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The timing of moult, morphology, and an assessment of the races of the Redwinged Starling

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Abstract. An examination of wing-moult and the morphology of museum specimens of the Redwinged Starling has revealed clinal variation in wing- and tail-length in eastern Africa, but only two distinct groups with regard to the timing of wing-moult. Multivariate analysis suggests that only two subspecies should be recognised, *O. morio rueppellii* in Ethiopia and *O. m. morio* from Kenya to South Africa. Overlap and intergradation occurs in northern Kenya and adjacent areas. The west African birds are highly distinctive, and may represent a separate species.

Key words. Aves, Sturnidae, *Onychognathus morio*, morphology, moult, distribution, subspecies, Africa.

Introduction

The Redwinged Starling *Onychognathus morio* has an extensive range in Africa, from the Cape of Good Hope through the eastern highland areas of the continent to Ethiopia, with isolated populations in mountainous areas across West Africa (Fig. 1). Although it is originally a bird of montane habitats, breeding on rocky ledges, it has adapted to human settlement and now frequently nests on buildings. This has enabled it to extend its range into areas where no suitable natural habitat exists, as at Gaborone in Botswana (Beesley & Irving 1976).

In a previous study (Craig 1983) I examined southern African material (from the area south of the Zambesi River) and described the moult cycle in relation to the breeding season of this species. Subsequently I have been able to examine museum specimens from the full range of the species. Four races are generally recognised: *O. morio morio* from the Cape to Tanzania; *O. morio rueppellii* in Kenya, Uganda, southern Sudan and Ethiopia; *O. morio neumanni* in western Sudan, Mount Cameroon and Nigeria; and *O. morio modicus* in the Niger basin area of Mali and the Ivory Coast. Some workers restrict *O. morio morio* to South African birds, and use *O. morio shelleyi* for birds from Zimbabwe, Malawi and Tanzania (Clancey 1980, Irwin 1981). Both moult and morphology have been used in assessing the status of these races.

Methods

For all adult specimens I took the following standard measurements: wing-length (maximum chord), tail length, tarsal length and bill length (from the base of the skull). In addition I measured the depth and width of the bill at the anterior border of the nostril, using vernier calipers. All measurements were taken by me personally. I have examined all the available material in the British Museum (Natural History), the Field Museum of Natural History (Chicago), the United States National Museum (Washington), the American Museum of Natural History (New York) and the Royal Ontario Museum (Toronto). Additional material on loan from the Los Angeles County Museum, the Carnegie Museum (Pittsburgh), the

Peabody Museum (Yale University), the Museum of Comparative Zoology (Harvard University) and the Philadelphia Academy of Sciences was examined in Chicago and New York. I have also measured all specimens in Albany Museum (Grahamstown), Durban Natural History Museum, East London Museum, and the Natural History Museum of Zimbabwe (Bulawayo). All birds were checked for moult, which was scored for the primary feathers only on the 0—5 scale used previously (Craig 1983). Latitude was recorded as degrees south of 7° N rather than from the equator, since southern Ethiopian birds are morphologically variable (see below), whereas those to the north of this line form a relatively uniform group. It was also difficult to map the collecting localities of many Ethiopian specimens. The data were analysed using the BMDP statistical package.

Results

Moult

For southern African birds, the additional material from South Africa, Zimbabwe and Mozambique confirmed my earlier conclusions (Craig 1983). I have now seen 340 specimens from this region, of which 131 had wing moult. Of these 122 came from the months November—April.

East African birds were initially divided into two groups: "southern" from Malawi, Tanzania and Kenya south of the equator, and "northern" from Kenya north of the equator, Uganda, Sudan and Ethiopia. It was immediately apparent that the southern group showed the same moult timing as southern African birds. They are consequently combined in Table 1. In southern Africa no birds with wing-moult were recorded in June, July or August. Four specimens from Kenya, taken in the first week of June had the outermost two primary feathers growing. These clearly fit the pattern. However, a bird in the collection of the U. S. National Museum labelled Zomba (Malawi), July 1873, had just started wing-moult. This is the only exception found; it is of course possible that the date on the label is an error.

Table 1: Monthly distribution of birds with wing-moult for Redwinged Starlings south of the equator.

	Month												
	J	A	S	O	N	D	J	F	M	A	M	J	Total
No. birds	39	49	33	35	51	29	49	29	32	30	35	30	441
Birds moulting (% of total)	1	0	2	3	13	13	25	15	12	10	4	2	170

The northern group was heterogenous with regard to moult cycles, and thus I subdivided this group further on morphological characters. Birds from the Ethiopian highlands are long-tailed, with tail-length exceeding wing-length. However, many specimens from East Africa north of the equator appear to be morphologically intermediate between short-tailed and long-tailed birds, so that three groups were used: (1) long-tailed; tail > wing, (2) intermediate; wing < 5 mm longer than tail, (3) short-tailed; wing > 5 mm longer than tail. Since allowance had to be made for moulting birds, these categories are not always clear-cut. Table 2 shows the results.

