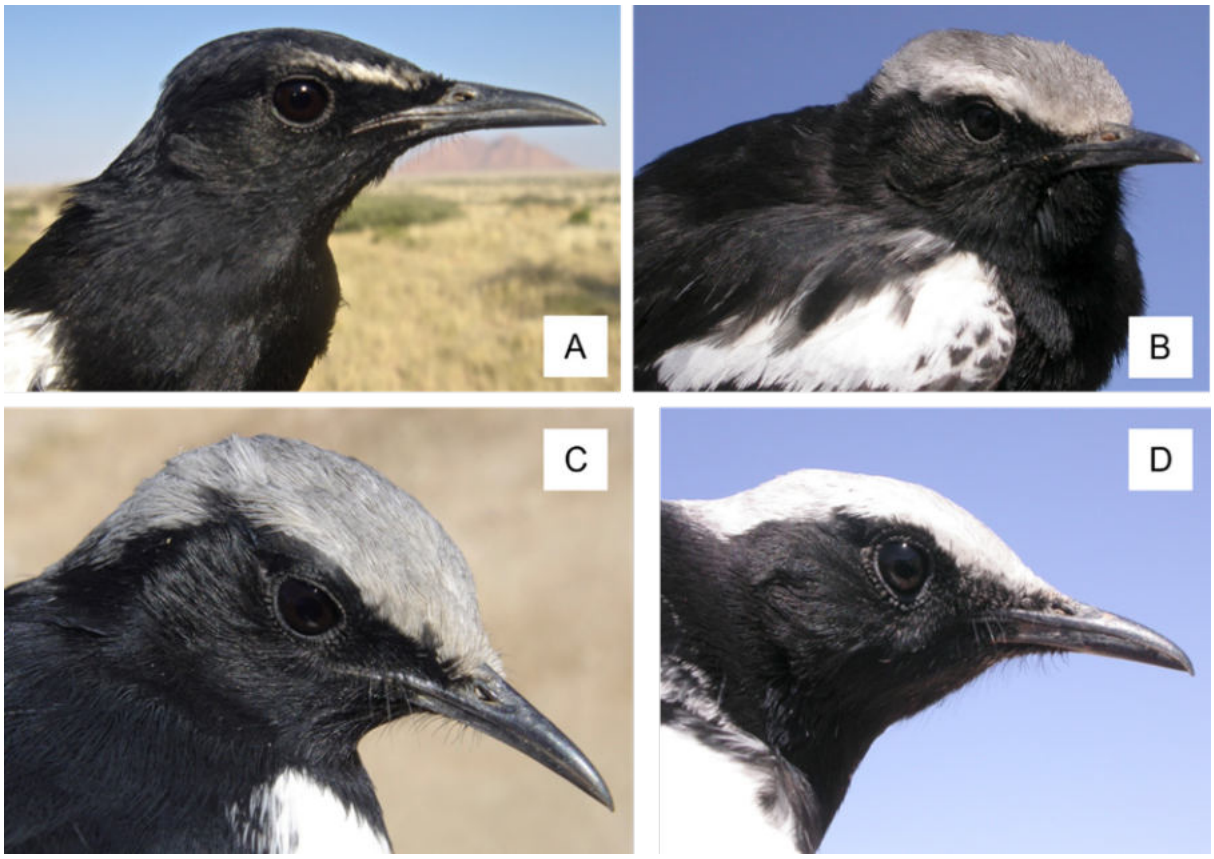

Figure 32: *The variety of head phenology of the black morph is well described. (A) Black head with white supercilium; (B) grey crown with white supercilium; (C) plain grey crown; (D) silver, almost white crown. 16 June 2006, 28 August 2004, 30 May 2006, 27 August 2004.*

in adjacent territories but always in fewer numbers (confirming the observations in Namibia of Hoesch & Niethammer 1940, p. 243). One group of our observation sample yielded 68 black and 17 grey individuals.

The variations of plumage features comprise head, crown, neck in various combinations, darkish grey, bluish-grey or white crown, at times a narrow white supercilium (Figure 32), white or white-mottled belly to vent, and a very variable tail pattern. This also seems to be the case in the subspecies *albipileata* from Angola where the plumage features are hardly described. (For further studies on plumage variations see the photographic records in the Macaulay Library of the Cornell Lab of Ornithology, Macaulay Library 2022a).