It appears that there is some consistent pattern for group 1 birds, while groups 2 and 3 remain heterogenous. Examination of the moult scores for the individual cases

Table 2: Monthly distribution of birds with wing-moult for Redwinged Starlings north of the equator.

	Month												
	J	F	M	A	M	J	J	A	S	O	N	D	Total
Group 1													
No. birds	9	5	5	4	2	3	3	0	5	10	14	8	63
No. in Moult	1	1	0	2	2	2	3	0	2	1	4	2	20
Group 2													
No. birds	7	3	4	0	5	2	4	4	2	9	7	3	50
No. in moult	6	2	2	0	5	2	3	0	0	4	4	0	28
Group 3													
No. birds	3	2	1	2	8	3	0	0	2	4	10	2	37
No. in moult	2	2	0	1	6	3	0	0	0	1	3	0	18

permits the following interpretation: Group 1 birds appear to start moulting in April—May; all records from September to December (with one exception) have moult scores exceeding 40, i. e. they have almost completed wing-moult. One bird from Yavello in southern Ethiopia is starting wing-moult in November. These birds are thus completing their moult at the time when most southern birds start wing-moult, and the timing appears to be six months out of phase. Groups 2 and 3 apparently include a mixture of birds following the southern moult schedule (November—April) and birds following the group 1 pattern. In several months moult scores range from birds just starting moult to those which have virtually completed their moult. There is no clear geographical pattern — birds collected at the same locality on the same day may show these contrasting modes of moult.

On the basis of moult cycles it appears that two groups can be distinguished: southern birds and Ethiopian birds, with the two patterns overlapping broadly in northern Kenya, Uganda, southern Sudan and southern Ethiopia.

The material for the western populations is not adequate to describe the moult season. Of 17 *O. morio neumanni*, six have wing-moult in March, April, July and August. There are no specimens from May or June. Similarly 6 of 21 *O. morio modicus* are moulting primaries in March, June and July. The moult scores are consistent with the suggestion that wing-moult may start as early as March and is completed by July or August.

Morphology

Specimens were assigned to eight geographical regions (Fig. 1): (1) South Africa, Lesotho, Swaziland and Botswana; (2) Zimbabwe and Mozambique south of the Zambesi River; (3) Zambia, Malawi and Mozambique north of the Zambesi River; (4) Tanzania and Kenya south of the equator; (5) Kenya north of the equator, Uganda and southeastern Sudan; (6) Ethiopia; (7) western Sudan, Cameroon and Nigeria; (8) Mali and Ivory Coast. Regional variations in morphology are summarised in Tables 3 and 4. The sexes are treated separately, since males are larger than females in all regions, for all the measurements taken. Females are readily distinguishable by their grey head, whereas the male has a glossy black head, matching the body plumage.

The Redwinged Starlings from the western Sudan (Jebel Marra) and West Africa (*O. morio neumanni* and *O. m. modicus*) share very distinctive feathering at the base of the culmen: the feathers are directed forward, so that they cover the nostrils. This pattern of feathering is typical of the Corvidae (Goodwin 1986), but amongst the African Sturnidae it is found only in two Ethiopian species, the Bristlecrowned Starling *Onychognathus salvadori* and the Whitebilled Starling *O. albirostris*. The feathering on the nostril of *O. morio neumanni* is illustrated in Sclater (1924), though he does not mention this feature.

Statistical analysis

Mean measurements for each region were compared using a oneway ANOVA programme (BMDP1V). The results are summarised in Table 5. The pattern is very con-

Table 3: Mean measurements of male Redwinged Starlings from different geographical regions, in mm ± 1 sd, with ranges shown below.

Region	Wing-length	Tail-length	Tarsus length	Bill length	Bill depth	Bill width	n
1	149.8±4.1	133.0±4.7	34.3±1.2	33.4±1.2	8.6±0.4	6.6±0.4	69
	142–159	120–143	30.6–36.8	30.0–36.5	7.8–9.8	6.0–8.4	
2	156.5±3.7	140.4±4.9	34.0±0.9	33.9±1.2	9.2±0.4	6.9±0.4	40
	148–164	127–149	32.0–36.1	32.0–37.4	8.4–10.0	6.1–7.6	
3	155.6±3.5	138.0±7.0	34.5±1.3	33.9±1.3	9.0±0.6	7.0±0.4	14
	152–163	124–150	32.0–36.4	32.3–36.0	8.2–10.3	6.2–7.6	
4	156.6±3.6	145.8±6.1	34.4±1.2	33.9±1.3	9.2±0.5	6.9±0.3	39
	147–164	133–163	31.7–36.9	30.6–36.0	8.3–10.4	6.3–7.6	
5	155.2±3.6	150.0±6.1	33.9±1.4	33.1±1.7	9.2±0.5	7.1±0.5	25
	148–162	134–164	30.5–36.3	30.0–37.1	8.3–10.6	6.3–8.2	
6	159.9±4.5	161.7±7.4	34.8±1.1	34.2±1.3	9.3±0.6	7.2±0.4	43
	153–169	146–177	32.0–36.7	31.9–37.3	8.3–10.7	6.4–7.8	
7	163.7±5.2	173.0±8.6	38.8±0.8	32.9±1.5	10.4±0.4	7.7±0.3	9
	155–171	159–189	37.2–39.8	29.3–34.3	9.9–11.0	7.3–8.4	
8	151.8±4.3	143.4±5.7	36.7±1.0	32.9±0.9	9.2±0.4	6.9±0.4	14
	146–160	134–155	35.2–38.3	31.6–34.4	8.6–9.9	6.4–7.4	

Table 4: Mean measurements of female Redwinged Starlings from different geographical regions, in mm ± 1 sd, with ranges shown below.

Region	Wing-length	Tail-length	Tarsus length	Bill length	Bill depth	Bill width	n
1	143.0±4.0	128.0±5.5	33.0±1.2	32.1±1.1	8.1±0.4	6.5±0.4	77
	134–153	109–139	30.6–36.0	28.7–34.1	7.3–9.2	5.7–8.0	
2	149.9±4.5	133.2±5.7	33.0±1.3	32.9±1.8	8.7±0.4	6.9±0.3	22
	142–159	118–142	30.0–34.6	30.1–36.8	8.0–9.5	6.5–7.5	
3	150.6±3.6	130.9±5.1	33.0±1.1	32.6±1.1	8.8±0.6	6.7±0.3	14
	144–158	120–138	31.2–35.2	30.5–34.0	7.8–10.0	6.2–7.4	
4	151.1±3.6	140.9±4.7	32.8±1.1	32.7±1.1	8.9±0.4	6.7±0.3	28
	144–157	132–150	30.3–34.8	30.9–35.2	8.1–9.6	6.1–7.2	
5	148.9±3.6	141.6±6.9	32.2±1.3	31.9±0.9	8.8±0.4	6.8±0.4	24
	143–156	125–153	30.3–35.0	30.0–33.4	7.9–9.5	6.1–7.5	
6	153.9±3.5	155.9±4.7	32.9±1.5	33.1±1.2	9.0±0.5	7.1±0.4	34
	147–160	147–165	29.7–35.8	31.2–35.5	7.8–10.0	6.2–8.1	
7	159.0±3.0	171.0±4.0	36.2±0.5	31.1±0.7	10.0±0.5	7.3±0.5	6
	156–164	167–177	35.8–37.3	30.3–31.9	9.4–10.8	6.5–8.0	
8	145.1±3.4	139.6±4.4	34.1±1.4	32.6±0.6	9.0±0.3	7.0±0.4	10
	141–151	134–145	32.6–36.5	31.2–33.5	8.7–9.6	6.4–7.5	