Figure 33: *Adult male Mountain Wheatears of the grey morph with (A) white and (B) grey marginal and lesser coverts. (B) The brown remiges and overall brownish colouration suggest that this is a second-year bird. SAFRING FB22190, 20 December 2013 and SAFRING FH30724, 18 June 2005.*

Figure 34: *A grey adult male with faint white supercilium and exceptional grey greater coverts. SAFRING FH13719, 22 June 2003.*

10.2 Grey morph

The grey morph, too, shows a number of individual variations of the plumage. In our sample it concerns mainly the amount of white in the tail and especially on the wing (Figure 33), and a fine white supercilium, which has not yet been described (Figure 34). Presumably, cold grey plumage is the sign for full adults, while the warmer and browner plumage of some individuals illustrates a second-year feature. We also found grey males with white and with grey marginal and lesser coverts (Figure 34). The variation of grey or black greater coverts has to our knowledge also not been described yet (Figures 35 and 36B).

In Summary: Colour differences in our sample originated mainly from age differences. Until the first complete moult, young grey individuals have brown (female-like) remiges and rectrices, a warm grey mantle and dark streaked and marked marginal and lesser coverts (Figure 35A). There is possibly a second-year plumage with transitional features: the upper body becomes greyer, but the covert-patch is still not fully white. Full adults are bluish-grey with black wings and tail and plain snow-white marginal and lesser coverts (Figure 35B).

Figure 35: *(A) First-year grey male before his first complete moult with dark horn-coloured beak, brown wing and tail and warm grey mantle. The white covert-patch shows streaked shafts and dark distal markings, one tail covert with a dark centre. SAFRING FH33709, 6 January 2007. (B) Fully adult male with black wing and tail, blue-grey mantle and (almost) plain white covert-patch. The greater coverts are black. SAFRING FH30737, 19 June 2005.*

11. NOTES AND OBSERVATIONS

11.1 Variation in the tail pattern

Clement & Rose (2015, p. 647) incorrectly attributed different tail patterns to different subspecies: beyond the three almost fully black inner tail feathers in all subspecies, *M. m. monticola* is claimed to have two fully white outer tail feathers, *M. m. atimorii* to have the three outer white with black tips, and *M. m. albipileata* to show transitional features. Unfortunately, no sources are given for this claim.

In "our" subspecies (*M. m. atimorii*), we found a great variety of tail markings. No change in the tail markings seems to occur during ageing, nor could a specific pattern be found for females or males. It appears that the amount of white on the outer rectrices as well as the breadth of the black tips are individual expressions that cannot be categorised.

We found variations of the tail pattern in females and males showing a wide array of markings on the outer tail feathers and the subterminal spots (Figures 36 and 37). All pictures show *M. m. atimorii*. Compare also the depictions of the tails in Figure 31 by Levaillant (1805, plate 185).

Figure 36: *Variation of tail markings of* ***female*** M. m. atimorii. *(A) and (B) with variant extent of brown along the edge of the outer rectrix, and (C) and (D) with varying width of the subterminal bar.*

11.2 Overall numbers of Mountain Wheatear

The South African Bird Atlas Project 2 (SABAP2) hosts statistical data about the birds of southern Africa (SABAP2 2022). In the database, the average reporting rate of Mountain Wheatear has declined over the years. In Namibia, since SABAP1 (1981–1998), there is a decline of over 10% in the reporting rate compared to SABAP2 (2007–present) (ibid.), with similar reports for the Northern and Western Cape. In Botswana, the species was recorded during SABAP1 in 12 Quarter Degree Grid Cells, and not reported during SABAP2 for the last 10 years.

It is not known if this decrease reflects real change of Mountain Wheatear numbers or if it is related to changes in observation patterns. 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 Mountain Wheatear in Namibia and Botswana.

11.3 Sex ratio

The ratio between the sexes in our sample was quite balanced, with 93 males and 90 females.

11.4 Retraps, site fidelity and longevity

Of the Mountain Wheatears that were trapped in the field and around buildings and waterholes, twelve were retrapped once, and six were retrapped twice, all in the same pentad of their original ringing.