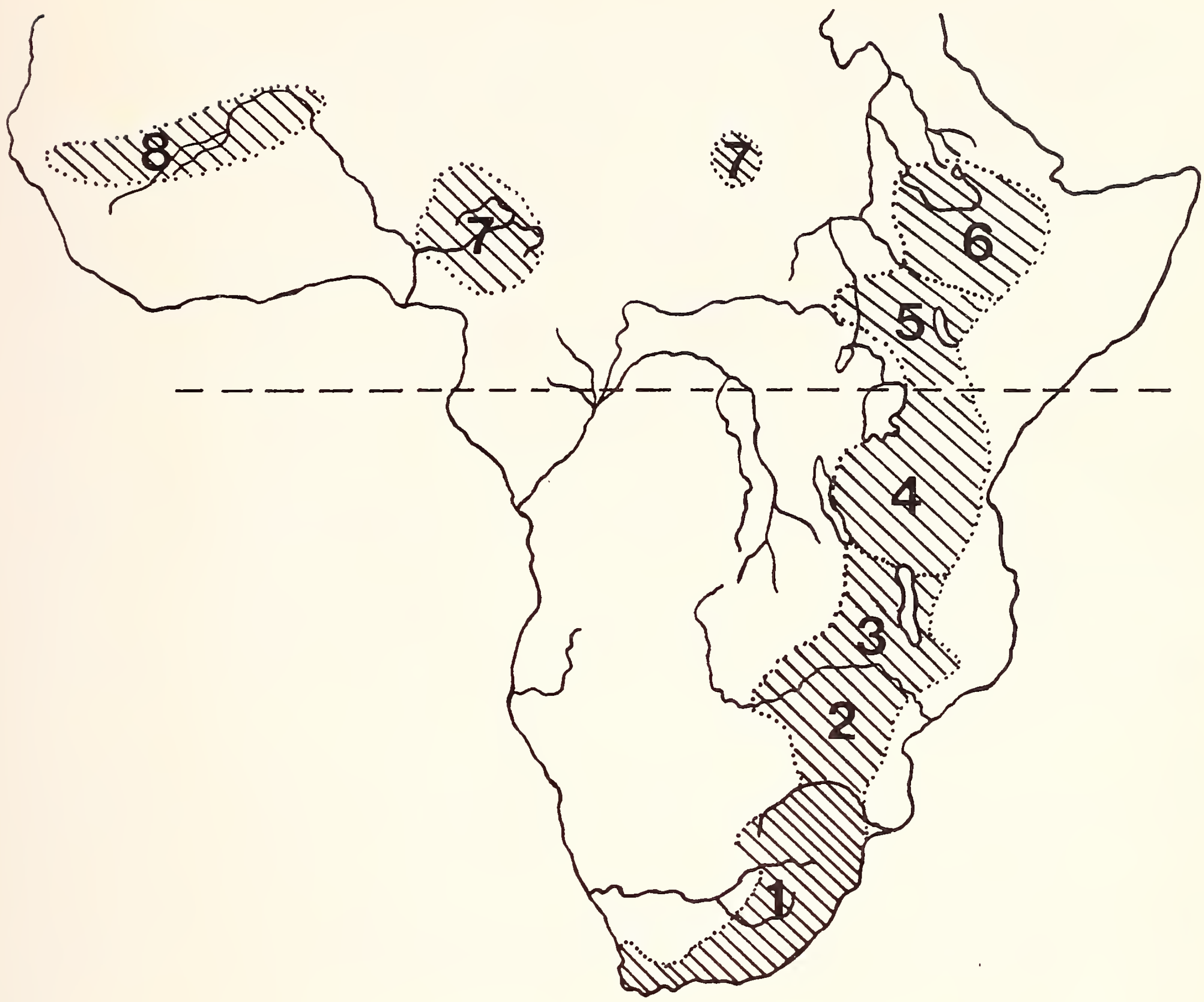

Fig. 1: The distribution of the Redwinged Starling in Africa. The numbers indicate the geographical regions to which specimens were assigned (see text).

sistent for both sexes. Zimbabwe and southern Mozambique birds do not differ significantly from Malawi and northern Mozambique birds in any measurements, and these groups differ from Tanzanian/southern Kenyan birds only in respect of tail-length. Tail-length is again the most consistent difference between these three groups and northern Kenya/Uganda/Sudan birds. South African specimens tend to be smaller in wing, tail and bill measurements, while Ethiopian birds are larger. West African birds (groups 7 and 8) are well differentiated from all other groups, and from each other.

The eastern populations are most clearly distinguished by wing- and tail-length, whereas tarsal length remains relatively constant. This suggests that the pattern of increasing wing- and tail-length may not represent an overall increase in body size. The correlation of these three measurements with latitude is shown in Table 6. Tarsal length is not strongly correlated with wing, tail or latitude. However, in both sexes wing-length and tail-length are very strongly correlated with latitude. Tail-length evidently changes more rapidly with latitude ($y = 157.12 - 0.67297x$) than does wing-length ($y = 159.14 - 0.20334x$). Unfortunately no comparative weight data are available.

Table 5: Pairwise comparison of mean measurements of Redwinged Starlings, listing those measurements which differed significantly ($p < 0.05$) in a one-way ANOVA. Males in lower left segment, females in upper right segment.

Regions	1		2		3		4		5		6		7		8	
			wing	lbill	wing	—	wing	lbill	wing	—	wing	lbill	wing	lbill	—	—
1			tail	dbill	—	dbill	tail	dbill	tail	dbill	tail	dbill	tail	dbill	tail	dbill
			—	wbill	—	wbill	—	wbill	tarsus	wbill	—	wbill	tarsus	wbill	tarsus	wbill
	wing	—			—	—	—	—	—	lbill	wing	—	wing	lbill	wing	—
2	tail	dbill			—	—	tail	—	tail	—	tail	dbill	tail	dbill	tail	—
	—	wbill			—	—	—	—	tarsus	—	—	wbill	tarsus	wbill	tarsus	—
	wing	—	—	—			—	—	—	—	wing	—	wing	—	wing	—
3	tail	dbill	—	—			tail	—	tail	—	tail	—	tail	dbill	tail	—
	—	wbill	—	—			—	—	—	—	—	wbill	tarsus	wbill	tarsus	—
	wing	lbill	—	—	—	—			wing	lbill	wing	—	wing	—	wing	—
4	tail	dbill	tail	—	tail	—			—	—	tail	—	tail	dbill	—	—
	—	wbill	—	—	—	—			—	—	—	wbill	tarsus	wbill	tarsus	—
	wing	—	—	lbill	—	—	—	lbill			wing	lbill	wing	—	wing	—
5	tail	dbill	tail	—	tail	—	tail	—			tail	—	tail	dbill	—	—
	—	wbill	—	—	—	—	—	—			—	wbill	tarsus	wbill	tarsus	—
	wing	lbill	wing	—	wing	—	wing	—	wing	lbill			wing	lbill	wing	—
6	tail	dbill	tail	—	tail	—	tail	—	tail	—			tail	dbill	tail	dbill
	—	wbill	tarsus	wbill	—	—	—	wbill	tarsus	—			tarsus	—	tarsus	—
	wing	—	wing	lbill	wing	—	wing	lbill	wing	—	wing	lbill			wing	lbill
7	tail	dbill	tail	dbill	tail	dbill	tail	dbill	tail	dbill	tail	dbill			tail	dbill
	tarsus	wbill	tarsus	wbill	tarsus	wbill	tarsus	wbill	tarsus	wbill	tarsus	wbill			tarsus	—
	—	—	wing	lbill	wing	lbill	wing	lbill	wing	—	wing	lbill	wing	—		
8	tail	dbill	—	—	tail	—	—	—	tail	—	tail	dbill	tail	—		
	tarsus	wbill	tarsus	—	tarsus	—	tarsus	—	tarsus	—	tarsus	wbill	tarsus	wbill		

Table 6: The correlation between latitude and wing-, tail- and tarsus length in Redwinged Starlings.

Correlation	Males		Females	
	r_{251}	P	r_{216}	P
latitude V tail	0.8139	<0.001	0.8172	<0.001
latitude V wing	0.5686	<0.001	0.6518	<0.001
latitude V tarsus	0.0862	0.172	0.1252	0.066
tarsus V tail	0.1457	0.020	0.0085	0.901
tarsus V wing	0.2188	<0.001	0.1261	0.062
wing V tail	0.7312	<0.001	0.7424	<0.001

The eastern populations have been separated into three races, *O. morio morio*, *O. m. shellyi*, and *O. m. rueppellii*. The data in Table 5 should support a division into three groups, but the latitudinal variation in the two most important distinguishing characters suggests that further analysis is required. Using the BMDP procedure means cluster analysis (programme BMDP KM), I produced clusters of the individual specimen records based on their measurements. Two different methods were used.

(1) the specimens were grouped into two clusters;

(2) the specimens were grouped into three clusters, with the midpoint of each cluster specified beforehand.

The three midpoints set were the mean values for the measurements of South African birds (cluster 1), Malawi birds (cluster 2), and Ethiopian birds (cluster 3). The results were then compared with the geographical areas from which the specimens had come.

Table 7: Cluster membership of Redwinged Starling specimens, using two clusters.

Source of specimens	Cluster 1		Cluster 2	
	Males	Females	Males	Females
South Africa	0	0	75	82
Zimbabwe	1	2	48	25
Malawi	1	1	16	14
Tanzania	11	16	33	14
N. Kenya	15	14	15	15
Ethiopia	42	39	5	1

With two clusters (Table 7), South African and Ethiopian birds are virtually completely separated. Almost all Zimbabwe, Malawi and Mozambique birds cluster with South African birds, as do most of the birds from Tanzania and southern Kenya. Northern Kenyan birds are split between the southern and Ethiopian groups. This conforms to the pattern shown by the moult of these populations. Three clusters again separate South African and Ethiopian birds, but Zimbabwe, Malawi and Mozambique birds are evenly split between the South African and intermediate clusters (Table 8). Tanzanian and Kenyan birds form a distinct intermediate category, with very little overlap with Ethiopian birds.

Table 8: Cluster membership of Redwinged Starling specimens using three clusters, corresponding to the races *O. m. morio*, *O. m. shelleyi* and *O. m. rueppellii.*

Source of specimens	Cluster 1		Cluster 2		Cluster 3	
	males	females	males	females	males	females
South Africa	70	67	5	15	0	0
Zimbabwe	23	10	26	17	0	0
Malawi	10	5	7	10	0	0
Tanzania	6	0	35	28	3	2
N. Kenya	2	3	24	19	4	4
Ethiopia	0	1	13	3	34	36

Stepwise discriminant function analysis (BMDP programme 7M) produced essentially similar results. A plot of the first two canonical variables (Fig. 2) shows that Ethiopian birds (region 1) are clearly separable from southern African birds (regions 1, 2 and 3), but the two groups are linked by east African birds (regions 4 and 5). This supports the grouping proposed on the basis of moult cycles.

Discussion

The moult data show that eastern Redwinged Starlings fall into two groups: those moulting during May to December, and those moulting between November and April. Birds with intermediate morphological characteristics from the "transitional zone" of northern Kenya, Uganda, Sudan and southern Ethiopia also fall into one or the other of these groups. It is striking that the timing of wing-moult should be consistent from the southern tip of Africa to north of the equator, and then switch abruptly to a cycle which is six months out of phase. This suggests that the moult cycles may be heritable in this species. Both Redbacked Shrikes *Lanius collurio* (Gwinner & Biebach 1977) and Garden Warblers *Sylvia borin* (Gwinner 1979) from different regions in Europe, held under constant environmental conditions, retained moult cycles characteristic of the geographical populations from which they were taken. Direct evidence of genetic determination of differences in the moult cycles of different subspecies has since been obtained for African and European populations of Stonechat *Saxicola torquata* (Gwinner & Neusser 1985). I suggest that the moult cycles of these Redwinged Starling populations constitute valid subspecific characters.

Of 30 breeding records for East Africa, 25 fall in the period October to March (Brown & Britton 1980). Thus moult-breeding overlap can be expected, as has been demonstrated in southern Africa (Craig 1983). In Ethiopia breeding has been reported in April (Friedmann 1937) and also in September—October (Urban & Brown 1971), so that here a post-breeding moult may be the rule. West African birds may also moult after breeding.