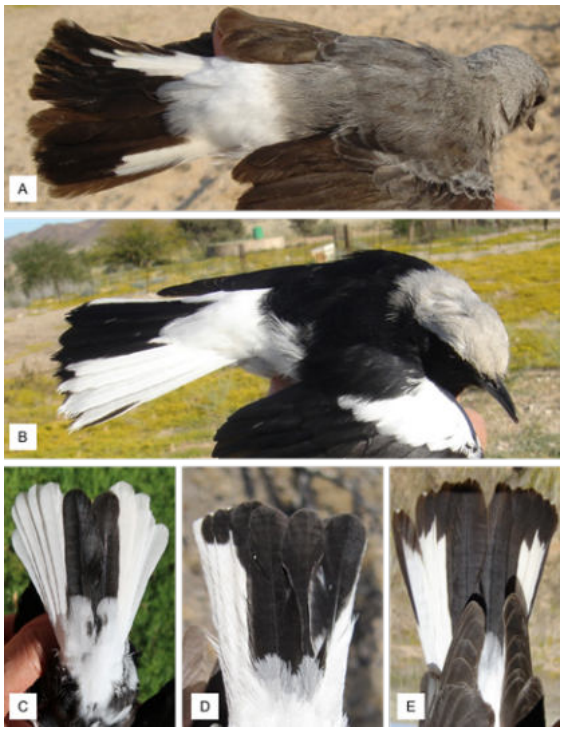

Figure 37: *Variation of tail markings of* ***male*** M. m. atimorii. *(A) Grey morph with dark outer vane, (B) male with the four outer rectrices full white except for a black streak on T6, (C) all white T2 to T6, (D) and (E) with small white spots on tip of the black markings.*

One male (SAFRING FH33533) living around a house and garden was ringed as an adult on 30 May 2006. It was retrapped and resighted at least 35 times over the next 12 years. The last sighting was on 25 February 2018. One year later, the territory had been abandoned. During these 11y 9m 4d, a longevity record for this species, we observed him being involved in breeding several times in an old building (see nest from Figure 14). The first female mate of several years (SAFRING FH34817) disappeared from the area from unknown causes, and we recorded another mate in the following season.

11.5 Behaviour

Our observations suggest that Mountain Wheatears can act quite insightfully. While the Tractrac Chats we observed in our research area are consistently trap-shy, i.e. we did not retrap any of more than 60 individuals ringed (Bryson *et al.* unpubl. data), we found that the Mountain Wheatears learn quickly. One became quite confident and used to us, especially as a food source. When it saw us arriving, after weeks or even months, or when we clinked a glass bowl with a few mealworms, the bird would come flying, even from far away. In another incident, we observed a Mountain Wheatear just released after ringing, going for the next trap nearby. After eight minutes of what looked like a thinking and decision-making process in front and around the trap, the male grabbed the worm with speed and escaped the closing trap (Franke-Bryson 2016).

11.6 Parasites

Out of 200 individuals ringed, 12 were hosts of ticks. Mostly, we counted one or two ticks, but young birds in February and March were more infested (with 17, 8 and 6 ticks). We found that young birds are more prone to be targeted by ticks than adults. In adult birds (SAFRING code 4) we found ticks in three of 226 birds, in juveniles (SAFRING code 5) in four individuals out of nine.

Despite uncertainties in identification, we presume after research and discussions that the tick species is the "cattle tick" *Rhipicephalus (Boophilus) microplus* of the family of *Ixodidae*, the so called 'hard ticks' since they display a hard shield on the front of their body. *Ixodidae* feed on the blood of reptiles, mammals and birds (Madder *et al.* 2023; Turner *et al.* 2017, see also Wikipedia 2022) (Figure 38). This species is clearly distinguishable from *Hyalomma* species which have striped legs and which we also found in birds in Namibia.

Occasionally we find feather parasites in birds we ring. Figure 39 shows a wing infested with mites or feather lice. In the inset, the colony can be seen on the outer vane and feeding marks on the inner vane.

11.7 Females with male features

We caught one Mountain Wheatear with features of both sexes (Figure 40). It was an adult bird, as visible by the wear of the plumage, and the lack of any signs of juvenile or immature age, like yellow gape flange or rufous tinge in the white areas of on the rectrices.

The overall colour was brown like a female, however with a thinly white covert-patch like found in males. Furthermore, the head, neck and chest showed tones of grey similar to the grey morph, while the ear-coverts were mildly brown like in females. The beak was dark horn-coloured like in females, not fully black like in males.

Females with male features have been described in other passerines species such as Red-backed Shrikes *Lanius collurio* and others (see Bryson & Paijmans 2023). This appearance might go undetected in Namibian (and southern African) birds since the features are not documented and thus not recognisable to the public or even researchers.

It is unclear how frequently this feature occurs. One female from the Angolan ssp. *albipileata* with similar features (Figure 41) is depicted in the Macaulay Library (2022b).

Figure 38: *Ticks found on Mountain Wheatears. We presume them to be common cattle ticks (*Rhipicephalus [Boophilus] microplus*). See the black shield on front of the body which gave them the name "hard ticks". Erongo region, 24 November 2017.*

Figure 39: *Feather parasites on the wing of a Mountain Wheatear. Inset: the colony on the outer vane can be seen and feeding marks on the inner vane. 21 February 2021.*