Even the limited range of morphological characters used here confirms the distinctiveness of the isolated West African populations. However, in the east, regional differences in morphology are not clearly indicative of subspecific divisions, and different techniques suggest different groupings of the populations. South African and Ethiopian birds are clearly at opposite poles, but the intervening populations intergrade to some degree.

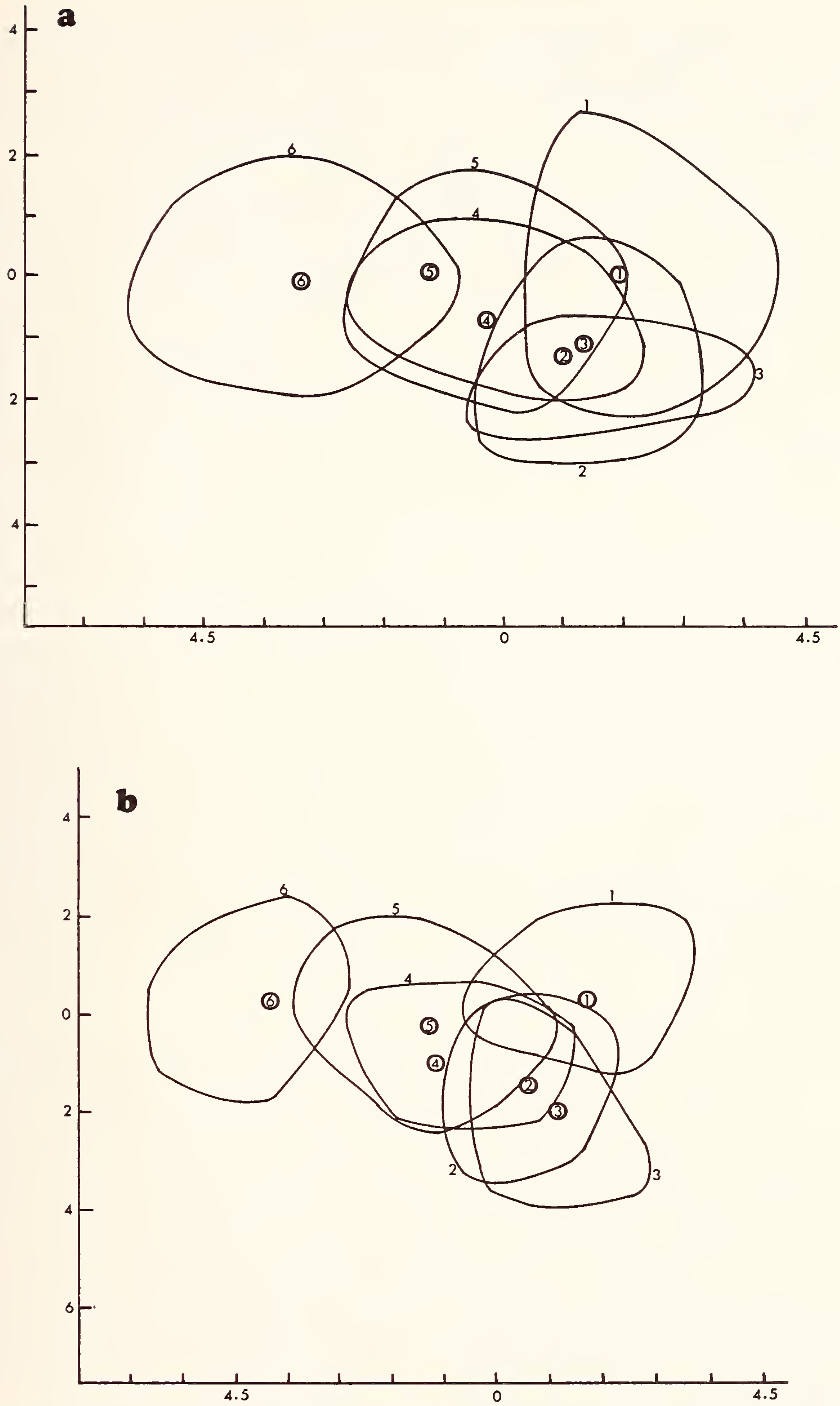

Fig. 2: Plots of the first two canonical variables for measurements of (a) male and (b) female Redwinged Starlings. West African birds are excluded; numbers correspond to the geographical regions (Fig. 1), circled numbers represent the midpoint of each cluster, and cluster boundaries are shown.

Thorpe (1976) is critical of the use of cluster analysis for the investigation of geographical variation, but concedes that the mathematical procedures make fewer assumptions concerning the nature of the data. However, ordination techniques as recommended by Thorpe (1976) support the two-cluster interpretation based on both morphology and moult.

The most obvious differences are in tail- and wing-length, and both characters show strong correlation with latitude. This appears to be the reverse of the trend known as Bergmann's Rule, according to which populations from the cooler regions (farthest from the equator) should be largest (Campbell & Lack 1985). The explanation may lie in the montane habitat of Redwinged Starlings. In South Africa the birds often occur at low altitudes, wherever suitable breeding sites are available. There is some indication that the largest birds in this region come from the Drakensberg Mountains, where they have been recorded at altitudes above 2500 m, but the available material is not adequate for any statistical comparisons. However, to the north the Redwinged Starling becomes primarily a bird of high mountains, notably on the Ethiopian plateau, which is where the largest individuals are found.