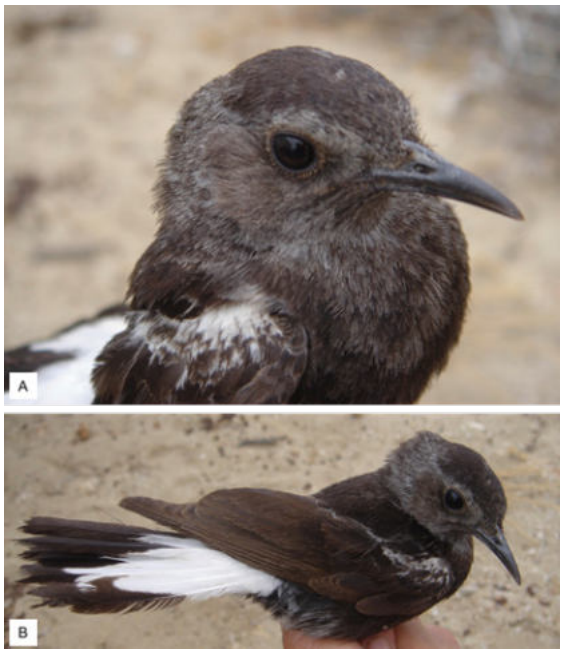

Figure 40: *Female Mountain Wheatear: overall brown, female plumage with traces of the male white covert-patch, and head, neck and chest in tones of grey, reminiscent of the grey morph of males. SAFRING FH31272, 8 January 2006.*

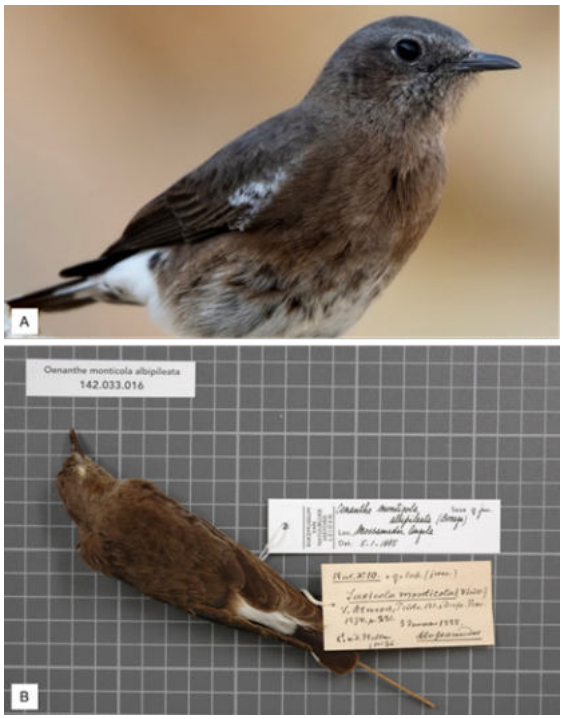

Figure 41: *A comparison of female Mountain Wheatears of the ssp.* albipileata. *(A) Adult female forming a pair (Figure 9) with grey crown and mantle, slight white supercilium and small white covert-patch. Namibe, Angola, 5 July 2018. Photo courtesy of Dubi Shapiro. (B) First-year, plain female. Collected in Moçamedes on 5 January 1885. Naturalis Biodiversity Center, Leiden, The Netherlands. [*Oenanthe monticola albipileata*; RMNH.AVES.145735], https://bioportal.naturalis.nl/multimedia/RMNH.AVES.145735_1/term=albipileata&from=0 [Accessed 26 September 2022].*

12. FURTHER RESEARCH

The Mountain Wheatear is considered to be a locally common to fairly common species (Maclean 1993, p. 509). Yet many aspects of basic information are missing. Extensive research is needed across the different subspecies to obtain sufficient samples for a sound validation of measurements.

In terms of plumage, research is required:

- to describe the plumage after the post-juvenile moult in first-year females and males;
- to describe the development through the first (three?) years until full adult plumage with focus on the development of the covert-patch;
- to describe the undertail coverts of female and male first-year birds, i.e. of juvenile and immature birds as possible indicators for more exact age determination;
- to document residual feathers from former plumages and plumage features from the other sex;
- to describe plumage variations of the Angolan subspecies, both for females and males.

Regarding moult, basic and detailed research is needed to gain sufficient data:

- to describe moult features and moult progress in the first and second year to allow a continuous moult and age description;
- to include the moult sequences of the different feather groups, both in first-year and adult birds, for both partial and complete moult.

For further research we recommend:

- examination and description of the colour of bill and inner mouth across all ages, in both the black and grey morph;
- recording possible changes of the beak colouration in the breeding and non-breeding season;
- exploration of possible hybridisation with other species;
- a thorough examination and determination of tick species as well as other parasite species hosted by southern African bird species.

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1240 and all birds were captured and handled under a ringing license issued by the Namibian Ministry of Environment, Forestry and Tourism (Enquiries: Holger Kolberg holgerk@afol.com.na).

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