Clinal variation in bird morphology has been reported in many studies. James (1970) compared patterns of wing-length variation in 12 North American birds, including both passerines and non-passerines from woodland and open country. The different species showed concordant patterns, which could be correlated with climatic gradients. The Red Bishop *Euplectes orix* shows the opposite trend to the Redwinged Starling in eastern Africa, with the largest birds in the south-western Cape, and the smallest in Kenya (unpub. data). However, this is a bird of the lowlands and altitude may explain the difference. In the drier western part of southern Africa the counterpart of the Redwinged Starling is the Palewinged Starling *Onychognathus nabouroup*. This species also shows some variation in wing-length, with northern birds having shorter wings than southern birds (Craig, in press). Climatic conditions are very different, and the birds occupy a much narrower altitudinal range than Redwinged Starlings.

James (1983) demonstrated that environment influences morphology by exchanging clutches of Redwinged Blackbirds *Agelaius phoeniceus* between different populations in the field. Young birds showed morphological characters more like those of birds in the area in which they were reared. In a laboratory study, Boag (1987) has shown that different dietary regimes influence the adult size of Zebra Finches *Poephila guttata*; wing-length was significantly affected, but not tail-length. There may be some functional (adaptive) advantage in the changing proportions of wing- and tail-length in Redwinged Starlings, but environmental effects may be responsible for the observed differences. The present material is not suitable for investigating this question, since the analysis should be restricted to birds taken at their breeding areas (James 1970).

A review of the described subspecies

Onychognathus morio was described by Linnaeus in 1766, thus the original description gives few details and no measurements. The type locality is accepted as the Cape of Good Hope. Six further races have been described.

Onychognathus morio gracilirostris (Neumann) is known only from the type specimen, from "South Africa", with no precise locality given. Neumann (1903) gives the measurements as follows: wing 147—150 mm, tail 122—125 mm, bill length 24—26 mm, bill depth at base 6 mm, at middle 6.5 mm, width at centre of nostrils 5.5 mm. The plumage is described as less glossy than *O. m. morio;* this, together with the very small bill, strongly suggests that it is a juvenile or subadult bird. None of the material examined resembles these measurements and this race can be disregarded; all subsequent authors have treated it as a synonym of *O. morio morio.*

Onychognathus morio montanus Van Someren. I have examined the type specimen, from Mount Elgon, in the American Museum of Natural History. Van Someren (1919) described this race as similar to *O. m. rueppellii*, but with a much more slender bill. He gives the wing-length as 155—160 mm, bill length 33—34 mm, depth at nostrils 8 mm. Sclater (1924) gives the measurements of the type as wing-length 160 mm, tail-length 154 mm, bill length 34 mm. My measurements of the type specimen are: wing-length 158 mm, tail-length 154 mm, bill length 37.1 mm, bill depth 8.3 mm. Sclater (op. cit.) noted that other specimens from Mount Elgon in the British Museum were not referable to this race, which was apparently represented only by the type, collected above 9000 ft (2740 metres). Amadon (1956) also regarded the type as an unusual individual, and did not recognise this subspecies. Mount Elgon birds for the most part show a moult cycle characteristic of southern birds, but are morphologically intermediate between southern and Ethiopian birds. In my view, this is probably explained by interbreeding between the two populations in this region. Grant & Mackworth-Praed (1943) listed *O. morio montanus* as one of the races occurring in eastern Africa, but noted that they had not seen any specimens. I do not think that *O. morio montanus* warrants recognition.

O. morio rueppellii (Verreaux). This name has been applied to Ethiopian birds, although Verreaux (1856) gave no characters by which they could be distinguished from the nominate race. Sclater (1924) gives measurements which indicate that tail-length exceeds wing-length in this race, but Grant & Mackworth-Praed (1943) mention only that the bill is longer and heavier than in *O. morio morio*, with a more curved culmen. There is clearly a tendency for Ethiopian birds to be heavier-billed than southern populations (Tables 3 and 4). However, there is considerable individual variation in bill morphology. I suggest that the long tail and the different moult cycle serve to define this population as a subspecies distinct from the southern birds, with overlap and intergradation in northern Kenya, Uganda and Sudan. Hall & Moreau (1970) state that this race was formerly common in Eritrea, but has apparently been replaced by the Somali Chestnutwinged Starling *O. blythii*. I have seen only one specimen from Eritrea labelled *O. morio*, in the collection of the Los Angeles County Museum, and it proved to be *O. blythii*. These records should be re-examined.

O. morio shelleyi (Hartert) was a name proposed for those birds which were morphologically intermediate between *O. m. morio* and *O. m. rueppellii*. The type in the British Museum (BM89.3.6.18) is an undated male specimen (with wing-moult) from Ujiji in Tanzania: wing-length 157 mm, tail-length 137 mm, tarsus 35.2 mm, bill length 34.5 mm, bill depth 9.4 mm, bill width 7.6 mm. Hartert (1891) gave no description or measurements in his original use of this name, which is merely a footnote under *O. morio*. Grant & Mackworth-Praed (1943) made *shelleyi* a synonym of *ruep-*

pellii because of similar bill characters. Amadon (1956) wrote: "I am inclined to follow this arrangement, because it is impossible to mark off an intermediate race satisfactorily."; he then defined the range of nominate *morio* as Zimbabwe, southern Mozambique and South Africa, with all other eastern birds assigned to *rueppellii*. Clancey (1972) reported that birds from Zimbabwe were larger than those from South Africa, and assigned them to *O. m. shelleyi*. This name has since been used in the standard checklists of Benson & Benson (1977), Clancey (1980) and Irwin (1981). I have examined the specimens in Durban Museum and the National Museum, Bulawayo on which this decision was based. There is clinal variation in wing- and tail-length, and here another subspecific name serves no useful purpose (cf. Mayr 1969 p. 46). Clancey (1972) showed a clear gap in distribution between birds from southern Zimbabwe and birds in the northern Transvaal, with no specimens from the Limpopo valley region. However, Tarboton et al. (1987) give numerous records for the Limpopo valley, including a breeding record. There is evidently little geographical separation between South African and Zimbabwe birds.

O. morio neumanni (Alexander) was described as like *O. m. rueppellii*, but with a shorter and stouter bill, a longer tail, and green gloss on the wing coverts, secondary remiges and rectrices. Alexander (1908) gave the measurements as: wing 162 mm, tail 198 mm, bill 26 mm. However, my measurements of the type specimen (BM 1911.12.23.3731) are wing 155 mm, tail 159 mm, bill 34.3 mm. These can scarcely refer to the same individual, and the difference between wing-length and tail-length cited by Alexander (op. cit.) is much greater than in any specimens which I have examined.

O. morio modicus (Bates) is clearly allied to *neumanni*. Bates (1932) compared it to *neumanni* and *rueppellii*, and noted that the wing-length was similar in all three races, but the bill of *modicus* was less stout, and the tail proportionately much shorter. The range of measurements in Bates (op. cit.) includes both male and female birds: wing 150—163 mm, tail 137—150 mm, tarsus 35.5—38 mm, bill 28—31 mm. These are very close to the measurements which I obtained from the same skins (Tables 3 & 4). Amadon (1956) did not examine either *modicus* or *neumanni* personally.

The nest and eggs of *O. morio modicus* remain undescribed (Lynes 1924, Bannerman 1948, Mackworth-Praed & Grant 1973). Parelius (1967) describes the nest of *O. m. neumanni* as a simple cup of straw, and makes no mention of mud. However, it is not clear how closely the nest was examined. Both *O. morio morio* and *rueppellii* use mud in nest-building (Rowan 1955, Brown 1965), but this is not typical of all cliff-nesting members of the genus. *O. salvadorii* (Urban et al. 1970) and *O. tenuirostris* use mud, but not *O. albirostris* (Brown & Thorogood 1976), *O. nabouroup* (pers. obs.) nor *O. tristramii* (Hofshi et al. 1987).

Further study is required, but if *O. morio neumanni* and *modicus* do not use mud in nest construction, this would support recognition of a separate west African species *O. neumanni* Neumann's Redwinged Starling, with the races *O. n. neumanni* and *O. n. modicus*. For the present, I propose that the following populations warrant recognition as distinct races:

O. morio morio (Linnaeus) South Africa to Kenya & Uganda, intergrading with

O. morio rueppellii (Verreaux) Ethiopia, southern Sudan, northern Kenya and Uganda;
O. morio neumanni (Alexander) Cameroon, Nigeria and western Sudan;
O. morio modicus (Bates) Mali, Ivory Coast.

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Zusammenfassung

Die Handschwingenmauser wurde an Bälgen des Rotflügelstars *Onychognathus morio* kontrolliert. Dabei wurden Flügel-, Schwanz-, Tarsus- und Schnabellänge und auch die Breite und Höhe des Schnabels bei den Nasenlöchern gemessen. Diese Maße wurden einer Multivariate-Analyse unterzogen. Vögel vom östlichen Afrika zeigen eine regelmäßige Zunahme in Schwanz- und Flügellänge vom Süden nach Norden, aber in Bezug auf den Zeitverlauf der Mauser lassen sich nur zwei Gruppen unterscheiden. Auch die Analyse der biometrischen Daten deutet auf eine Aufteilung in nur zwei Rassen: *Onychognathus morio morio* von Südafrika bis Kenya (Flügel länger als Schwanz, Mauser der Handschwingen von November bis April) und *O. m. rueppellii* in Äthiopien (Schwanz länger als Flügel, Mauser der Handschwingen April bis November). Im Überlappungsgebiet stehen Schwanz- und Flügellänge nicht immer im Einklang mit Unterschieden in der Zeit der Mauser, und solche Individuen sind vielleicht Mischlinge. Die isolierten westafrikanischen Populationen *O. m. modicus* und *neumanni* unterscheiden sich unter anderem durch die Kopfbefiederung und sollten vielleicht als eine selbständige Arte gelten.

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